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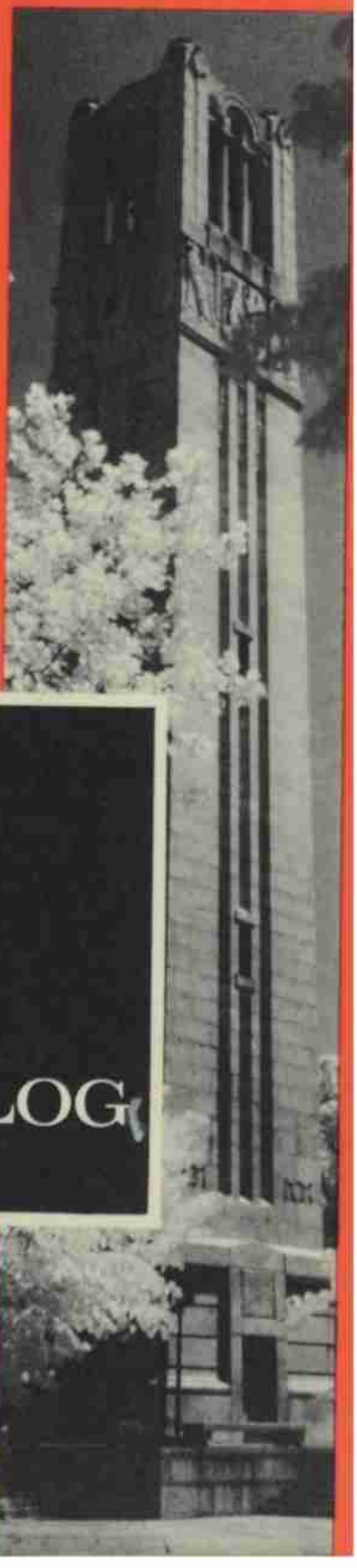

ORTH CAROLINA

TATE

ENERAL CATALOG

62-1964

NORTH CAROLINA STATE RECORD

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ORTH CAROLINA

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ENERAL CATALOG

Catalog Issue 1962-1964

nouncements for Sessions 1962-1963, 1963-1964

NORTH CAROLINA STATE OF THE UNIVERSITY OF NORTH CAROLINA AT RALEIGH

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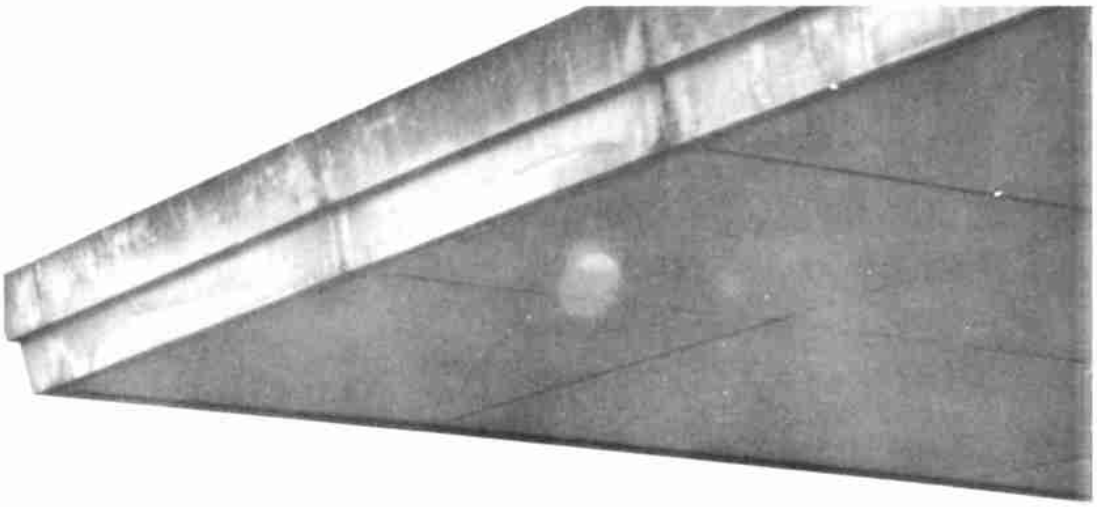

THE CONSOLIDATED UNIVERSITY OF NORTH CAROLINA

OFFICERS OF ADMINISTRATION

(General Administrative Officers at Chapel Hill)

By act of the General Assembly of 1931 the University of North Carolina at Chapel Hill, the North Carolina College for Women at Greensboro, and the North Carolina State College of Agriculture and Engineering at Raleigh were consolidated into the University of North Carolina.

The administrative officers of The University of North Carolina include:

William Clyde Friday, B.S., LL.B., LL.D., President

Vice President and Finance Officer (Position Vacant)

Donald Benton Anderson, B.A., B.Sc., Ed., M.A., Ph.D., Vice President for Graduate Studies and Research

Alexander Hurlbutt Shepard, Jr., A.B., M.A., Business Officer and Treasurer

Frederick Henry Weaver, A.B., M.A., Secretary

The Vice President and Finance Officer has general administrative responsibilities and is specifically concerned with the development programs of the University, the presentation of University budget requests to the several agencies of State Government, the Escheats Fund, and relationships with national foundations and agencies of the Federal Government.

The Vice President for Graduate Studies and Research, working with the University Graduate Executive Council and the three Deans of the Graduate School, has the responsibility for the coordination of the graduate offerings and research programs of the University.

The Business Officer and Treasurer has the responsibility of overall supervision of the preparation of the University budget requests and the expenditure of authorized budgets. This officer is also responsible for the administration within the University of those enactments of the General Assemblies that relate to the classification of personnel under the State Personnel Act.

The Secretary of the University performs general administrative duties and is the principal liaison officer with the Board of Trustees.

Each of these officers and the Chancellors of the component institutions are responsible to the President as the principal executive officer of the University of North Carolina.

NORTH CAROLINA STATE OF THE UNIVERSITY OF NORTH CAROLINA AT RALEIGH

OFFICERS OF ADMINISTRATION

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SCHOOL OF EDUCATION

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R. G. Carson, Jr., Director of Instruction, 232 Riddick Building
N. W. Conner, Director, Engineering Research, 129 Riddick Building
W. C. Bell, Director, Industrial Experimental Service, 3 IES Building

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SCHOOL OF LIBERAL ARTS

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SCHOOL OF PHYSICAL SCIENCES AND APPLIED MATHEMATICS

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SCHOOL OF TEXTILES

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B. C. Talley, Jr., Director, 202 Peele Hall

RELIGIOUS PROGRAMS

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MUSIC ACTIVITIES

J. Perry Watson, Director, 104 Pullen Hall

COLLEGE UNION

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Kingston Johns, Jr., Financial Aid Officer, 205 Peele Hall

STUDENT HEALTH SERVICE

J. J. Combs, College Physician, Clark Infirmary

MILITARY TRAINING

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Army ROTC, Col. R. R. Summers, 154 Coliseum

INTERCOLLEGIATE ATHLETICS

Roy B. Clogston, Athletics Director and Director of Coliseum, 105 Coliseum

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H. W. Taylor, Director, Alumni Affairs, 103 Alumni Building
Hardy D. Berry, Director, Information Services, 202 Holladay Hall

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John D. Wright, Assistant Budget Officer, "B" Holladay Hall
John C. Williams, Purchasing Agent, 107 1911 Building
J. McCree Smith, Director, Maintenance and Operations, College Engineer, Morris Building
Fred V. Coleman, Slater Food Service, Leazar Dining Hall
L. L. Ivey, Manager of Student Stores, SSS Building

Calendar

Spring Semester, 1964

Jan. 30	Thursday	New student orientation.
Jan. 31	Friday	Registration. Late registration fee of $5 payable by all who register after Jan. 31.
Feb. 3	Monday	Classes begin at 8:00 a.m.
Feb. 7	Friday	Last day to register. Last day to withdraw with refund less $7 registration fee.
Feb. 14	Friday	Last day to add a course.
Feb. 21	Friday	Last day to drop a course without failure.
March 21	Saturday	Mid-term reports.
March 25	Wednesday	Easter holidays begin at 6:00 p.m.
March 31	Tuesday	Classwork resumes at 8:00 a.m.
April 6	Monday	Last day for withdrawing from school without failures.
May 20	Wednesday	Last day of classes.
May 21	Thursday	Reading day.
May 22-29	Friday-Friday	Final examinations.
May 30	Saturday	Commencement.

Summer Sessions, 1964

First Session

June 8	Monday	New student orientation.
June 9	Tuesday (9:00 a.m.-1:00 p.m.)	Registration and fee payment for regular session. Late registration fee of $5 payable by all registering after 1:00 p.m. June 9.
June 10	Wednesday	First day of classes.
June 15	Monday	Last day for registration. Last day to withdraw with refund and last day to drop any course with refund.
June 19	Friday	Last day to drop courses without failure and last day to withdraw without failure.
July 15	Wednesday	Last day of classes.
July 16	Thursday	Final examinations.

Second Session

July 20	Monday	New student orientation.
July 21	Tuesday (9:00 a.m.-12:00 noon)	Registration and fee payment. Late registration fee of $5 payable by all registering after 12:00 noon July 21.
July 22	Wednesday	First day of classes.
July 27	Monday	Last day for registration. Last day to withdraw with refund and last day to drop any course with refund.

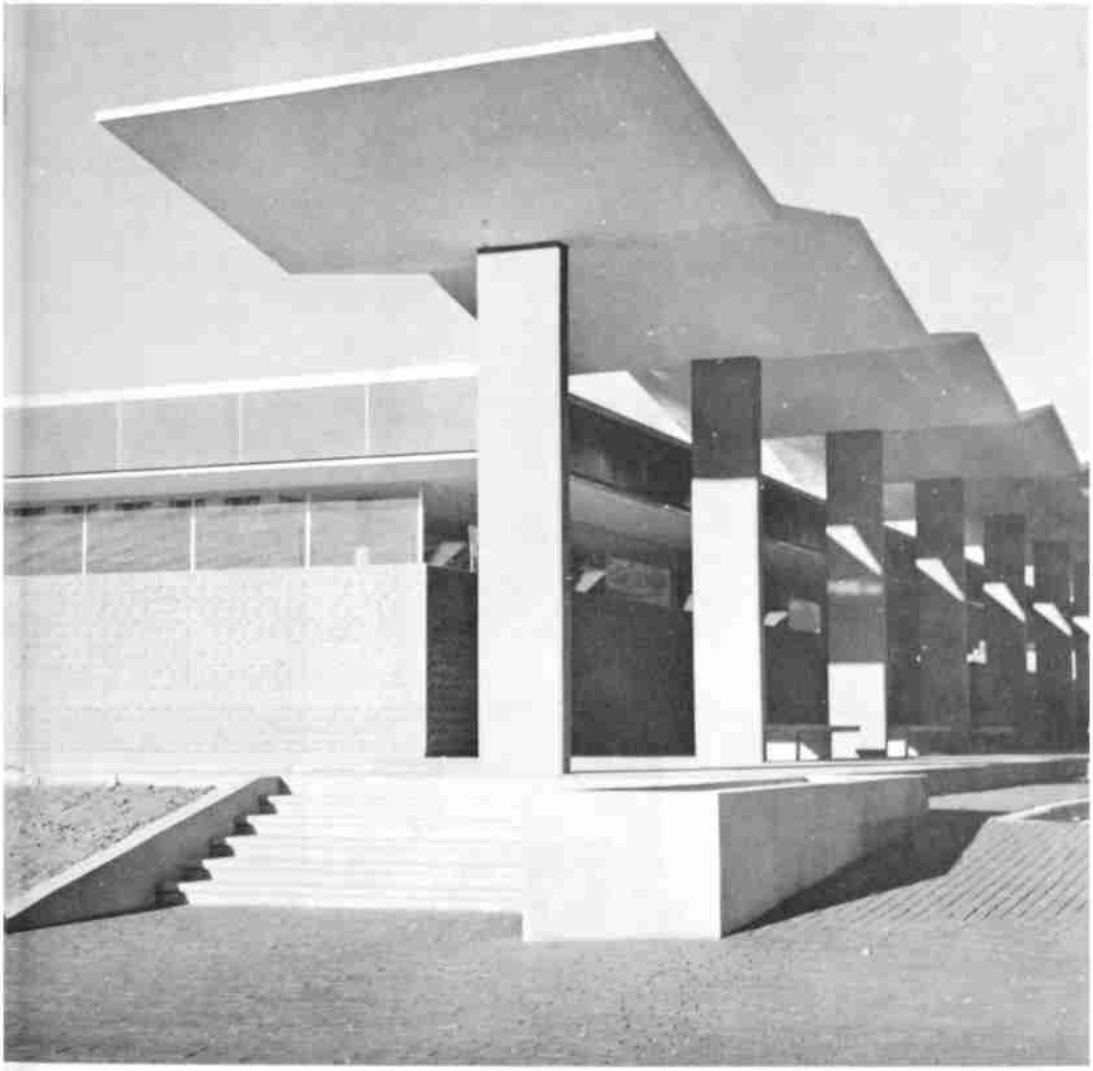
July 31	Friday	Last day to drop courses without failure and last day to withdraw without failure.
Aug. 26	Wednesday	Last day of classes.
Aug. 27	Thursday	Final examinations.

Fall Semester, 1964

Sept. 7-8	Monday-Tuesday	New student orientation.
Sept. 8	Tuesday	General faculty meeting.
Sept. 9	Wednesday	Registration day. All new students and all other students not preregistered. Late registration fee of $5 payable by all who register after Sept. 9.
Sept. 10-11	Thursday-Friday	New student orientation continued.
Sept. 14	Monday	Classes begin.
Sept. 16	Wednesday	Last day to register.
Sept. 18	Friday	Last day to withdraw less $7 registration fee. Last day to add a course.
Sept. 25	Friday	Last day to drop a course without failure.
Nov. 7	Saturday	Mid-term reports due.
Nov. 24	Tuesday	Thanksgiving holidays begin at 6:00 p.m.
Nov. 30	Monday	Classes resume at 8:00 a.m.
Dec. 17	Thursday	Christmas holidays begin at 6:00 p.m.
Jan. 4, 1965	Monday	Classes resume at 8:00 a.m.
Jan. 13	Wednesday	Last day of classes.
Jan. 14	Thursday	Reading day.
Jan. 15-22	Friday-Friday	Final examinations.

Spring Semester, 1965

Jan. 26	Tuesday	New student orientation.
Jan. 27	Wednesday	Registration day. All new students and all other students not preregistered. Late registration fee of $5 payable by all who register after Jan. 27.
Feb. 1	Monday	Classes begin.
Feb. 3	Wednesday	Last day to register.
Feb. 5	Friday	Last day to withdraw less $7 registration fee. Last day to add a course.
Feb. 12	Friday	Last day to drop a course without failure.
March 20	Saturday	Mid-term reports due.
April 14	Wednesday	Easter holidays begin at 6:00 p.m.
April 20	Tuesday	Classes resume at 8:00 a.m.
May 19	Wednesday	Last day of classes.
May 20	Thursday	Reading day.
May 21-28	Friday-Friday	Final examinations.
May 29	Saturday	Commencement.



GENERAL INFORMATION

History

North Carolina State College, the State's technological institution of higher learning and Land-Grant College, was founded by legislative act on March 7, 1887. Prior to this time, the Morrill Act of 1862 authorized the use of public land or its equivalent in land script for the creation of an agricultural and mechanical college in each State. North Carolina did not establish such a specialized institution until State College was founded.

First named the North Carolina College of Agriculture and Mechanic Arts, the institution began operations with 45 students and six teachers on October 3, 1889. The first president was Colonel Alexander Q. Holladay for whom the first building was later named.

The College's name was changed to the North Carolina State College of Agriculture and Engineering in 1917. In 1931, the North Carolina General Assembly formed the Consolidated University of North Carolina, embracing the University of North Carolina in Chapel Hill, the North Carolina State College of Agriculture and Engineering in Raleigh, and the Woman's College in Greensboro.

After World War II, returning service men nearly tripled any previous State College enrollment. Today, State College is one of the best-housed and best-equipped technological institutions of higher learning in the nation. Through its expanded operations, State College has grown in size and service to the people of North Carolina and in prestige throughout the nation and the world for its diverse programs in teaching, research, and extension services. At the beginning of the 1961 fall semester the student body numbered more than 7,000 young men and women with 660 members of the teaching staff and a total staff of nearly 3,000 persons including administrative, extension, and research personnel across the State.

Campus

Adjoining the central North Carolina State College campus at Raleigh are the College farms. In addition to these holdings in the Raleigh area, the State College Experiment Station operates a number of forest farms in every geographical area of the State, and the School of Forestry has large holdings of experimental woodlands in the Coastal Plain, the Piedmont, and the mountain regions of North Carolina.

The College's physical plant is valued at over $50,000,000 with a multi-million dollar construction program now in progress. The College has 73 major buildings.

Of the buildings, new and old, a few deserve special mention.

Harrelson Hall . . . circular classroom building, can seat 3,500 students at a time in 77 classrooms which can hold 18 to 189 students.

William D. Carmichael Gymnasium . . . valued at approximately $2,600,000, features modern facilities.

Bragaw Dormitory . . . first occupied in 1958, built at a cost of $2,000,000, all corridors are on the outside.

Student Supply Store . . . ultra-modern structure, offers reading material ranging from 25 cent paperbacks to the latest engineering encyclopedia.

Memorial Tower . . . a 116-foot campanile of white Mount Airy granite, is a monument to the State College men who lost their lives in World War I.

Holladay Hall . . . oldest building on campus, once the total college plant, completely remodeled inside, housing administration.

William Neal Reynolds Coliseum . . . one of the country's largest indoor stadiums, seating 12,500 for sports attractions and more for stage events.

Erdahl-Cloyd Union . . . one of the nation's most modern student-faculty activities centers.

McKimmon Village . . . a 300-unit married student housing center.

Services

State College serves the people of North Carolina in six main ways. The citizenry is reached through: resident instruction, off-campus instruction in College Extension Division courses, off-campus Agricultural Extension Service demonstrations, special instruction in technical institutes, industrial and agricultural research—both basic and applied, and direct contact with the home by means of radio and television.

Summary of Enrollment

The enrollment at North Carolina State College for the 1961 fall semester totaled 7,117 students, 6,944 men and 173 women.

Enrollment by Classification

Freshmen	1961
Sophomores	1348
Juniors	1095
Seniors	1339
5th Year Professionals	35
Graduates	897
Unclassified	198
Agricultural Institute	212
Special and Auditors	32
	7117

Enrollment by Schools

Agriculture	867
Design	351
Education	577
Engineering	3485
Forestry	413
Physical Sciences and Applied Mathematics	554
Textiles	448
General Studies (Auditors and Unclassified)	151
Graduate (Unclassified)	59
Agricultural Institute	212
	7117

Admission Requirements

To be admitted to a regular session of North Carolina State College, an applicant must be of good moral character and present evidence of acceptable preparation for work at the college level. Every applicant must complete an application form which may be obtained from:

Director of Admissions
Peele Hall
North Carolina State
Raleigh, North Carolina

The completed form should be returned to the above address. Applications for admission for both the fall and spring semesters will be considered as soon as they are received. The deadline for submitting fall semester applications is September 1; for the spring semester, January 1. A $10 fee should accompany all applications for admissions. This fee will be refunded to those who are denied admission, or applied to the college fees of those who are cleared for admission and who subsequently register for the semester for which application was made.

Admission to Freshman Standing

To be admitted as a freshman, the applicant should be a graduate of an accredited high school. It is possible for graduates of non accredited high schools and holders of high school equivalency certificates to have individual consideration for admission. Applicants must take the Scholastic Aptitude Test of the College Entrance Examination Board and have the scores submitted to the Office of Admissions. These scores, together with the high school record, will be considered in determining admissibility. The high school record should be submitted along with the application and must show at least 16 units of completed high school work which should be distributed as follows:

4 units of English (see English paragraph below)
2 units of algebra; 1 unit of geometry
(see mathematics paragraph below)
1 unit of United States history (see paragraph below)
2 units of science

The remainder of the 16 units will be accepted from other courses, except that not more than one unit will be accepted from activity courses such as physical education, music, band or military science.

English

Students who lack proficiency in English are advised to take a special non credit course in English composition before taking the regular credit courses in English. This remedial work may be taken in summer school or by cor

respondence before the first regular semester. Such students usually are invited to come to the College for counseling and further testing to help plan their preparatory work. Students with high scores on the verbal section of the Scholastic Aptitude Test are invited to participate in an accelerated English program. Foreign students lacking a satisfactory command of English are required to take courses in English for foreign students until they are sufficiently familiar with the language to proceed with regular courses in English.

Mathematics

The entrance requirements in mathematics for all curricula include two units of algebra and one unit of geometry—preferably a unified course covering concepts in both plane and solid geometry.

Students entering in Agricultural Engineering, Mathematics Education, and the Schools of Design, Engineering, and Physical Sciences and Applied Mathematics are urged to present four units of college preparatory mathematics which should include advanced algebra and trigonometry. Students entering these curricula without this four-unit sequence in college preparatory mathematics may be delayed in their regular progress.

Foreign Language

Students entering either the liberal science or liberal arts degree programs in the School of Liberal Arts are urged to present two units in a single modern foreign language (Spanish, French, German, or Russian). Failure to present these units may delay the student's program in these curricula.

History

Students may make up a deficiency in United States history after enrollment and receive college credit for the course. Foreign students are required to complete a course in United States history before graduation.

Applicants with at least three years of high school work who present satisfactory scores on the regular Scholastic Aptitude Test of the College Entrance Examination Board and a satisfactory rank in class may be admitted, subject to the completion of the course requirements stated above and any other requirements for high school graduation.

Applicants from other states of the United States must meet the preceding requirements and, in addition, must be recommended by the school in which enrollment is sought.

Applicants from foreign countries are not required to take the Scholastic Aptitude Test. The previous school records of foreign students provide the primary basis for their admission. In addition, a foreign student must show proficiency in the English language and submit a statement of financial responsibility.

Admission of Transfer Students

Transfer students with less than 29 semester hours of transfer credit must meet the admissions criteria for entering freshmen as outlined above. To be admitted as a nonfreshman transfer student, the applicant must have acquired at least 29 semester hours of college work (the equivalent of sophomore standing) at an accredited institution. The applications of transfer students from non-accredited institutions will be reviewed by the Admissions Committee.

All applicants for transfer must have an overall "C" average on work taken at other institutions and must be eligible to return to the last institution regularly attended. Students whose records show below "C" average work cannot be admitted unless such admission is approved by the Admissions Committee.

If the prospective transfer student's record shows an overall "C" average or better, it will be evaluated by the dean or director of instruction of the school in which the student wishes to enroll. A $2.00 transcript evaluation fee, payable to North Carolina State College, is charged for this service. Evaluation by the school will be final. No previously earned credit can be disregarded in evaluating a student's record.

Students eligible to continue at other units of the Consolidated University may transfer even though they do not have an overall "C" average. Students transferring between units of the Consolidated University will receive credit and honor points for all courses taken at the former unit.

All transfer students must have official transcripts sent to the Office of Admissions directly from each other college attended. Failure of the student to submit a transcript from all colleges previously attended may result in his dismissal.

Admission of Unclassified Students

An unclassified student is one who is earning college credit but is not working toward a degree at North Carolina State College. Admission of an unclassified student requires the recommendation of the dean of the school in which the student wishes to enroll. Unclassified students must meet the same admissions requirements as regular students. If, at a later date, an unclassified student wishes to change to regular status, his credits must be evaluated for his major. Credits earned by the student while he is unclassified will be accepted only if he has completed the proper prerequisites. Where credit is allowed, the student will receive the grades he earned in the courses accepted.

Admission of Special Students

Admission to the College in this category requires the recommendation of the dean of the school concerned. The usual college admission requirements may be waived for mature students, but regular rules of scholarship will apply after admission. If special students wish to change to regular status at a later date they must meet the same admission requirements as regular students. The special student may not represent the College in any intercollegiate contest or become a member of any fraternity—professional or social.

Admission as an Auditor

Admission as an auditor requires the permission of the instructor and the department head. The participation of auditors in class discussion or in tests or examinations is optional with the instructor. Auditors receive no college credit; they are expected, however, to attend classes regularly.

Readmission of Former North Carolina State Students

To be readmitted after having withdrawn from the College or having been out of school for one or more semesters, the student must be academically eligible to return and should apply to the Office of Admissions and Registration for readmission at least 30 days prior to the date of desired enrollment.

Admission of Graduate Students

All students working toward advanced degrees are enrolled in the Graduate School. Procedures and policies governing graduate admission are outlined in a special catalog issued by the Graduate School. Any student interested in enrolling for graduate study may obtain a copy of the Graduate School Catalog from:

Dean of the Graduate School
Peele Hall
North Carolina State
Raleigh, North Carolina

Grades and Scholarship

Grading System

North Carolina State College operates on a credit point system. Semester credits represent the number of hours completed with a passing grade; quality points are determined by the grade earned.

A	*Excellent*	*4 quality points for each credit hour*
B	*Good*	*3 quality points for each credit hour*
C	*Average*	*2 quality points for each credit hour*
D	*Passing*	*1 quality point for each credit hour*
F, FA, FD	*Failing*	*0 quality point for each credit hour.*
AU	*Audit*	*0 credit hours and 0 quality points*
AB	*Absent from examination*	
IN	*Incomplete*	
S	*Satisfactory (for graduate students)*	
U	*Unsatisfactory (for graduate students)*	
P	*Passed (for graduate students)*	
*D**	*Failure removed by re-examination (for seniors only)*	
H	*Indicates work of outstanding quality (for Chapel Hill graduate students)*	
P	*Indicates clearly satisfactory work (for Chapel Hill graduate students)*	
L	*Indicates low passing work (for Chapel Hill graduate students)*	

Explanations

At the discretion of the teacher, a student who has at least a C average in a course may be given an "Incomplete" grade for work not completed because of a serious interruption in his work, not caused by the student's own negligence. An incomplete must be made up during the next semester the student is in residence, unless the department involved is not able to allow the make-up. In the latter case, the department will notify the student and the Office of Registration when the incomplete must be made up. Any incomplete not removed during the period specified by the department will automatically become a failure and will be recorded as "Fi".

A grade of "Fa" is recorded for an unexcused absence from the final examination. If an absence from examination is excused, the student must arrange to take the examination during the next semester he is in residence or a grade of "Fa" will be recorded.

A grade of "Fd" is posted if a student has unofficially dropped a course for which he has been scheduled, or if he has officially dropped the course after the final date for dropping courses without failure. A failure may be made up only by repeating the subject. Such a repeat course must be regularly scheduled on the student's roster.

Any student who fails a course within two semesters of graduation, and who fails only one course during that semester, may apply to the Office of Registration for permission to remove that failure by standing a re-examination on the total subject matter of the course. If a senior fails more than one course during the next to the last semester and removes all but one of these deficiencies by repeating the course or courses, and if he has not had another re-examination, he may apply at the end of his last semester in residence for permission to take a re examination. When such a re-examination is taken to remove an "F", only the re-examination grade will be counted. A senior who has passed a re-examination will have his grade for this course changed from "F" to D*, which is equivalent in quality points to a grade of "D". A fee of $5.00 will be charged for administering such a re examination.

Course Repeat Rule

Any undergraduate student will be permitted to substitute the second grade made on any course for the first grade earned on that course, until he has repeated a total of 15 hours of course work. If a course is taken a third time, both the second and third grades will be counted. In computing the cumulative scholastic average for a student who has repeated a course (within the 15-hour and one-repeat-per-course limitations), the hours and quality points earned the first time will be omitted from the computation and only the second earned grade, whether an F or higher, will count.

Scholarship Standards

Semester Rule

Any student carrying 14 or more semester hours must pass at least 6 hours of work during the first semester in which he is registered at State College, and 8 hours each semester thereafter. A student carrying less than 14 hours must pass at least half of the work rostered in order to continue.

1.5 and 2.0 Average Rule

Students who have earned 40 or more semester hours of college credit are expected to maintain a 2.0 quality point average. Students who have fewer than 40 semester hours are expected to maintain a 1.5 quality point average. Any student who fails to meet these standards will be placed on provisional status. Students will enter provisional status at the start of either the fall or spring semester. Any student on provisional status who fails to meet scholarship standards within two semesters and included summer sessions will be suspended.

A student in the School of Engineering must have earned a minimum

grade of "C" on MA 102 to be eligible to roster courses taught by the School of Engineering above the freshman level.

Graduation Requirements

A student is scholastically eligible for graduation when he has satisfied all the specific requirements of his department, his school, and the College, and has earned at least a cumulative 2.0 average.

Students who have satisfactorily completed the requirements for more than one bachelor's degree may, upon the recommendation of their deans and payment of a double diploma fee, be awarded two bachelor's degrees at the same or at different commencement exercises.

To be graduated with high honors, a student must have attained a 3.5 quality point average on all semester hours of work taken at this institution (or at one or both of the other units of the University of North Carolina).

To be graduated with honors. a student must have attained a 3.0 quality point average on all semester hours of work taken at this institution (or at one or both of the other units of the University of North Carolina).

Residence Requirement

A candidate for the bachelor's degree who transfers from some other institution must spend at least one academic year in residence and earn a minimum of 24 semester hours of credit before being eligible for a degree. Residence at either of the other two units of the University of North Carolina satisfies the residence requirement at this institution.

Classification Requirements

Students progress from one class to a higher class after they have completed the required number of hours for the next classification. At the present time students are classified at the beginning of the fall semester and at no other time. The required number of hours for each classification is as follows:

Freshman	*1-28 semester hours of earned credit*
Sophomore	*29-62 semester hours of earned credit*
Junior	*63-96 semester hours of earned credit*
Senior	*97 or more semester hours of earned credit*
Professional (School of Design)	*140 or more semester hours*

General Policies

Grades and Residence at Other Units of The University of North Carolina

For courses transferred from other units of the Consolidated University, the student receives full credit and the same number of quality points he would have received if the same grades had been made on these courses at North Carolina State. Residence is also interchangeable.

Required Freshman English and Required Physical Education

Each student is expected to schedule the required course in freshman English and the required freshman and sophomore courses in physical education every semester until these courses are passed satisfactorily.

Withdrawals from the College

Students who wish to leave college during a semester or summer session must withdraw officially. There is no penalty if a student withdraws prior to the date specified in the college calendar as the last date for withdrawing without failures. Failures are recorded on all courses for students who withdraw after that date. A student who wishes to withdraw should report to the Counseling Center in Peele Hall to initiate the official withdrawal process. A student completing a semester or summer session, and not planning to return, need not officially withdraw.

Changes in Curricula

Students may change from one curriculum to another by filing with the Office of Registration (at the time of registration) a curriculum change card signed by the dean or director of instruction concerned. Such changes are effective only at the beginning of a semester or summer session.

Scholastic Loads

A student may not carry more than 21 semester hours or less than 12 semester hours during a regular semester, without securing the written approval of the dean or director of instruction of his school. For a six-week summer session, a student must have the same approval if he carries more than seven semester hours. Veterans or other students receiving federal educational benefits must meet the work load requirements of the appropriate federal agency.

Opportunities for Superior Students

Since it has often been found that gifted students do their best work when confronted with programs adapted to their abilities, North Carolina State College offers challenging opportunities to such individuals through superior student programs in mathematics, physics, chemistry, and English; honors programs for upperclassmen in engineering, physical sciences and applied mathematics, forestry, and agriculture; and a program in undergraduate research participation. The College also allows well-prepared students to seek advanced placement by means of qualifying examinations. A brochure describing these programs may be obtained by writing to the director of admissions.

Residence Status for Tuition Payment

The tuition charge for legal residents of North Carolina is less than for nonresidents. A legal resident of North Carolina is one who has his domicile in this State. It is important that each applicant for admission and each enrolled student know his residence status for tuition payment and understand the regulations governing residence status. The following regulations cover most factual situations:

1. A person 21 years of age or older is not deemed eligible for the lower tuition rate unless he has maintained his legal residence in North Carolina for at least the six months next preceding the date of his first enrollment in an institution of higher education in this State.

2. The legal residence of a person under 21 years of age at the time of his first enrollment in an institution of higher education in this State is that of his parents, surviving parent, or legal guardian. In cases where parents are divorced or legally separated, the legal residence of the father will control unless custody of the minor has been awarded by court order to the mother or to a legal guardian other than a parent. No claim of residence in North Carolina based upon residence of a guardian in North Carolina will be considered if either parent is still living unless the action of the court appointing the guardian antedates the student's first enrollment in a North Carolina institution of higher education by at least 12 months.

3. The residence status of any student is determined as of the time of his first enrollment in an institution of higher education in North Carolina and may not thereafter be changed except: (a) in the case of a nonresident minor student at the time of his first enrollment whose parents have subsequently established legal residence in North Carolina; and (b) in the case of a resident who abandons his legal residence in North Carolina. In either case, the appropriate tuition rate will become effective at the beginning of the semester or term next following the date of change of residence status.

4. The legal residence of a wife follows that of her husband, except

that a woman student currently enrolled in this institution as a resident may continue as a resident even though she marry a nonresident.

5. Military personnel attached to military posts or reservations in North Carolina are not considered eligible for the lower tuition rate unless they have maintained a legal residence in the State for at least the six months next preceding the date of first enrollment in an institution of higher education in the State.

6. Aliens lawfully admitted to the United States for permanent residence who have established a legal residence in North Carolina according to Paragraphs number 1, 2, or 4, above, are eligible for the lower tuition rate.

7. Ownership of property in or payment of taxes to the State of North Carolina apart from legal residence will not qualify one for the lower tuition rate.

8. Discretion to adjust individual cases within the spirit of these regulations is lodged in the vice president and finance officer of the University.

Any student or prospective student in doubt concerning his residence status must bear the responsibility for securing a ruling by stating his case in writing to the director of admissions.

Tuition and Fees

Charges for tuition and fees vary according to (1) the student's status as a resident or non resident of North Carolina; (2) type of student (regular undergraduate, special or unclassified undergraduate, auditor or graduate student); and (3) to a minor degree, the curriculum in which the student is enrolled.

An application for admission must be accompanied by an application fee of $10. This fee is refunded to students whose applications are denied. It is forfeited by applicants who are accepted but who do not enroll.

Tuition and fees are payable during the registration period. All charges are subject to change without notice, but the charges in effect currently are as follows:

Regular Undergraduate Students

Schools	*In-State Students*		*Out-of-State Students*	
	Fall Semester	*Spring Semester*	*Fall Semester*	*Spring Semester*
Agriculture	$162.50	$156.50	$375.00	$369.00
Design	162.50	156.50	375.00	369.00
Education	162.50	156.50	375.00	369.00
Engineering	162.50	156.50	375.00	369.00
Forestry	172.50	156.50*	385.00	369.00*
Liberal Arts	162.50	156.50	375.00	369.00
Physical Sciences and Applied Mathematics	162.50	156.50	375.00	369.00
Textiles	162.50	156.50	375.00	369.00

* Add $10.00 if not registered in fall semester.

Late Registration

Registration schedules are set for specific days, and certain definite procedures are outlined. A student has not completed registration until all of the required steps are taken. All students, graduate and undergraduate, who fail to register on dates scheduled must pay a $5.00 late registration fee.

Undergraduate Students Taking Less Than Seven Hours

Undergraduate students taking one course of not more than four hours during a regular semester will be charged one-fourth tuition, one-fourth academic fees and no non-academic fees. These students will not be entitled to any of the services and privileges provided by the non-academic fees. Undergraduate students taking five or six hours during a regular semester will be charged one-half tuition, one-half academic fees and all non-academic fees. All other undergraduate students will pay full tuition and fees.

Audits

Subject to academic regulations, regularly enrolled graduate or undergraduate students may audit courses by registering for them. The first audit will be disregarded in determination of course load on which tuition and fee payments are based, but any additional audits are to be added to the course load at full credit hour value. Students registered for audits only will pay the rates applicable to special unclassified students.

Unclassified Students

A student registering for course work as an unclassified student but requesting graduate credit will be charged the regular graduate student rate.

Graduate Students

Applicants interested in graduate work may receive a schedule of fees upon application to the Graduate School.

Commencement Fee

A fee of $9.00, covering cost of diploma and rental of cap and gown, is charged candidates for the baccalaureate degree during the last semester before the degree is awarded.

Deposits

(a) As partial security for library books, laboratory equipment, etc., a general deposit of $20 must be paid by regularly enrolled undergraduate and graduate students at the time of their first enrollment (see also under "Refunds").

(b) Certain departments are allowed to collect small deposits, in addition to the general deposit referred to above, for such things as lockers, etc. In such instances departmental regulations will apply.

Professional Students in Engineering

Students in the various fifth-year professional curricula will be charged on the same basis as undergraduate students.

Thesis Preparation

Graduate students who have completed course requirements and are in residence for thesis work only will be charged $15 per semester for tuition, plus all fees. Graduate students not in residence who have completed all requirements for the degree sought, except for the thesis, will be required to register for the term in which final requirements for the degree are to be completed and pay a tuition fee of $15 and a $7.00 registration fee.

Degree Only

Graduate students who have completed all requirements for the degree sought are required to register for the term in which the degree will be awarded and pay a tuition fee of $10.

Room Rent

Rooms in the College dormitories rent for $100 per person per semester. Dormitory room applications are for the period of a school year and the rent is payable in advance prior to the beginning of each semester as announced. When a new student is accepted by the College, he is sent a letter of clearance together with a dormitory room reservation request form. If he wishes to reserve a dormitory room, he should fill out the reservation request and return it with his remittance. Rooms will be assigned as long as space is available, in the order in which payment of rent is received. Individual preferences as to location of room and or choice of roommate will be complied with as far as possible. All reservations are subject to published dormitory rules and regulations.

Male freshman students are required to live in the College dormitories unless they are married, veterans, or living with parents or relatives. Each of these freshmen must make a written application to the director of student housing for permission to live outside of the dormitories.

Married Student Housing

College-owned apartments for married students rent for the following amounts:

Efficiency apartment	*$43.00 per month*
One-bedroom apartment	*57.50 per month*
Two-bedroom apartment	*69.00 per month*

Linen Rental Service

Linen Rental Service is available upon request at the rate of $10 per semester, and includes a weekly issue of two sheets, one pillow case, and three bath towels. Students living in dormitories may submit their application along with remittance at the time of room rent payment. Students living off campus may make application at the Business Office in Holladay Hall or at the College Laundry.

Board

Meals are served cafeteria style, and the cost depends upon the individual student. Average cost is approximately $550 per year.

Books and Supplies

The cost for books and supplies is variable, depending upon the curriculum in which the student is enrolled. A reasonable estimate is $100 per year, but students who have to buy drawing supplies and slide rules have an additional original outlay. All books and supplies are paid for in cash as purchased.

Estimated Annual Cost

(Items such as tuition, fees, and room rent in dormitories are fixed costs. Other items are variable with the individual student.)

	First Semester	*Second Semester*	*Year*
Tuition (Non-resident students add $212.50 per semester)	$ 87.50	$ 87.50	$ 175.00
Other college fees	75.00	69.00	141.00
General deposit (paid only upon first enrollment)	20.00		20.00
Dormitory room	100.00	100.00	200.00
Linen service (optional)	10.00	10.00	20.00
Board	250.00-300.00	250.00-300.00	500.00-600.00
Books and supplies	50.00-100.00	25.00	75.00-125.00
Other personal expenses and incidentals	100.00-150.00	100.00-150.00	200.00-300.00
Total (N. C. residents)	$692.50-842.50	$611.50-741.50	$1334.00-1584.00
Total (non-residents)	$905.00-1055.00	$854.00-954.00	$1759.00-2009.00

Refunds

Tuition and Fees

A student who withdraws from school on or before the last day for registration will receive a refund of the full amount paid, less a $5.00 registration fee. On withdrawal later than the period specified, no refund will be made.

Room Rent

Refund of room rent will be made if reservation is cancelled:

a. Prior to the first day of the registration period, the rent paid will be refunded less a $10 reservation fee.

b. During the registration period, the rent paid will be refunded less a $10 reservation fee or a charge of $1.00 per day (whichever amount is greater) from the first day of the registration period (or date of reservation, whichever is later) to date of cancellation.

c. After the last day for registration, no refund will be made for any reason other than withdrawal from college.

Cancellation of reservations must be made in person or in writing to:

Housing Rental Office
Lazar Hall
North Carolina State
Raleigh, North Carolina

Linen Rental

No refunds or credits will be made to a student for those weeks he fails to use the linen rental service. The exception to this case is the student who officially withdraws from college. He will be refunded for the unused service at the rate of fifty cents (.50) per week provided he returns the final issue of linen to the College Laundry.

General Deposit

Miscellaneous charges for laboratory breakage, traffic fines, dormitory and property repair charges, military property charges, physical education equipment and property charges, and all other miscellaneous charges when less than $15 will be deducted from the general deposit of $20, as incurred throughout the year. The $20 general deposit must be rebuilt to the $20 level by the student at the beginning of the fall semester before the completion of registration or whenever the deposit has been depleted to the $5.00 level.

The general deposit of $20 or the remaining balance is refunded when a student has completed the requirements for a degree or has dropped out of school permanently. The student must apply to the Business Office for the refund at which time a correct mailing address must be given. Refund

will be made by check after 30 days from the date the application is received.

Refund Committee

In some instances circumstances justify the waiving of rules regarding refunds. An example might be withdrawal from school because of illness. Students have the privilege of appeal to the Refund Committee when they feel that special consideration is merited. Applications for such appeals may be secured from the Division of Student Affairs.

Student Activities and Services

State College makes every effort to provide the student with surroundings which are pleasant and conducive to intellectual growth. Respecting the student as an individual, the College assures him the maximum of personal liberty within the limits necessary for orderly progression of class work. In return, he is expected to pay serious attention to his purpose in attending college and to observe rules of conduct consistent with maturity. Through the various services and activities identified with everyday life on the campus, as well as through the several extracurricular organizations and functions, the student at State College has an excellent opportunity for acquiring experience in group leadership and community living which may serve him well in his professional career.

As the student progresses in his development, especially after his freshman year, he will find many opportunities to increase his growth in citizenship by participating in the activities of his academic class and of the student body in general. Following is a survey of the various activities at State College.

Student Government and Honor System

When a student enters State College, he becomes a member of a self-governing community.

Legislative, executive, and judicial authority, insofar as student affairs are concerned, rest with the Student Government which operates within the framework of over-all college administration. The Student Government members and Judicial Department members are elected in campus-wide elections. The student has a voice in his own government by participating in these elections. Often in general elections he is asked to vote on proposed changes in regulations which affect the student body.

The student also becomes part of the Honor System. He is expected to adhere to its general aims, which are honesty in class work and honor in general conduct.

Clubs and Societies

Through the various honorary, professional, technical, and social organizations at State College, the interested student finds many opportunities to participate in activities that appeal to him and to meet others who have similar interests.

College Honorary

Honorary societies and fraternities at State College are Golden Chain, senior leadership; Blue Key, junior leadership; Thirty and Three, sophomore leadership; Phi Eta Sigma, freshman scholarship; and Phi Kappa Phi, junior, senior, and graduate student scholarship.

Professional and Technical

Each school at State College sponsors or supervises a large number of professional and technical societies and clubs. Students in every area of instruction are encouraged to join with their fellow students in pursuing their common interests. Many of these organizations contribute greatly to the student's professional and social growth.

Social Fraternities

Eighteen national social fraternities have chapters at State College. Each sends two representatives to the Interfraternity Council, which has as its objectives promoting the general interests and welfare of the associated fraternities and insuring cooperation between them in their relations with the faculty, the student body, and the general public.

The social fraternities are Alpha Gamma Rho, Delta Sigma Phi, Farmhouse, Kappa Alpha, Kappa Sigma, Lambda Chi Alpha, Phi Epsilon Pi, Phi Kappa Tau, Pi Kappa Alpha, Pi Kappa Phi, Sigma Alpha Epsilon, Sigma Alpha Mu, Sigma Chi, Sigma Nu, Sigma Phi Epsilon, Sigma Pi, Tau Kappa Epsilon, and Theta Chi.

State College has one national social sorority, Sigma Kappa, which recently established a chapter here.

Student Publications

A variety of publications, both general and school-sponsored, are edited and managed by student officers, with faculty members serving as advisers. A student may gain journalistic experience and training in writing, editing, or management by working on these publications.

The three general publications, *The Agromeck*, The Student Broadcasting System, and *The Technician*, are supported in large part by a publication fee which is a part of each student's fees.

The Agromeck

The Agromeck is the college yearbook, providing a record of the classes and of the principal events of the school year. The yearbook recalls in pictures the varied activities of the student body throughout the year, and is published for the entire student body.

The Technician

The Technician is a student newspaper, issued three times a week and delivered to the dormitories and fraternity houses. Students living off-campus pick up their copies of the newspaper from special Technician boxes located at Watauga Hall, the Coliseum, and at the main desk in the College Union. The Technician serves as a forum for student expression as well as a medium for news of particular interest to State College students.

The Student Broadcasting System

Although it is not a publication in the strictest sense of the word, The Student Broadcasting System, a carrier-current station with coverage limited to the campus, serves the same function through a different medium. It offers many opportunities for extra-curricular training in actual broadcasting techniques as well as training in administration and program planning.

The Tower

Each student receives a copy of *The Tower*, the college handbook, which contains detailed information about student regulations, organizations, and activities.

Other Publications

Several of the schools have their own publications which are published under the general supervision of the particular school and deal with material of special interest to students in that school. These publications include *The Pi-ne-tum*, published by the School of Forestry; *The Southern Engineer*, published by the School of Engineering; *The Textile Forum*, published by the School of Textiles; and *The Publications* of the School of Design.

Athletics

In addition to voluntary programs of intramural and intercollegiate sports, State College requires freshmen and sophomores to enroll in credit courses in physical education. Juniors and seniors may take physical education as an elective.

Intramural

The College maintains an extensive program of intramural sports which is administered by the Department of Physical Education. Participation in

these sports is purely voluntary and college credit is not given. Competition is divided into three divisions: Dormitory, Fraternity, and Open. Thirteen sports are offered in the dormitory and fraternity divisions, and four sports plus special events in the open division.

Sports offered in the intramural program are correlated with those taught in the required programs of physical education. Instruction in these sports is given in the classes and opportunity for competition is provided in the intramural program. An Intramural Advisory Board, composed of student representatives and one physical education staff member, determines the policies to be administered by the intramural director.

The intramural facilities, both indoor and outdoor, are excellent. The intramural playing fields, adjacent to the gymnasium, provide space for 10 softball or 10 football games to be played simultaneously. Twenty tennis courts are available for tennis and construction of additional courts is being considered.

The gymnasium has 10 four-wall handball courts, six squash courts, and separate rooms for boxing, wrestling, golf, correctives and weight-lifting. The main gymnasium floor provides seven basketball courts which may be adjusted to accommodate eight volleyball courts, 20 badminton courts, indoor tennis and various other sports. This space also includes a gymnastic area greater than the size of a regulation basketball court.

The swimming pool, located in an adjoining building, is 25 meters by 25 yards and has two one-meter and one three-meter diving boards.

Intercollegiate

Intercollegiate athletics at State College come under the supervision of a separate department of the College. Policies governing intercollegiate competition are recommended, however, by the Athletic Council which is composed of faculty, students, and alumni. The policies are in full accord with the Atlantic Coast Conference and N. C. A. A. rules of eligibility for intercollegiate contests. Membership of the Atlantic Coast Conference includes—in addition to State College—Duke University, Wake Forest College, the University of North Carolina, the University of Maryland, Clemson College, the University of South Carolina, and the University of Virginia.

The program in intercollegiate athletics consists of the organization and training of "Wolfpack" teams in football, basketball, baseball, track cross-country, wrestling, swimming, tennis, golf, soccer, and rifle competition.

Facilities for intercollegiate athletics at State College include Riddick Stadium, a 20,000-seat stadium for football; William Neal Reynolds Coliseum, a 12,500-seat arena for basketball; football practice fields; tennis courts; a swimming pool of olympic dimensions; a gymnasium; a baseball field, and facilities in the Coliseum for wrestling and other sports.

Music

Since the early days of North Carolina State College, its musical organizations have played an important part in the life of the campus. These groups present concerts, furnish music for official college functions, and perform at athletic events. Rehearsal schedules have been carefully arranged to avoid conflicts with other classes or with study time. The combined membership of these organizations constitutes the largest voluntary student organization on campus.

The Men's Glee Club

The Men's Glee Club performs several concerts each year, both on and off the campus. In addition to these concerts, this group makes appearances on television and radio. The Club makes tours and provides small ensemble music for special occasions.

Bands

The Symphonic Band, the Fanfare Band, the Marching Band, and the ROTC Band make up the four divisions of the North Carolina State Bands. Each band serves a specific purpose in the musical life on the campus. Assignments to the various bands are made according to the interests and ability of the individual student.

The Symphonic and Fanfare Bands are concert organizations. Students who are unable to meet the rigid requirements for the Symphonic Band are eligible to try for the Fanfare Band.

The Marching Band operates primarily during football season and is widely known for its spectacular half-time performances.

The ROTC Band consists of freshman and sophomore ROTC and AFROTC students. Participation in band excuses the student from all ROTC drill on the field.

Additional information concerning musical activities may be obtained by writing or visiting the director of music in Pullen Hall.

Student Centers

Two important centers for the extra curricular activities of State College students are the E. S. King Religious Center and the Erdahl-Cloyd College Union.

College Union

The Erdahl-Cloyd College Union Building is not only the center for an extensive social and cultural program, but also provides facilities for recreation and relaxation. In addition to a snack bar, dining room, barber shop, and ballroom, there are meeting rooms, a library and lounge area, a gallery area for exhibits, a darkroom, craft shop, music listening room, guest

rooms, a games room and a theater. The offices of the College Union and other organizations are located on the second floor.

The purpose of the College Union is to provide a facility and a program which will complement the academic life of the student and offer him an opportunity to further already existing interests and to develop new ones. Many of the programs at the College Union are organized and executed by students. Everyone is encouraged to participate in some aspect of the Union's activities.

Religious Center

In addition to the functions and activities held in the College Union Building, many other activities especially those of a religious, spiritual, and devotional nature—are held within the E. S. King Religious Center. The Center has an attractive lobby equipped with writing and reading tables and chairs, a television room, and four conference rooms where student and faculty groups may meet. The coordinator of religious affairs and several denominational chaplains have their offices in this building.

The Danforth Chapel, located in the Center, provides a place for religious services and meditation for students of all faiths.

The E. S. King Religious Center plans social events and lectures on various topics related to student life in addition to, or in connection with, its programs of religious emphasis.

D. H. Hill Library

The College's modern and well-equipped D. H. Hill Library has shelves for 400,000 volumes, seats for 900 readers, private studies and conference rooms, and well-lighted ventilated reading rooms. The Library's book stacks provide ample space for the fast growing book collection. In addition, facilities for photoprinting and microfilming are available, and the building's service and reading areas are used as a working center for both students and faculty.

The book collection, which is primarily scientific and technological, strongly reflects the teaching and research requirements of State College. There is also available a fine and well selected collection of books and materials on every phase of cultural interest as well as for recreational reading. At the present time the collection exceeds 240,000 volumes. More than 3,300 journals are received currently, and more than 3,000,000 documents are held resulting from the depository status which the College Library holds for publications of the Federal Government.

Books for recreational reading are housed in the lobby of the building. Students may explore this area and check out books. The big well-lighted West Reading Room is an invitation to study. In addition to this room, on the top floor is a special smaller study open to the students who prefer to work in a more secluded place.

For the graduate students there are desks and private lockers in the

stacks and adjoining the ground floor stacks, a large room where faculty members and graduate students may work. In addition to these facilities, there are several conference rooms open to any college groups requesting them, and rooms which can be temporarily assigned.

In addition to the D. H. Hill Library, specialized branch libraries are maintained in the Schools of Textiles and Design.

Housing

At State College, the dormitory is considered something more than merely a suitable place for living and studying. A well-organized dormitory program plays an important role in the student's all-around development. Under the program each dormitory is organized much like a club, with officers elected by the residents and paid student counselors.

Each student is encouraged to participate in the athletic, social, and recreational activities of his dormitory and in this way he has an opportunity to meet and make friends with students of varied backgrounds, to use his leisure time pleasantly and profitably, and to grow in personality. Each dormitory elects its representatives to the Interdormitory Council, a student organization which coordinates interdormitory activities and programs. In each of seven major dormitories, faculty couples occupy apartments and act as hosts. They assist the occupants with their problems and provide a pleasant atmosphere in which the parents and friends of the occupants may visit the dormitory.

The College has no dormitory for women students. They must make their own housing arrangements. A list of available off campus rooms for rent is maintained at the Housing Rental Office in Leazar Hall.

For married students, the College has for rent 300 permanent efficiency, one and two bedroom apartments. Priority for occupancy goes to graduate students first, prior military servicemen eligible for government educational benefits second, and all other married students third.

At the beginning of the 1961 62 academic year, approximately 327 students were housed in off-campus residences maintained by the social fraternities which have chapters at State College. Each chapter is represented in the Interfraternity Council which sponsors athletic events and social functions of particular interest to fraternity members.

Dormitory Counseling

Each of the dormitories at State College has a dormitory counselor who is an upperclassman with the qualifications for, and responsibility of, helping individual students in his dormitory—particularly freshmen—in any way that he can. Floor counselors and assistant floor counselors, chosen on the same basis, assist the dormitory counselor. Whenever these counselors cannot answer particular questions or give aid in solving special problems, they direct the student to the administrative official who can. Also, in the larger dormitories, faculty couples are in residence to provide the influence and assistance that such mature persons can give.

Food Services

The State College student does not have to travel far for food, whether it is a full meal or a snack.

Leazar Hall

Leazar Hall, the main dining facility, provides four cafeteria lines where the student may secure nutritious food at reasonable prices. Meals are served cafeteria style and the cost depends upon the selection of food. A typical student may spend approximately $2.00 per day or $550 a year for meals, although some students may eat at the college cafeteria for as little as $1.25 per day or $300 a year.

College Union and Shuttle Inn

The College Union Building offers dining room facilities for groups, and also a snack bar. Shuttle Inn in the Textile Building serves sandwiches and grill items. Shuttle Inn is operated by the Student Supply Store Store.

Dormitory Snack Bars

In addition, each dormitory area has its own snack bar, also operated by the Student Supply Store system.

Laundry and Dry Cleaning

The college laundry provides on-campus laundry and dry cleaning service on a cash-and-carry basis for both students and staff. The rates are inexpensive.

Linen Rental Plan

This service provides for an initial issue of two sheets, one pillow case, three towels, and a complete change of linen each week during the school year. A student who elects to use this service need not purchase or bring these items with him when he enters school. The service is available to all students at a cost of $10 per semester. Applications for the linen rental plan are mailed with dormitory room forms, or they may be obtained from the Housing Rental Office.

Barber Service

Two barber shops are provided—one in the E. S. King Religious Center and one in the College Union.

Books and Supplies

Student Supply Store

State College's ultra-modern Student Supply Store, located on Dunn Avenue, houses an excellent book department, general student supplies, engineering equipment, and a fountain-snack bar.

Book Exchange

Alpha Zeta, student honor fraternity, maintains a book exchange in the College Union where students may exchange or sell used books.

Health

State College seeks to safeguard the health of the student in every way possible. The College maintains a 76-bed infirmary which is open 24 hours a day, with 15 staff members. There are college physicians, a supervising nurse, a night supervisor, six general duty nurses, one full-time laboratory and X-ray technician, and four other employees. Among the many valuable features of the infirmary are an up-to-date first aid department and X-ray department.

The college physicians observe regular daily office hours in the infirmary in the mornings and afternoons. In addition, they visit the infirmary more often when necessary. A graduate nurse is on duty day and night. Students have free access to the infirmary at all times.

In case of accident or serious illness of a student, parents or guardians will be notified immediately. No surgical operation will be performed without full consent of parents or guardians, except in cases of extreme emergency.

The medical fee which each student pays provides for infirmary service, general medical treatment, and for the services of nurses. It does not provide for surgical operations, outside hospital care, or the services of dentists or other specialists.

Before the student enters State College he should have a complete, thorough examination by his family physician. Any abnormality should be noted and all remedial defects corrected in order to prevent unnecessary loss of time while the student is in college. If the examination is not made before he enters, the student will be given a physical examination at the College, for which a fee is charged. Blanks for the physical examination may be secured from the Office of Admissions and Registration.

The College offers annually a plan of student accident and health insurance. The insurance is planned to cover the surgical, accident and hospital needs of the student, as a supplement to the services of the infirmary. Each year complete information will be made available to students before the opening of school.

Foreign students are required to enroll in the sickness and accident insurance plan provided through the College or to have similar coverage under other insurance plans or arrangements with their sponsors.

Orientation

Several days before the registration of upperclassmen in the fall semester, new students arrive on the campus for a series of activities planned during Orientation Week. To help freshmen with the transition from high school to college and to help new students become acquainted with the campus and with college regulations, the College arranges during this period a series of meetings and conferences with faculty and student leaders.

Throughout the first semester, there are other activities designed to continue orientation and to supplement orientation courses conducted by the individual schools. In addition, the individual schools provide for regular contact with faculty advisers in order that each student may have the opportunity of discussing matters connected with his adjustment to college life.

Counseling: Student Questions and Problems

The main source of general information for students at State College is the Division of Student Affairs which includes the various administrators handling admissions, registration, records, student activities, student housing, orientation and counseling, and student financial aid.

Academic

Upon enrolling at State College, each student is assigned a faculty adviser, usually a member of the department in which the student is taking his major work. This faculty adviser works with the student in planning his program of studies and is available for other help in solving problems of an academic nature. The deans, directors of instruction, and department heads are also available to the student to help provide information about the different curricula and to assist with long-range curricular or career planning. Teachers of courses in which the student is enrolled are the best sources of help with particular subjects. Members of the teaching staff maintain a schedule of office hours and expect the student to consult them individually whenever special help is needed.

Dormitory Counseling

As described in the section on *Housing*, student dormitory counselors and floor counselors and the hosts and hostesses assigned to the larger dormitories, provide assistance with various questions and problems.

Counseling Center

The Counseling Center has a staff of full-time counselors to help students with problems of vocational and curricular choice, and personal adjustment. The Center is prepared to administer various aptitude and interest tests and maintains a file of occupational information. Referral can be made for students desiring remedial work in speech, reading, and other special areas.

Students may come to the Center on their own initiative or may be referred by teachers, advisers, or other members of the college staff. There is no cost to the student for conferences but a small materials fee is charged when tests are administered.

Placement

Each of the degree-granting schools at State College provides its students with assistance in obtaining employment during summer vacations and upon graduation. In some curricula a period of approved summer work is required for graduation.

Financial Aid

Help in meeting college expenses is available to North Carolina State College students in several forms. Financial aid, other than graduate fellowships and assistantships, is administered by the Student Financial Aid Officer under policies set by the College Committee on Scholarships and Student Aid. Students seeking information or counseling on financial matters, or wishing to apply for assistance, should write or visit the Student Financial Aid Office.

Scholarships, Grants-In-Aid, Loans

A student's single application for financial aid will gain consideration for all available scholarships, grants in-aid, and long term loans. In general, awards are approved in amounts proportionate to demonstrated need of students with satisfactory records of achievement and school citizenship. Entering freshmen also must make strong scores on the College Entrance Examination Board Scholastic Aptitude Test.

The main means for providing financial aid to entering freshmen is the annual Talent For Service Scholarship Program. For the most complete consideration, high school seniors should submit application materials by February 1 of the year preceding fall enrollment. Enrolled students are encouraged to make application at the end of one school year for financial aid in the next year. There is, however, no deadline for applications, except in the cases of certain competitive scholarships which are announced.

The College seeks to assign the kind of aid best suited to the needs and qualifications of the applicant, and a recipient may expect a portion of the aid offered him each year to be in the form of a loan. Renewal of finan

cial aid is based upon the student's making a clearly satisfactory record of achievement and campus citizenship.

State College participates in the National Defense Student Loan Program, under which loans are made that draw no interest until one year after leaving college. Other college loans accrue interest at the rate of 3 per cent from the date of execution of the note. Repayments of long-term loans begin after graduation or withdrawal from college.

Emergency loans are available to meet unforeseen expenses. These loans must be repaid in 30 to 60 days and are not extended beyond the end of a term.

Graduate Fellowships

Graduate Fellowships are funds offered to graduate students to assist in the support of programs of advanced study. Holders of fellowships have no obligations to the College and may devote full time to the prosecution of their graduate programs. Funds for these fellowships are provided by various government agencies, professional groups, and business organizations. Applicants for fellowships should contact the head of the department in which they wish to pursue studies.

Graduate Assistantships

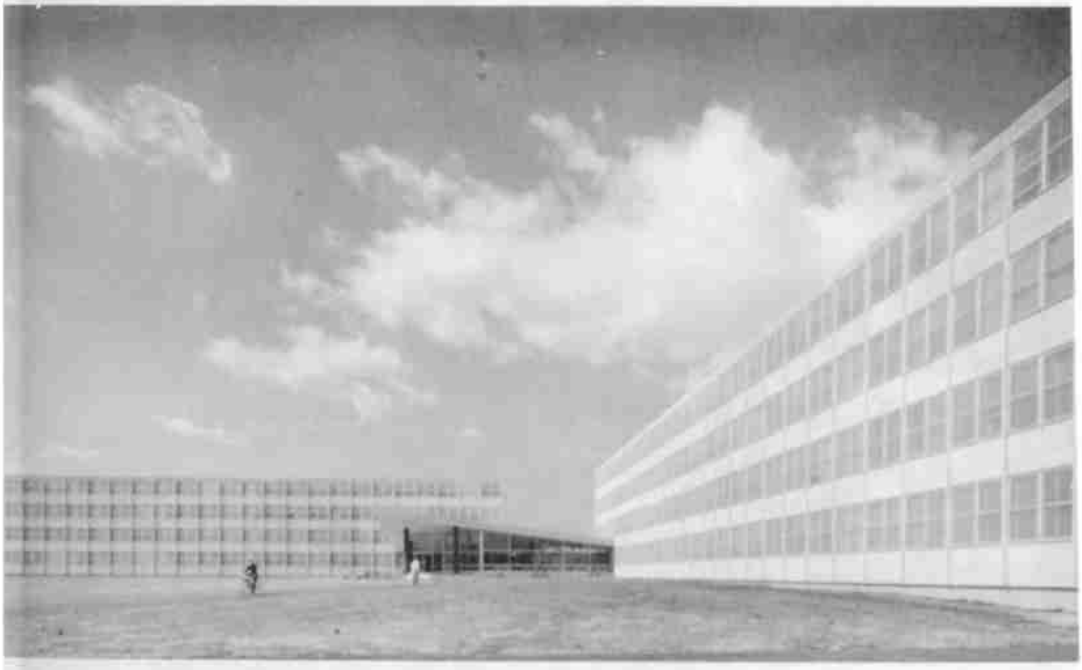
Graduate Assistantships are short-term staff appointments that carry stipends ranging from $1,200 to $4,800 depending upon the magnitude of the service obligation and the experience of the appointee. Teaching assistants are customarily appointed annually for the nine-month academic year. Research assistants are often appointed on a calendar year basis and, accordingly, stipends may be 20 per cent larger than those for teaching assistants. Only graduate students in good standing are eligible for appointment to graduate assistantships. The course loads permitted graduate assistants are adjusted in proportion to the service obligation. Graduate assistants giving half-time to their service obligation may register for 60 per cent of a full course load.

Athletic Awards

Athletic Awards are made upon the recommendation of the Athletic Department to athletes who meet the established qualifications for such awards.

Part-time Employment

A Part-time Employment Service is provided to assist students in locating jobs both on and off campus. Students who desire part-time work should call at the Financial Aid Office when they arrive on the campus.



MILITARY TRAINING

Department of Military Science

Professor of Military Science COLONEL L. W. MERRIAM
Assistant Professors of Military Science:
LIEUTENANT COLONEL WILFORD L. WILLEY, LIEUTENANT COLONEL JAMES F. BARRETT, MAJOR MAX A. CRAIG, MAJOR JOSEPH W. JENKINS, MAJOR JAMES E. LAWSON, MAJOR ROBERT E. WICKHAM, MAJOR WOODROW O. WILSON, CAPTAIN NORMAN G. ERIKSEN, CAPTAIN CHARLES I. MCLAIN, CAPTAIN MAYNARD E. SHIELDS

Department of Air Science

Professor of Air Science COLONEL JAMES D. HOWDER
Assistant Professors of Air Science:
LIEUTENANT COLONEL FRANKLIN D. BLANTON, LIEUTENANT COLONEL EARL R. DICKEY, LIEUTENANT COLONEL MAYNARD C. CUSWORTH, MAJOR GERALD L. WATERMAN, MAJOR ROBERT J. SHELDON, CAPTAIN CHARLES W. ROWAN, CAPTAIN WILLIAM S. CLARKE, JR.

Objectives

The Reserve Officers' Training Corps (ROTC) at State College designates those students enrolled for training in the Department of Military Science or in the Department of Air Science. These departments are integral academic and administrative subdivisions of the institution. The senior Army officer and the senior Air Force officer assigned to the College are designated as professor of military science (PMS) and professor of air science (PAS). These senior officers are responsible to the Secretary of the Army, the Secretary of the Air Force, and the chancellor of the College for conducting their training and academic program in accordance with instructions issued by the respective secretaries and as required by college regulations. Army officers who are assigned to the College as instructors in ROTC are called assistant professors of military science; Air Force officers, as assistant professors of Air Science. Non-commissioned officers of the Army are assigned as assistant instructors and administrative personnel.

Non-commissioned officers of the Air Force are assigned as administrative and supply personnel.

The Army ROTC, in four years of military training, produces junior officers who have the qualities and attributes essential to their progressive and continued development as officers of the United States Army.

The mission of the Air Force ROTC is to develop in selected college students, through a permanent program of instruction at designated civilian educational institutions, those qualities of leadership and other attributes essential to their progressive advancement to positions of increasing responsibility as commissioned officers in the United States Air Force.

Course of Instruction

Programs of instruction for both Army and Air Force ROTC consist of a two-year basic course and a two-year advanced course. The satisfactory completion of the basic course in either the Army or Air Force ROTC is required for all physically fit male freshmen and sophomores unless they are excused by the college administration. (All veterans who were in active service for as long as six months are excused from this requirement, but may enroll in the basic course of Army or Air Force ROTC to qualify for later enrollment in advanced courses.)

The College provides, in cooperation with the Air Force and the Army, a flight instruction program. A limited number of highly qualified cadets from both ROTC units participate in this instruction which includes approximately 35 hours of flying in light aircraft plus ground school. Successful completion of this phase of the ROTC course qualifies the cadet for a Federal Aviation Agency pilot's certificate.

Satisfactory completion of the advanced courses qualifies a student for commissioning as a second lieutenant in the Army or Air Force Reserve upon graduation from the College. A detailed description of all military courses is given under each of the departments in the section of the catalog which lists course descriptions.

Military Science

The satisfactory completion of the first year of the Army ROTC course is a prerequisite for entering the second year. Enrollment in advanced courses is elective on the part of the student. The selection of advanced course students is made from applicants who are physically qualified and who have above average academic and military records. Veterans who have one year or more of service in the Armed Forces are eligible for enrollment in the Army ROTC advanced course upon reaching their junior year, provided they are in good academic standing, physically qualified,

have not reached their 27th birthday, and are selected by the PMS and the Chancellor.

The Army ROTC course includes instruction in American military history, map reading, leadership, military teaching methods, military administration, operations, and logistics. These subjects not only prepare students to be officers in the United States Army, but also awaken in them an appreciation of the obligations of citizenship and secure for them personal benefits resulting from practical application of organization and responsible leadership. An elective subject is chosen from general academic areas in effective communication, science comprehension, general psychology, or political development and political institutions for utilization in the junior and senior years.

Air Science

Enrollment in the Air Force ROTC advanced course is elective on the part of the student. Selection of advanced course students is made from applicants who are physically qualified and who have above average academic and military records. Qualified veterans desiring a commission through the AFROTC will be required to take that portion of the basic course, with their non-veteran contemporaries, which remains before they are classified as academic juniors. All veterans must have completed their academic and military requirements prior to their 28th birthday.

The Air Force ROTC course of study includes instruction in foundations of air power, Air Force officer development, leadership, and air power concepts. The Air Force ROTC curriculum is designed to prepare the student for his obligations of citizenship to his country as an officer in the United States Air Force or as a civilian.

Uniforms and Equipment

Officer-type uniforms for students enrolled in both basic and advanced courses in Army ROTC are provided by the Federal Government. Students enrolled in the basic course in Air Force ROTC are provided Air Force-type uniforms. For students enrolled in advanced courses in either Army or Air Force ROTC, the College is furnished a monetary allowance by the Federal Government for the purchase of uniforms. Army and Air Force equipment for instruction of students is provided by the Federal Government. Both uniforms and equipment are issued to the College, which is responsible for their care.

Credit

Credit is allowed for work at other institutions having an ROTC unit established in accordance with the provisions of the National Defense Act and regulations governing the ROTC. Record of a student's prior training in the ROTC is obtained from the institution concerned.

Financial Aid

Students enrolled in the advanced course are paid a monetary allowance in lieu of subsistence at the daily rate equal to the value of the commuted ration ($0.90) for a total period not to exceed 595 days during the two years of the course. Students in the basic course receive no monetary allowance.

Organization of the ROTC

Army

The Army ROTC unit at State College consists of an Army brigade and a drum and bugle corps. The Army brigade, commanded by a cadet colonel and staff, consists of a provisional batallion and three battle groups. The cadet colonel and all other cadet officers are selected from students enrolled in the second year advanced course. Cadet first sergeants and sergeants first class are appointed from students enrolled in the first year advanced course. Certain specially selected students in the second year basic course also are appointed as cadet non commissioned officers. Cadet officers and non commissioned officers obtain invaluable experience in leadership by being responsible for conducting all drill instruction. They are observed and supervised in this by the officers and non commissioned officers of the Army assigned to the College.

Air Force

The Air Force ROTC unit consists of an Air Force wing and a drill team. The Air Force ROTC wing, commanded by a cadet colonel, consists of three groups which are composed of four squadrons each. These squadrons are divided into three flights per squadron, each flight consisting of three squads. The wing, group, squadron, and flight commander and their staff are cadet commissioned officers and are selected from cadets enrolled in the advanced course. All other positions are held by cadet non-commissioned officers who are selected from the first year advanced and second year basic cadets. Cadet officers and non commissioned officers ob-

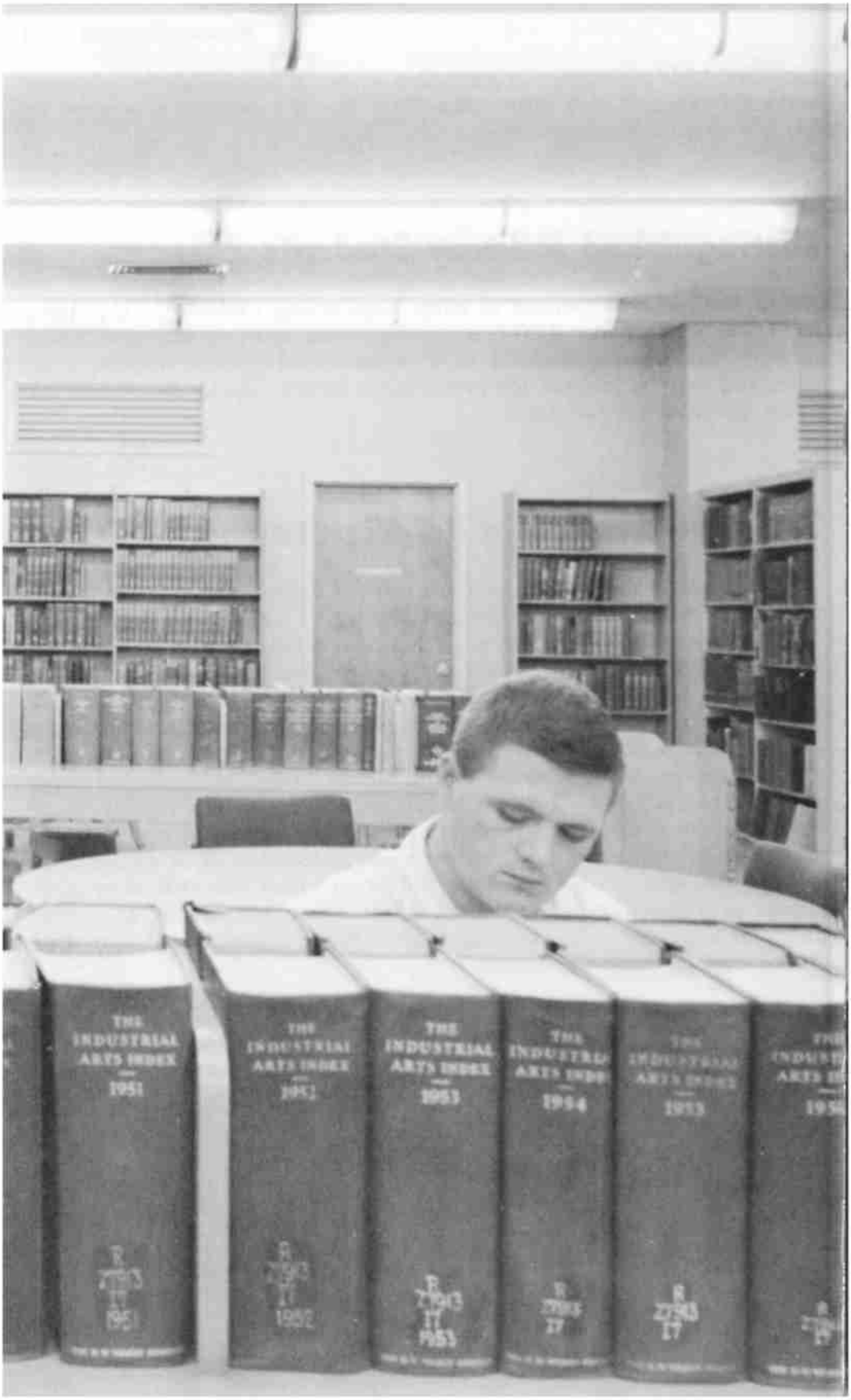
tain invaluable experience in leadership by being responsible for planning and conducting all drill instruction. They are observed and supervised by the officers and airmen assigned to the College.

Distinguished Military Students

The College is authorized to name outstanding students of the Army ROTC and Air Force ROTC as distinguished military students. These students may, upon graduation, be designated distinguished military graduates and may be selected for commissions in the regular Army and Air Force, provided they so desire.

Selective Service in Relation to the ROTC

Enrollment in the ROTC does not in itself defer a student from induction and service under the Universal Military Training and Service Act. The law provides that "within such numbers as may be prescribed by the Secretary of Defense, any person who (a) has been or may hereafter be selected for enrollment or continuance in the senior division, Reserve Officers' Training Corps, or the Naval Reserve Officers Training Corps; (b) agrees, in writing, to accept a commission, if tendered, and to serve, subject to order of the secretary of the Military Department having jurisdiction over him; and (c) agrees to remain a member of a regular or reserve component until the eighth anniversary of the receipt of a commission in accordance with his obligation under subsection 'd' of section four of this title, shall be deferred from induction under this title after completion or termination of the course of instruction and so long as he continues in a regular or reserve status upon being commissioned, but shall not be exempt from registration."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SCHOOLS AND PROGRAMS OF STUDY

This section of the catalog lists the eight schools of the College and explains the programs of study within the schools.

Each of the College's schools is administered by a dean. The main academic divisions of the College are the Schools of Agriculture, Design, Education, Engineering, Liberal Arts, Forestry, Physical Sciences and Applied Mathematics, and Textiles.

North Carolina State College, the technical branch of the Consolidated University of North Carolina, provides an opportunity for its students to obtain top level scientific as well as technical training. Also, the students are offered the broad general education which is a necessary prerequisite to specialization.

Throughout the programs of study given in this section, departmental codes, course numbers, and course titles are used. Additional information concerning specific courses may be found in the *Description of Courses* section. The following code is given to assist in locating course descriptions.

Code	Name
AC	Agricultural Communications (see Agriculture)
AG	Agriculture
AGC	Agricultural Economics
AGE	Agricultural Engineering
ANS	Animal Science
ANT	Anthropology
ARC	Architecture
AS	Air Science
BO	Botany and Bacteriology
BS	Biology
CE	Civil Engineering
CH	Chemistry
CHE	Chemical Engineering
CS	Crop Science
DN	Design
E	Engineering
EC	Economics
*ED	Education (General Courses)
EE	Electrical Engineering
EH	Engineering Honors
EM	Engineering Mechanics
ENG	English
ENT	Entomology
FOR	Forestry
FS	Food Science
GN	Genetics

* Also, Agricultural Education courses, a few Industrial Arts courses, Industrial Education courses, Mathematics and Science Education courses, and Occupational Information and Guidance courses

Code	Name
HI	History
HS	Horticultural Science
IA	Industrial Arts
IE	Industrial Engineering
ISO	International Student Orientation
LA	Landscape Architecture
MA	Mathematics
ME	Mechanical Engineering
MIC	Ceramic Engineering
MIG	Geological Engineering
MIM	Metallurgical Engineering
ML	Modern Languages (General Courses)
MLE	Modern Languages (English for Foreign Students)
MLF	Modern Languages (French)
MLG	Modern Languages (German)
MLI	Modern Languages (Italian)
MLR	Modern Languages (Russian)
MLS	Modern Languages (Spanish)
MS	Military Science
NE	Nuclear Engineering
PD	Product Design
PE	Physical Education
PHI	Philosophy
PO	Poultry Science
PP	Plant Pathology
PS	Political Science
PSM	Physical Sciences and Applied Mathematics
PSY	Psychology
PY	Physics
REL	Religion
RPA	Recreation and Park Administration
RS	Rural Sociology
SOC	Sociology
SS	Social Studies
SSC	Soil Science
ST	Experimental Statistics
TC	Textile Chemistry
TX	Textile Technology, Knitting Technology, and General Course
ZO	Zoology

School of Agriculture

H. BROOKS JAMES, Dean

EDWARD W. GLAZENER, Director of Instruction

The agriculture of our modern world amounts to more than growing food and fiber. Agriculture includes all of the technical, professional, and business occupations connected with the processing and distribution of farm products.

The men who produce and supply the farmer with his complex needs, the farmer himself, those to whom he sells, the processor of these products, and the retailer are all part of today's agriculture.

All told, they add up to nearly 40 per cent of the 65 million employed people in the United States making agriculture the nation's biggest single industry. There are more than 500 distinct occupations in today's agriculture—jobs that each year need more than twice the number of people trained to fill them.

The new concept of agriculture is defined to include three important groups in our economy. The first is the farmers themselves. The people who are engaged in the production of crops and livestock. The second includes those industries which furnish supplies and services to farmers. The third includes those industries which process, store, handle, and merchandise farm products.

The overall objective of the School of Agriculture is the development of well-rounded, educated citizens capable of assuming important roles in business, science, and technology as they relate to farming and associated industries.

Facilities

A sound teaching and research program is based on taking advantage of the most modern equipment available in each field. North Carolina State College is fortunate to have at its disposal the newest equipment and facilities in many fields.

Laboratories are well equipped with the necessary materials for learning and practicing the basic and applied sciences. Machinery and equipment, in some cases provided by private industry, keep students abreast of the latest technological advances. Extensive plant, animal, and insect collections are available for use in teaching and for research.

The D. H. Hill Library at State College has a large collection of scientific books and periodicals which provides excellent source material for many courses. In addition, students may draw from the specialized periodicals and textbooks located in the department libraries.

State College's 16 outlying research farms provide a practical classroom for many courses, as well as a place where researchers can carry on basic and applied research.

Student Activities

Students in the School of Agriculture have ample opportunities to take part in many broadening extra curricular activities, both within the school and in the College itself.

Most departments have student organizations which provide professional as well as social experience. Student tours provide an opportunity to see first-hand the application of classroom principles.

In addition, judging teams representing animal industry, horticulture, and poultry compete regionally and nationally providing student members a chance to travel while learning more about their field.

Curricular Offerings and Requirements

The modern concept of agriculture has given State College's oldest school its newest look.

A freshman enrolling in the School of Agriculture now chooses from four curricula *agricultural business*, *agricultural science*, or *agricultural technology*, *biological sciences* devised to more closely parallel the new concept.

After completing the first two years, consisting largely of basic courses in the biological, physical, and social sciences, the student can choose his major from among the 15 departments.

The student's needs for learning "how to make a living" and for learning "how to live" are both given consideration in the three curricula. Not only does each student get the solid background in science so necessary for today's agriculture, he has a chance to develop a program to fit his individual needs and wants.

Although requirements vary in the curricula, students in all four get a solid background in the sciences, plus a variety of electives. All the curricula have requirements in English and modern languages, the social sciences and humanities, and the physical and biological sciences. In addition, electives can be chosen from several specified areas (see curricula listing below), depending on the curriculum. The student also will have departmental requirements and electives in his major field.

In general, requirements are similar no matter which curriculum the student chooses. However, the program in science places more emphasis on the physical and biological sciences, while that in business emphasizes economics and business management, and the course in technology is stronger in the applied science and technology courses.

The majors offered in the three curricula are as follows:

Agricultural Business—agricultural economics, animal husbandry, crop science, food science, dairy husbandry, horticultural science, poultry science and soil science.

Agricultural Science—agricultural economics, agricultural engineering (joint program with the School of Engineering), animal husbandry, botany, crop science, food science, dairy husbandry, entomology, horticultural science, poultry science, rural sociology, soil science, wildlife biology, and zoology. Pre-veterinary work also is taken in this curriculum.

Agricultural Technology—agricultural economics, agricultural engineering, animal husbandry, crop science, dairy husbandry, horticultural science, plant protection, poultry science, and soil science.

Biological Sciences—This curriculum emphasizes the basic biological and physical sciences on a non departmental, broad spectrum, especially designed as preparatory for graduate study or educational or teaching careers in biology.

Degrees

The degree of Bachelor of Science is conferred upon the satisfactory completion of one of the curricula in this school.

The degrees of Master of Science, Master of Agriculture and professional degrees are offered in the various departments of the School of Agriculture after the satisfactory completion of at least one year of graduate study in resident.

The Doctor of Philosophy degree is offered by the following departments: Agricultural Economics, Agricultural Engineering, Animal Science, Crop Science, Botany, Entomology, Food Science, Genetics, Plant Pathology, Soil Science, and Zoology.

Further information may be found in the Graduate School Catalog.

Opportunities

Agriculture is a broad field with fascinating new opportunities. It needs trained persons to process and distribute agricultural products, to give special services to people who actually produce these products, and to do research and teaching that will make our agricultural production and distribution even more efficient.

The eight major fields of agriculture—research, industry, business, education, communications, conservation, services, as well as farming and ranching—need 15,000 college graduates each year in the United States. But at present our colleges are graduating only about 7,000 a year trained for these jobs. This leaves more than two jobs for each graduate.

In North Carolina alone, there is a desperate need for college-trained people to farm their own land, and for well schooled specialists in the fertilizer, dairy, feed, insecticide, farm implement and distribution industries. These industries put graduates in key positions and call for more than State College can supply.

Some of the opportunities in the nine fields of agriculture are as follows:

Research—production, marketing, engineering, processing, conservation, reclamation, etc.

Industry—machinery and equipment, chemicals, food processing, grain and seed processing, meat and poultry packing, etc.

Business—banking and credit, insurance, farm management, land appraisal, marketing, transportation, etc.

Education—vocational agriculture, agricultural extension, college instruction, governmental agencies, etc.

Communications—writing, reporting, radio, television, newspapers, magazines, advertising, publications, etc.

Conservation—soil, water, range, forest, fish, wildlife, parks, turf, etc.

Services—inspection and regulation, production field service, quality control and grading, agricultural technicians and consultants, etc.

Farming and ranching—general, dairy, swine, beef, sheep, poultry, cotton, forage, grain, fruits, tobacco, etc.

Biological Areas—graduate or professional training, high school teaching, etc.

Practically all types of occupations—more than 500 of them—are available to a graduate in agriculture. There are many opportunities in technology, science, and business. The School of Agriculture stands ready to help meet the challenge of the new concept of agriculture with forward-looking curricula.

Freshman Year

(The departments in the School of Agriculture have a common freshman year with the exception of the science program in the Department of Agricultural Engineering. For the agricultural science, agricultural engineering freshman year see Department of Agricultural Engineering.)

Fall Semester	*Credits*
AG 103, School Orientation	1
ENG 111, Composition	3
MA 111, Algebra and Trigonometry	4
or	
MA 101, Algebra and Trigonometry	5
HI 261, U. S. in Western Civilization	3
BO 103, General Botany	4
PE 101, Physical Education	1
MS 101, Military Science I	
or	
AS 121, Air Science I	1
	17-18

Spring Semester	*Credits*
ENG 112, Composition	3
MA 112, Analytic Geometry and Calculus	
or	
MA 102, Analytic Geometry and Calculus	4
PS 201, American Governmental System	3
ZO 103, General Zoology	4
PE 102, Physical Education	1
MS 102, Military Science I	
or	
AS 122, Air Science I	1
	16

Agricultural Business Curriculum

Sophomore Year

Fall Semester	*Credits*
ENG 231, Basic Speaking Skills	3
CH 101, General Inorganic Chemistry	4
PSY 200, Introduction to Psychology	3
RS 301, Sociology of Rural Life	3
EC 201, Economics	3
PE 201, Physical Education	1
MS 201, Military Science II	
or	
AS 221, Air Science II	1
	18

Spring Semester	*Credits*
ML, Modern Language Elective	
or	
ENG, English Elective	3
AGC 212, Economics of Agriculture	3
PY 221, College Physics	5
Group D Elective	3
PE 202, Physical Education	1
MS 202, Military Science II	
or	
AS 222, Air Science II	1
	16

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Group B Electives	6	Group B Electives	6
Group A or C Electives	3	Departmental Requirements	6
Departmental Requirements	6	Free Elective	3
Free Elective	3		15
	18		

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Group B Electives	6	Group B Electives	6
Group A or C Elective	2	Departmental Requirements	7
Departmental Requirements	7	Free Elective	3
Free Elective	3		16
	18		

Agricultural Science Curriculum

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ML, Modern Language Elective		ML, Modern Language Elective	
or		or	
ENG, English Elective	3	ENG, English Elective	3
CH 101, General Inorganic Chemistry		CH 103, General and Qualitative	
or		Chemistry	4
CH 105, General Inorganic Chemistry	4	PY 212, General Physics	4
*PY 211, General Physics	4	Group D Elective	3
Group D Elective	3	PE 202, Physical Education	1
PE 201, Physical Education	1	MS 202, Military Science II	
MS 201, Military Science II		or	
or		AS 222, Air Science II	1
AS 221, Air Science II	1		16
	16		

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Group A Elective	5	Group A, B, or C Elective	3
Group D Elective	3	Group D Elective	3
Departmental Requirements	6	Departmental Requirements	7
Free Elective	3	Free Elective	3
	17		16

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Group A Elective	4	Group A Electives	6
Group A, B, or C Elective	3	Group D Elective	3
Departmental Requirements	7	Departmental Requirements	6
Free Elective	3	Free Elective	3
	17		18

* Physics 221 substituted for 211 212 in some agricultural programs

Agricultural Technology Curriculum

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 231, Basic Speaking Skills	3	SOI 200, Soils	4
CH 101, General Inorganic Chemistry	4	CH 103, General and Qualitative Chemistry	4
PY 221, General Physics	5	AGC 212, Economics of Agriculture	3
EC 201, Economics	3	RS 301, Sociology of Rural Life	3
PE 201 Physical Education	1	PE 202, Physical Education	1
MS 201 Military Science II or AS 221, Air Science II	1	MS 202, Military Science II or AS 222, Air Science II	1
	17		16

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Modern Language Elective or English Elective	3	Group A Elective	3
Group D Elective	3	Group D Elective	3
Departmental Requirements	6	Departmental Requirements	7
Group C Elective	3	Free Elective	3
Free Elective	3		16
	18		

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Group A or B Elective	5	Group C Electives	6
Group C Elective	3	Departmental Requirements	7
Departmental Requirements	7	Free Elective	3
Free Elective	3		16
	18		

Credits Required for Graduation

	Agricultural Business	*Agricultural Science*	*Agricultural Technology*
Language	12	12	12
Social Science and Humanities (Group D*)	21	21	21
Physical and Biological Sciences	25	28	33
Restricted Electives:			
Group B	24	Group AA** 26	Group A, B 9-11
Group A and C	5		Group C 9-12
Introduction to Agriculture	1	1	1
Departmental Requirements	26	26	27

* Group A includes the physical and biological sciences; Group B, economics and business management; Group C, applied science and technology and Group D, social sciences and humanities.
** Six credits may be elected from Groups B and C. Social Science majors may select from Group D.

Free Electives	12	12	12
	126	126	126
Physical Education PE 101, 102, 201, 202	4	4	4
Military Science I and II MS 101, 102, 201, 202 or			
Air Science I and II AS 121, 122, 221, 222	4	4	4

Group Electives

Group A

Physical Sciences

Chemistry

CH 103	General and Qualitative Chemistry
CH 107	General and Qualitative Chemistry
CH 108	General and Qualitative Chemistry Lab
CH 215	Quantitative Analysis
CH 220	General and Organic Chemistry
	All courses at 400 level and above

Mathematics

MA 201	Calculus I
MA 202	Calculus II
MA 211, 212	Analytical Geometry and Calculus
MA 215	Finite Mathematics
	All courses at 300 level and above

Mineral Industries

MIG 120	Physical Geology
MIG 222	Historical Geology
MIG 323	Paleontology
MIG 330	Mineralogy
MIG 442	Petrology

Physics

PY 202 or 212	General Physics
PY 223	Astronomy and Astrophysics
	All courses at 300 level and above

Soil Science

SSC 200	Soils
SSC 302	Soils and Plant Growth
SSC 452	Soil Classification
SSC 511	Soil Physics
SSC 521	Soil Chemistry
SSC 551	Soil Morphology, Genesis and Classification

Statistics

ST 302	Statistical Laboratory
ST 311	Introduction to Statistics
ST 361, 362	Introduction to Statistics for Engineers I, II
	All courses at 500 level

Biological Sciences

Agricultural Engineering

AGE 303	Energy Conversion for Agricultural Production

Animal Science

ANS 312	Principles of Livestock Nutrition
ANS 408	Reproduction and Lactation

Bacteriology

BO 412	General Bacteriology

Botany

BO 214	Dendrology
BO 403	Systematic Botany
BO 421	Plant Physiology
BO 441	Plant Ecology
	All courses at 500 level

Entomology

ENT 301	Introduction to Forest Insects
ENT 312	Economic Entomology
	All courses at 500 level

Food Science

FS 502	Food Chemistry
FS 505	Food Microbiology
FS 506	Advanced Food Microbiology

Genetics

GN 301	Genetics in Human Affairs
GN 411	Principles of Genetics
GN 512	Genetics
GN 513	Cytogenetics

Plant Pathology

PP 315	Plant Diseases
PP 318	Diseases of Forest Trees
PP 500	Advanced Plant Pathology
PP 501	Advanced Plant Pathology Lab, Field Crop Diseases
PP 502	Advanced Plant Pathology Lab, Horticulture Crop Diseases

Poultry

PO 401	Poultry Diseases
PO 521	Poultry Nutrition
PO 522	Endocrinology of the Fowl

Zoology

ZO 212	Human Anatomy
ZO 213	Human Physiology
ZO 223	Comparative Anatomy
ZO 301	Animal Physiology
ZO 315	Animal Parasitology
	All courses at 500 level except ZO 521, 551 and 552 which appear in Group C.

Other courses in the Physical and Biological Sciences not presently listed may be elected upon approval of the director of instruction.

Group B

Economics and Business Management

Students in the Agricultural Business curriculum will select one course each in the areas of accounting, macro-economics, marketing, and management. In addition, two courses will be selected in the area of general business and two courses in general economics. It is suggested that students in Agricultural Science and Agricultural Technology choose Group B electives from the first four areas.

1. *Accounting:*	EC 312	Accounting for Engineers*
2. *Macro-economics:*	EC 302	National Income and Economic Welfare
3. *Marketing:*	EC 411	Marketing Methods
	or	
	AGC 311	Organization and Business Management of Marketing Firms
4. *Management:*	EC 425	Industrial Management
	or	
	AGC 303	Organization and Business Management of Farms

5. *General Business:* (select two courses)

EC 315	Salesmanship
EC 401, 402	Principles of Accounting**
EC 407	Business Law I
EC 409	Introduction to Production Costs
EC 414	Tax Accounting
EC 420	Corporation Finance
EC 426	Personnel Management
EC 431	Labor Problems
EC 432	Industrial Relations
EC 525	Management Policy and Decision Making
AGC 413	Farm Appraisal and Finance
AGC 523	Planning Farm and Area Adjustments

6. *General Economics:* (select two courses)

EC 310	Economics of the Firm
EC 410	Industry Studies
EC 413	Competition, Monopoly and Public Policy
EC 440	Economics of Growth
EC 446	Economic Forecasting
EC 448	International Economics
EC 450	Economic Decision Processes
AGC 521	Procurement, Processing & Distribution of Agricultural Products
AGC 533	Agricultural Policy
AGC 551	Agricultural Production Economics

Group C

Applied Science and Technology

Agricultural Communications

AC 311	Agricultural Communications Methods and Media

Agricultural Engineering

AGE 201	Farm Shop Woodwork
AGE 202	Farm Shop Metalwork
AGE 211	Farm Power and Machinery I
AGE 321	Irrigation, Drainage and Terracing
AGE 332	Farm Building and Crop Processing
AGE 341	Farm Electrification and Utilities

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* If a one year sequence in accounting is desired, the student should elect EC 409 from Group 5.

** EC 401 may be substituted for EC 312 if the sequence EC 401, 402 is preferred.

Animal Science

ANS 201	Elements Dairy Science
ANS 202	Fundamentals of Animal Husbandry
ANS 302	Selecting Dairy and Meat Animals
ANS 308	Advanced Selecting Dairy and Meat Animals
ANS 404	Dairy Farm Problems
ANS 407	Advanced Livestock Production
ANS 503	Animal Breeding
ANS 505	Diseases of Farm Animals

Crop Science

CS 211	Field Crops I
CS 311	Field Crops II
CS 312	Pastures and Forage Crops
CS 413	Plant Breeding
CS 414	Weeds and Their Control
CS 511	Tobacco Technology

Entomology

ENT 322	Beekeeping

Food Science

FS 303	Meat and Meat Products
FS 309	Meat Selection
FS 401	Mktg. Milk and Related Products
FS 404	Poultry Products

Horticultural Science

HS 201	Principles of Horticulture
HS 301	Plant Propagation
HS 342	Landscape Gardening
HS 421	Fruit Production
HS 432	Vegetable Production
HS 441, 442	Floriculture I and II
HS 481	Breeding of Horticulture Plants

Poultry Science

PO 201	Poultry Production
PO 301	Poultry Quality Evaluation
PO 351	Poultry Grading
PO 402	Commercial Poultry Enterprises
PO 520	Poultry Breeding

Soil Science

SSC 341	Soil Fertility and Fertilizers
SSC 161	Soil Conservation and Management

Zoology

ZO 312	Principles of Game Management
ZO 321	Wildlife and Natural Resource Conservation
ZO 521	Fishery Biology
ZO 551, 552	Wildlife Management

Group C Electives in Other Schools

Engineering

EM 341	Mechanics A (Statics)
EM 342	Mechanics B (Dynamics)
EM 343	Strength of Materials A
IE 332	Motion and Time Study
MIM 321	Metallurgy

Forestry

FOR 311	Principles of Farm Forestry

Psychology

PSY 337	Industrial Psychology I

Other courses in Applied Science and Technology not presently listed may be elected upon approval of the director of instruction.

Group D

Social Science and Humanities

Agricultural Economics

AGC 212	Economics of Agriculture
AGC 512	Economic Analysis of Factor Markets

Economics

EC 201, 202	Economic Principles
EC 301	Production and Prices
EC 310	Economics of the Firm
EC 440	Economics of Growth
EC 442	Evolution of Economic Ideas
EC 446	Economic Forecasting
EC 448	International Economics
EC 501	Intermediate Economic Theory
EC 502	Money, Income and Employment
EC 541	Origins of the United States Economy
EC 550	Mathematical Models in Economics
EC 552	Econometrics
EC 555	Introduction to Linear Programming

History

HI 201	The Ancient World
HI 202	The Medieval World
HI 205	The Modern Western World
HI 225, 226	Modern Europe
HI 251	The United States to 1865
HI 252	The United States since 1865
HI 261	The United States in Western Civilization
	All courses at 300 level and above

Political Science

PS 201	The American Governmental System
PS 202	County and Municipal Government
PS 301	Comparative Political Systems
PS 302	Contemporary World Politics
PS 376	Latin American Governments and Politics
	All courses at 400 level and above

Philosophy and Religion

PHI 201	Logics
PHI 203	Introduction to Philosophy
PHI 205	Problems and Types of Philosophy
REL 301	Religious Groups & Trends in the U. S.
REL 302	The Bible and Its Background
REL 303	Christian Ethics
PHI 305	Philosophy of Religion
PHI 306	Philosophy of Art
PHI 307	Ethics
PHI 309	Marriage and Family Living
PHI 311	Parent-Child Relationships
PHI 395	Philosophical Analysis
	All courses at 400 level and above

Psychology

PSY 200	Introduction to Psychology
PSY 201	Elementary Experimental Psychology
PSY 302	Psychology of Personality and Adjustment
PSY 304	Educational Psychology
PSY 337	Industrial Psychology I
	All courses at 400 level and above including:
PSY 476	Psychology of Adolescence
PSY 490	Social Psychology
PSY 511	Advanced Social Psychology
PSY 565	Industrial Management Psychology

Rural Sociology

RS 301	Sociology of Rural Life
RS 321	Introduction to Social Research
RS 322	Introduction to Rural Social Work
RS 441	Rural Social Pathology
RS 442	Rural Social Structure

Sociology and Anthropology

ANT 305	People of the World
ANT 251	Physical Anthropology
ANT 252	Cultural Anthropology
SOC 202	Man and Society (General Sociology)
SOC 301	Human Behavior
SOC 302	Public Relations and Modern Society
SOC 303	Current Social Problems
SOC 304	Contemporary Family Life
SOC 305	Race Relations
SOC 306	Criminology
	All courses at 400 level and above

Social Studies

SS 301, 302	Contemporary Civilization
SS 491, 492	Contemporary Issues

Other courses in Social Sciences and Humanities not presently listed may be elected upon approval of the director of instruction.

Department of Agricultural Economics

Professor CHARLES E. BISHOP, *Head of the Department*
TEACHING AND RESEARCH
Professors:
ARTHUR J. COUTU, H. BROOKS JAMES, RICHARD A. KING, JAMES G. MADDOX, WALTER H. PIERCE, GEORGE S. TOLLEY, WILLIAM D. TOUSSAINT
Visiting Professor: ERWIN E. LIEBHAFSKY
Associate Professors:
WILLIAM R. HENRY, JAMES A. SEAGRAVES, T. DUDLEY WALLACE, JAMES C. WILLIAMSON, JR.
Assistant Professors:
DALE M. HOOVER, LOREN A. IHNEN, DUANE F. NEUMAN, R. JAMES PEELER, JR., RICHARD L. SIMMONS
Instructors:
WAYNE E. BOYET, GARNETT L. BRADFORD, ADGER B. CARROLL, BOBBY R. EDDLEMAN, WARREN E. JOHNSTON, JOSEPH C. MATTHEWS, JR., JOHN W. NIXON, GORDON S. SANFORD, T. KELLEY WHITE, JR.
EXTENSION
Associate Professor CHARLES R. PUGH, *In Charge of Farm Management*
Professor:
WILLIAM L. TURNER
Associate Professors:
ROBERT L. JOHNSTONE, CLYDE R. WEATHERS
Assistant Professors:
JAMES G. ALLGOOD, E. WALTON JONES
Instructors:
HUGH L. LINER, FRED A. MANGUM, PAUL S. STONE
Professor GEORGE L. CAPEL, *In Charge of Marketing*
Professor:
CLAYTON P. LIBEAU
Associate Professors:
ROBERT S. BOAL, GUY R. CASSELL, HENRY A. HOMME, T. EVERETT NICHOLS, JR., EDWIN A. PROCTOR
Assistant Professors:
MAURICE E. THIGPEN, RUBY P. UZZLE
Instructor:
ROBERT D. DAHLE

The Department of Agricultural Economics offers programs of study leading to the Bachelor of Science, Master of Agricultural Economics, Master of Science, and Doctor of Philosophy degrees.

Three options are available to undergraduate students majoring in agricultural economics. These options include agricultural business, agricultural science, and agricultural technology. Students are given training in all aspects of organizing and operating agricultural business firms. A sound foundation in basic economic principles in production and marketing is provided in order that graduates will be able to deal with problems associated with the rapid changes in technical and economic conditions.

The general objectives of the department are as follows:

(1) To train students to make sound decisions in organizing and managing farms and other agricultural businesses.

(2) To train students in the fundamentals of business organization.

(3) To provide an understanding of the relation of agriculture to other parts of the economy and how to evaluate agricultural policy and economic changes which affect agriculture.

(4) To train graduate students in advanced economic theory and research techniques.

Opportunities

Training in agricultural economics qualifies a student for a wide range of opportunities. Many graduates of the department are employed in research and educational work by various agencies of the federal and state governments. These agencies include the Agricultural Extension Service, the Agricultural Experiment Station, the State Department of Agriculture, and other agencies of the United States Department of Agriculture.

The growing number of companies processing and manufacturing agricultural products has created an increasing demand for people trained in agricultural economics. Opportunities here include employment by companies handling farm supplies such as feed, fertilizer, and equipment; general marketing and processing firms; agricultural cooperatives; professional farm management agencies, and various credit agencies.

Openings in all of these areas greatly exceed the number of graduates trained to fill them. And as industrial and agricultural development of the region continues, employment opportunities are expected to increase.

Facilities

The department has a modern and well equipped library, including all of the major professional journals and USDA publications. Experiment station publications from other institutions throughout the United States are kept on file. Modern computational and reproduction equipment is available. In addition, the department has access to cooperative use of IBM equipment in the Department of Experimental Statistics, including a 650 digital computer and a Rand 1105 computer. The department is housed in Patterson Hall.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in Agricultural Economics may be earned under the agricultural business and agricultural science curricula in the School of Agriculture. In addition, students must meet all of the basic requirements of the College and the School of Agriculture.

For the freshman year and basic requirements see pages 54-56.

Agricultural Business—The requirements for the agricultural business curriculum are as follows:

Group B Courses (24 Credits)

	Credits
AGC 311, Organization and Business Management of Marketing Firms	3
AGC 551, Agricultural Production Economics	3
AGC 552, Consumption, Distribution and Prices in Agriculture	3
EC 302, National Income and Economic Welfare	3
EC 312, Accounting for Engineers	
or	
EC 401, Principles of Accounting	3
EC 407, Business Law I	3
Electives	6

Group A and C Courses (6 Credits)

CH 103, General and Qualitative Chemistry	4
Electives	2

Departmental Requirements and Electives (26 Credits)

AGC 303, Organization and Business Management of Farms	3
ST 311, Introduction to Statistics	3
AGC 533, Agricultural Policy	3
AGC 521, Procurement, Processing and Distribution of Agricultural Products	
or	
AGC 523, Planning Farm and Area Adjustments	3
Electives	14

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Group A Courses (26 Credits)

	Credits
MA 211 and 212, Analytic Geometry and Calculus B, C	
or	
MA 201 and 202, Analytic Geometry and Calculus II and III	6 or 8
Electives	18 or 20

Departmental Requirements and Electives (26 Credits)

	Credits
AGC 303, Organization and Business Management of Farms	3
AGC 311, Organization and Business Management of Marketing Firms	3
AGC 533, Agricultural Policy	3
AGC 551, Agricultural Production Economics	3
AGC 552, Consumption, Distribution, and Prices in Agriculture	3
ST 311, Introduction to Statistics	3
EC 312, Accounting for Engineers	
or	
EC 401, Principles of Accounting	3
Electives	5

Graduate Study

The Department of Agricultural Economics offers programs of study leading to the Master of Agricultural Economics, the Master of Science, and the Doctor of Philosophy degrees.

Special emphasis is placed on the economics of agricultural production and marketing, analysis of programs and policies affecting agriculture, and statistical techniques which can be used in solving agricultural problems.

Department of Agricultural Engineering

Professor F. J. HASSLER, *Head of the Department*
TEACHING AND RESEARCH
Professors:
H. D. BOWEN, J. M. FORE, W. E. SPLINTER, JAN VAN SCHILFGAARDE, JOHN W. WEAVER, JR.
Associate Professor:
EZRA L. HOWELL
Assistant Professors:
GEORGE B. BLUM, JR., W. H. JOHNSON, K. A. JORDAN, DAVID A. LINK, C. W. SUGGS
Instructors:
E. O. BEASLEY, J. F. BEEMAN, E. G. HUMPHRIES, EDWARD H. WISER, F. SCOTT WRIGHT
Head Mechanic:
RALPH B. GREENE
EXTENSION
Professor H. M. ELLIS, *In Charge*
Associate Professors:
J. C. FERGUSON, R. M. RITCHIE, W. C. WARRICK
Assistant Professors:
J. W. GLOVER, R. W. WATKINS
Instructor:
R. E. SNEED

Students in agricultural engineering are educated and trained to deal with problems of agriculture that are engineering in nature. Involved are the application of scientific and engineering principles to the conservation and utilization of water and soil, the development of power and labor-saving devices for all phases of agricultural production, the design of structures and equipment for housing and handling livestock and field products, and the processing and marketing of farm products.

The need for men to carry out the technical aspects such as development and research as well as less technical work, such as sales and service of farm equipment requires the offering of two distinct curricula as described below.

The Department of Agricultural Engineering is housed in the Agricultural Engineering Building.

Opportunities

Men trained in agricultural engineering under the science curriculum are qualified for positions in design, development and research in public institutions and in industry, and for teaching and extension work in institutions of higher education. The curriculum also provides adequate training for postgraduate work leading to advanced degrees.

Men trained in the field of agricultural engineering technology are qualified for positions in sales and service of agricultural equipment such as farm machinery, irrigation systems, etc.; as county agents or farmers; and for farm advisory work with such organizations as electric power companies.

Undergraduate Curriculum

Agricultural Science—This curriculum, offered in conjunction with the School of Engineering, is designed to develop young men capable of engineering leadership in agriculture. Emphasis is placed on basic science

courses such as mathematics, physics, mechanics, biology, soils, and thermodynamics, which provide a sound background for engineering and agricultural technology. Courses in agricultural engineering are directed to those methods of thought and techniques whereby science can be applied with understanding and judgment to engineering situations in agricultural operations. General agriculture courses are provided in order that the student can better understand the agricultural industry with which he deals.

Since agricultural engineering involves two distinct technical fields—agriculture and engineering—this curriculum is a joint responsibility of the two schools and is so administered. Graduates in the program receive the degree of Bachelor of Science in Agricultural Engineering.

Freshman

	Credits
ENG 111, 112, English Composition	6
MA 101, 102, Algebra and Trigonometry; Analytic Geometry and Calculus I	9
AG 103, School Orientation	1
CH 101, General Chemistry I	4
AGE 151, 152, Farm Mechanics	4
ME 101, 102, Engineering Graphics I, II	4
MS 101, 102, Military Science I	
or	
AS 121, 122, Air Science I	2
PE 101, 102, Physical Education	2
	32

Sophomore

	Credits
EM 200, Introduction to Mechanics	3
CH 103, General Chemistry II	4
CE 201, Surveying I	3
AGE 211, Farm Power and Machinery	3
MA 201, 202, Analytic Geometry and Calculus II and III	8
PY 201, 202, General Physics	10
MS 201, 202, Military Science II	
or	
AS 221, 222, Air Science II	2
PE 201, 202, Physical Education	2
	35

Junior

	Credits
BO 103, General Botany	4
EC 201, Economics	3
EE 320, Elements of Electrical Engineering	4
EM 301, Solid Mechanics I	3
EM 303, Fluid Mechanics I	3
ENG 231, Basic Speaking Skills	3
ME 301, Engineering Thermodynamics I	3
MA 301, Differential Equations	3
SSC 200, Soils	4
English Elective	3
Electives	6
	39

Senior

	Credits
HI 261, The United States in Western Civilization	3
AGC 212, Economics of Agriculture	
or	
AGC 551, Agricultural Production Economics	3
AGE 371, Soil and Water Conservation Engineering	4
AGE 451, Conditioning Principles for Plant and Animal Systems	2
AGE 452, Senior Seminar	1
AGE 462, Farm Power and Machinery IIA	4
AGE 481, Agricultural Structures as Production Units	4
AGE 491, Rural Electrification	4
AGE 552, Instrumentation for Agricultural Research and Processing	1
PS 201, The American Governmental System	3
RS 301, Sociology of Rural Life	3
Humanities Elective	3
Electives	6
	41

ST 361, Introduction to Statistics for Engineers, and PY 407, Introduction to Modern Physics, are recommended for electives.

Agricultural Engineering Technology—This curriculum is designed for those who are working on a practical level with farm people. Graduates are equipped to apply to the farm the new technology as developed and revealed by the research engineer. The courses are presented and directed toward the solution of consumer problems with emphasis on the techniques employed. Graduates from this program will receive the degree of Bachelor of Science in Agriculture.

For the freshman year program in agricultural engineering technology see page 54.

The requirements of the agricultural engineering technology curriculum are as follows:

Group A and B Courses (9-11 Credits)

*PY 211, 212, General Physics (8 credits total)	3
Electives	6-8

Group C Courses (9-11 Credits)

	Credits
Electives	9--11

Departmental Requirements and Electives (27 Credits)

AGE 151, 152, Farm Mechanics	4
AGE 211, Farm Power and Machinery	3
AGE 303, Energy Conversion	2
AGE 321, Irrigation, Terracing and Drainage	3
AGE 411, Farm Power and Machinery IIB	3
AGE 332, Farm Buildings and Crop Processing	3
AGE 341, Farm Electrification and Utilities	3
AGE 452, Seminar	1
ME 101, Engineering Graphics I	2
AGE 331, Food Process Engineering	3

* PY 211 and 212 will be taken in place of PY 221 as shown in the Agricultural Technology Curriculum. These 3 additional credits are Group A electives required by the department.

Graduate Study

The Department of Agricultural Engineering offers advanced study leading to the Doctor of Philosophy degree in any one of five fields of specialization: power and machinery, rural structures, soil and water conservation, rural electrification, or agricultural processing.

The Master of Science program in agricultural engineering provides a broad background in science and engineering through advanced study in mathematics and physics.

For those interested primarily in existing technology, a program of study for the Master of Agricultural Engineering degree permits selections from a variety of advanced application courses. This program provides training appropriate for those engaged in the dissemination of information either as extension workers with public institutions or service representatives for industry. It is not intended as preliminary study to the Doctor of Philosophy degree.

Agronomy

See Crop Science and Soil Science

Department of Animal Science

Professor I. D. PORTERFIELD, *Head of the Department*

TEACHING AND RESEARCH

Professors:

E. R. BARRICK, E. G. BATTE, GEORGE HYATT, J. E. LEGATES, H. A. STEWART, G. MATRONE, W. R. MURLEY, F. H. SMITH, S. B. TOVE, L. C. UTLEY, G. H. WISE

Associate Professors:

A. J. CLAWSON, E. U. DILLARD, LEMUEL GOODE, J. G. LEECT, R. D. MOCHRIE, H. A. RAMSEY, W. W. G. SMART, JR., M. B. WISE

Assistant Professors:

H. B. CRAIG, J. P. EVERETT, J. M. FEATHERWOOD, J. J. MCNEIL, D. J. MONGOL, J. L. MOORE, R. M. MYERS, O. W. ROBISON

Instructors:

G. L. ELLIS, I. J. ELLIS, J. H. GREGORY, D. O. MORGAN, J. D. PETTYJOHN, W. L. TUCKER

EXTENSION

Professors:

A. V. ALLEN, T. C. BLALOCK, J. S. BUCHANAN, JACK KELLEY, M. E. SINGER

Associate Professors:

J. D. GEORGE, G. S. PARSONS, J. W. PATTERSON, J. R. WOODARD

Assistant Professors:

F. N. KNOTT, R. L. MCGUIRE, R. R. RICH, D. G. SPEIER

Undergraduate students in the Department of Animal Science are instructed in the basic principles of subjects relating to various phases of dairy and livestock production. To meet the needs of specialized interests, two majors, animal husbandry and dairy husbandry, are offered in each of the three curricula in the School of Agriculture. A third major, animal nutrition, in the agricultural science curriculum, is in the advanced planning stage. Thus, the purpose of these offerings is to present challenges to and to provide preparation of students from various backgrounds for

constructive and progressive participation in the ever-expanding fields of animal agriculture.

Opportunities

There are many and varied opportunities for students who major in any of the animal industry programs.

Animal Husbandry

Kinds of work for which graduates are qualified include the following: farm operations, livestock management, fieldmen for breed associations and livestock organizations, agricultural extension, education work with business and industries serving agriculture, meat grading, communications (livestock and market news with radio and TV stations), sales work with feed, equipment and pharmaceutical companies, graduate study, research with industry and educational institutions, livestock buying and livestock and farm loans with banks and lending agencies.

Dairy Husbandry

Kinds of work for which graduates are qualified include: agricultural extension and other educational work, feed consulting and sales work, dairy herd management, dairy breed promotion, dairy equipment sales, research and development, marketing dairy cattle and dairy products, dairy field work, dairy cattle nutrition, and dairy cattle breeding.

Undergraduate Curriculum—Animal Husbandry

The degree of Bachelor of Science with a major in animal husbandry may be obtained under any of the three curricula offered by the School of Agriculture.

For the freshman year and basic requirements see pages 54-56.

Agricultural Business—The requirements of the agricultural business curriculum are as follows:

Group B Courses (24 Credits)

	Credits
Electives	24

Group A Courses (6 Credits)

	Credits
CH 351, Introductory Biochemistry	3
ZO 301, Animal Physiology	3

Departmental Requirements and Electives (26 Credits)

	Credits
ANS 202, Fundamentals of Animal Husbandry	4
ANS 303, Meat and Meat Products	3
ANS 312, Principles of Livestock Nutrition	3
ANS 406, Animal Industry Seminar	1
CH 103, General and Qualitative Chemistry	4
BO 412, General Bacteriology	4
GN 411, The Principles of Genetics	3
ANS 407, Advanced Livestock Production	4

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Group A Courses (25 Credits)

	Credits
BO 412, General Bacteriology	4
CH 351, Introductory Biochemistry	3
ZO 301, Animal Physiology	3
GN 411, The Principles of Genetics	3
*Electives	12

Departmental Requirements and Electives (26 Credits)

	Credits
ANS 202, Fundamentals of Animal Husbandry	4
ANS 303, Meat and Meat Products	3
ANS 312, Principles of Livestock Nutrition	3
ANS 406, Animal Industry Seminar	1
ANS 408, Reproduction and Lactation	4
ANS 503, (GN 503), Genetic Improvement of Livestock	3
ANS 505, Animal Diseases	3
ANS 407, Advanced Livestock Production	4
Elective	1

Agricultural Technology—The requirements of the agricultural technology curriculum are as follows:

Group A and B Courses (10 Credits)

	Credits
BO 412, General Bacteriology	4
CH 351, Introductory Biochemistry	3
ZO 301, Animal Physiology	3

Group C Courses (11 Credits)

	Credits
Electives	11

Departmental Requirements and Electives (27 Credits)

	Credits
ANS 202, Fundamentals of Animal Husbandry	4
ANS 302, Selecting Dairy and Meat Animals	2
ANS 303, Meat and Meat Products	3
ANS 312, Principles of Livestock Nutrition	3
ANS 406, Animal Industry Seminar	1
ANS 503, (GN 503), Genetic Improvement of Livestock	3
CH 103, General and Qualitiative Chemistry	4
GN 411, The Principles of Genetics	3
ANS 407, Advanced Livestock Production	4

Undergraduate Curriculum—Dairy Husbandry

The degree of Bachelor of Science with a major in dairy husbandry may be obtained under any of the three curricula offered by the School of Agriculture.

For the freshman year and basic requirements see pages 54-56.

Agricultural Business—The requirements of the agricultural business curriculum are as follows:

Group B Courses (24 Credits)

	Credits
Electives	24

* Six credits may be elected from Groups B and C.

Group A Courses (7 Credits)

	Credits
GN 411, Principles of Genetics	3
ZO 301, Animal Physiology	4

Departmental Requirements and Electives (25 Credits)

	Credits
ANS 201, Elements of Dairy Science	4
ANS 312, Principles of Livestock Nutrition	3
BO 412, General Bacteriology	4
ANS 404, Dairy Farm Problems	3
ANS 406, Animal Industry Seminar	1
CH 103, General and Qualitative Chemistry	4
CH 351, Introductory Biochemistry	3
ANS 408, Reproduction and Lactation	3

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Group A Courses (26 Credits)

	Credits
ZO 301, Animal Physiology	4
CH 351, Introductory Biochemistry	3
GN 411, Principles of Genetics	3
*Electives	16

Departmental Requirements and Electives (26 Credits)

ANS 201, Elements of Dairy Science	4
ANS 302, Selecting Dairy and Meat Animals	2
ANS 312, Principles of Livestock Nutrition	3
BO 412, General Bacteriology	4
ANS 404, Dairy Farm Problems	3
ANS 406, Animal Industry Seminar	1
ANS 408, Reproduction and Lactation	3
ANS 503, (GN 503), Genetic Improvement of Livestock	3
Elective	3

Agricultural Technology—The requirements of the agricultural technology curriculum are as follows:

Group A and B Courses (10-13 Credits)

	Credits
ZO 301, Animal Physiology	4
CH 351, Introductory Biochemistry	3
GN 411, The Principles of Genetics	3
Electives	0-3

Group C Courses (9-12 Credits)

	Credits
Electives	9-12

Departmental Requirements and Electives (26 Credits)

	Credits
ANS 201, Elements of Dairy Science	4
ANS 302, Selecting Dairy and Meat Animals	2
ANS 312, Principles of Livestock Nutrition	3
BO 412, General Bacteriology	4
ANS 404, Dairy Farm Problems	3
ANS 406, Animal Industry Seminar	1
ANS 408, Reproduction and Lactation	3
ANS 503, (GN 503), Genetic Improvement of Livestock	3
Electives	3

* Six credits may be elected from Groups B & C.

Graduate Study

The Department of Animal Industry offers the Master of Science and Doctor of Philosophy degrees in animal industry. The degrees of animal industry provide for major programs of work in the fields of animal husbandry, dairy husbandry, animal nutrition, animal diseases, animal physiology, and animal breeding.

Department of Botany and Bacteriology

Professor H. T. SCOFIELD, *Head of the Department*
TEACHING AND RESEARCH
Professors:
E. A. BALL, J. B. EVANS, L. A. WHITFORD
Associate Professors:
E. O. BEAL, J. W. HARDIN, J. R. TROYER
Assistant Professors:
F. B. ARMSTRONG, A. W. COOPER, G. H. ELKAN, JOSEPH S. KAHN, HEINZ SELTMANN
Research Associate:
W. J. DOBROGOSZ

The course program in the department has the objective of providing undergraduate and graduate instruction in the various specialized phases of basic plant science including microbiology. Undergraduates majoring in the department are usually oriented toward graduate work in this or other fields of science. Courses are supplemented by supervised programs of research for graduate students studying for master's or doctor's degrees. Course work in the department also is designed to provide a basis for study in the applied sciences in agriculture and forestry.

Opportunities

Majors in botany and bacteriology may choose to continue graduate work leading to the Master of Science and Doctor of Philosophy degrees in one of the several specialized fields. Majors specializing in botany are qualified for many technological positions with various government institutions or private industries concerned with agriculture. Majors specializing in bacteriology find employment opportunities in medical and agricultural industry or in the field of public health.

Undergraduate Curriculum—Botany

The Bachelor of Science degree with a major in the agricultural science curriculum from the School of Agriculture can be obtained in botany. For the freshman year and basic requirements see pages 54-56. The general requirements of the agricultural science curriculum are as follows:

Group A Courses (25 Credits)

	Credits
CH 103, General and Qualitative Chemistry	4
*Electives 6 credits may be elected from Groups B and C)	21

Departmental Requirements and Electives (27 Credits)

	Credits
BO 301, General Morphology	3
BO 403, Systematic Botany	3
BO 421, Plant Physiology	4
BO 441, Plant Ecology	3
GN 411, Principles of Genetics	3
PP 315 or 318, Plant Diseases, Disease of Forest Trees	4
BO 412, General Bacteriology	4
Elective	3

Undergraduate Curriculum—Bacteriology

The department does not offer an undergraduate major program in bacteriology, however, programs can be arranged to provide training that is well suited to prepare a student for graduate work in bacteriology or microbiology or to seek employment as a bacteriologist.

Anyone interested in undergraduate work emphasizing bacteriology should see a departmental adviser.

Graduate Study

Botany and bacteriology offer work leading to the Master of Science degree in the special fields of plant physiology, ecology, anatomy, morphology, bacteriology, and systematic botany. Graduate work in preparation for the Doctor of Philosophy degree is offered in the fields of plant physiology, plant ecology, systematic botany, bacteriology and morphology.

Department of Crop Science

Professor P. H. HARVEY, *Head of the Department*

TEACHING AND RESEARCH

Professors:

D. S. CHAMBLEE, D. U. GERSTEL, W. C. GREGORY, G. L. JONES, K. R. KELLER, G. C. KLINGMAN, R. L. LOVVORN, T. J. MANN, P. A. MILLER, R. P. MOORE, J. C. RICE, J. A. WEYBREW

Associate Professors:

C. A. BRIM, J. W. DUDLEY, D. A. EMERY, H. D. GROSS, L. A. JONES, W. M. LEWIS, F. W. MCLAUGHLIN, D. E. MORELAND, L. L. PHILLIPS, LUTHER SHAW, D. L. THOMPSON, D. H. TIMOTHY, R. P. UPCHURCH

Professor Emeritus:

G. K. MIDDLETON

Assistant Professors:

W. A. COPE, W. T. FIKE, W. B. GILBERT, G. R. GWYNN, J. L. HALL, J. A. LEE, J. R. MAUNEY, D. A. MILLER, C. F. MURPHY, E. C. SISLER, D. C. WHITENBERG

Instructor:

F. L. SELMAN

EXTENSION

Professor E. R. COLLINS, *In Charge of Agronomy Extension*

Professors:

R. R. BENNETT, S. H. DOBSON, A. D. STUART

* No more than 6 hours of Group A electives may be courses in the Department of Botany and Bacteriology.

Associate Professors:
S. N. HAWES, ASTOR PERRY
Assistant Professors:
C. T. BLAKE, D. M. GOSSETT, A. D. WORSHAM
Intructor:
W. G. TOOMEY

The curriculum in crop science has as its objectives training the student in the fundamental principles of the plant sciences, along with the application of these principles to the problems of crop production.

The importance of agronomic training in North Carolina agriculture is shown by the fact that the State ranks third among the states in cash income from farm crops. Yet the maximum potential production of farm crops has by no means been reached. With continued improvement in varieties, cultural practices and cropping methods, further advances will be made. In carrying out this broad program there is, and will continue to be, a real need in North Carolina for men well trained in plant breeding, crop production and management and related fields.

The Department of Crop Science is housed in Williams Hall.

Opportunities

Graduates in crop science are trained to fill positions as county extension agents; farm operators and managers; salesmen in seed and fertilizer companies and similar commercial concerns; seed analysts; and as leaders in various forms of agricultural development work. The crop science programs also offer training for those students who might want to continue their education with graduate study in preparation for extension, teaching or research positions with state or Federal institutions or private industry.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in crop science can be earned under any of the three curricula in the School of Agriculture.

For the freshman year and basic requirements see pages 54 56.

Agricultural Business—The requirements of the agricultural business curriculum are as follows:

Group B Courses (24 Credits)

	Credits
AGC 303, Organization and Business Management of Farms	3
AGC 311, Organization and Business Management of Marketing Firms	3
EC 407, Buisiness Law 1	3
Electives	15

Group A and C Courses (5 Credits)

GN 411, The Principles of Genetics	3
Elective	2

Departmental Requirements and Electives (26 Credits)

CS 211, Crop Science	3
CS 312, Pastures and Forage Crops	3
CS 414, Weeds and Their Control	3
BO 421, Plant Physiology	4
ENT 312, Economic Entomology	3
PP 315, Plant Diseases	3
SSC 200, Soils	4
SSC 302, Soils and Plant Growth or SSC 341, Soil Fertility and Fertilizers	3

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Group A Courses (25 Credits)

BO 412, General Bacteriology	4
GN 411, The Principles of Genetics	3
PP 315, Plant Diseases	3
MA 201, Analytic Geometry and Calculus II or MA 211, Analytic Geometry and Calculus B	4 or 3
*Electives	11 or 12

Departmental Requirements and Electives (26 Credits)

	Credits
CS 211, Crop Science	3
CS 312, Pastures and Forage Crops	3
CS 414, Weeds and Their Control	3
BO 421, Plant Physiology	4
ENT 312, Economic Entomology	3
SSC 200, Soils	4
SSC 302, Soils and Plant Growth or SSC 341, Soil Fertility and Fertilizers	3
Elective	3

Agricultural Technology—The requirements of the agricultural technology curriculum are as follows:

Group A and B Courses (8-11 Credits)

	Credits
GN 411, The Principles of Genetics	3
PP 315, Plant Diseases	3
Electives	2-5

Group C Courses (9-12 Credits)

Electives	9-12

Departmental Requirements and Electives (27 Credits)

CS 211, Crop Science	3
CS 311, Field Crops II	3
CS 312, Pastures and Forage Crops	3
CS 413, Plant Breeding	3
CS 414, Weeds and Their Control	3
BO 421, Plant Physiology	4
ENT 312, Economic Entomology	3
SSC 302, Soils and Plant Growth or SSC 341, Soil Fertility and Fertilizers	3
Electives	2

* Six credits may be elected from Groups B and C.

The Departments of Crop Science, Entomology, and Plant Pathology offer a joint major in plant protection. See section on plant protection for details.

Graduate Study

The Department of Crop Science offers training leading to the degrees of Master of Science and Doctor of Philosophy in the following fields: plant breeding, crop production, forage crop ecology, and weed control.

Dairy Husbandry

See Animal Science

Department of Entomology

Professor CLYDE F. SMITH, *Head of the Department*
TEACHING AND RESEARCH
Professor Emeritus:
T. B. MITCHELL
Professors:
C. H. BRETT, F. E. GUTHRIE, D. A. YOUNG, JR.
Associate Professors:
W. V. CAMPBELL, M. H. FARRIER, W. J. MISTRIC, R. L. RABB
Assistant Professors:
R. C. AXTELL, W. C. DAUTERMAN, E. HODGSON, H. H. NEUNZIG
Instructors:
M. D. JACKSON, H. B. MOORE, D. A. MOUNT
RESEARCH
Assistant Professors:
R. B. CHALFANT, G. F. TURNIPSEED
EXTENSION
Professor:
G. D. JONES
Assistant Professor:
R. L. ROBERTSON
TEACHING AND EXTENSION
Assistant Professor:
W. A. STEPHEN

The entomology faculty offers instruction at both the undergraduate and graduate levels and provides students in this field the broad fundamental training necessary in this profession. Undergraduate instruction also is designed to provide introductory and terminal courses in insect control technology for students majoring in other areas of agriculture and forestry.

The Department of Entomology is housed in Gardner Hall.

Opportunities

Opportunities for employment of well-trained entomologists are plentiful and varied. Research and teaching opportunities exist in many state institutions. Federal agencies offer many positions in research and regulatory work. Private industry is using more and more entomologists in the

development, production, control, testing and sale of agricultural chemicals. Other opportunities in entomology as consultants in domestic or foreign service as well as in private business and sales are available. One can go into business for himself as a pest control operator or an insecticide formulator.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in entomology is offered under the agricultural science curriculum of the School of Agriculture.

For the freshman year and basic requirements see pages 54-55.

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Group A Courses (26 or 28 Credits)

	Credits
SSC 200, Soils	4
or	or
MIG 120, Geology	3
BO 412, General Bacteriology	4
GN 411, Principles of Genetics	3
CH 351, Introductory Biochemistry, or Equivalent	3
ST 311, Introduction to Statistics	3
BO 421, Plant Physiology	4
or	or
ZO 301, Animal Physiology	3
ZO 205, Invertebrate Zoology	4
*Elective	3

Departmental Requirements and Electives (20 Credits)

ENT 312, Economic Entomology	
or	
ENT 301, General Entomology	3
ENT 511, Systematic Entomology	3
Advised Electives	14

Agricultural Technology—The Departments of Crop Science, Entomology, and Plant Pathology offer a joint major in plant protection. See section on plant protection for details.

Graduate Study

The Master of Science and Doctor of Philosophy degrees are offered in entomology. The work in entomology is well supported by strong Departments in Chemistry, Statistics, and the Plant and Animal Sciences.

* May be taken from Groups B and C.

Department of Food Science

Professor W. M. ROBERTS, *Head of the Department*
TEACHING AND RESEARCH
Professors:
L. W. AURAND, T. N. BLUMER, J. L. ETCHELLS, W. M. HOOVER, I. D. JONES, M. L. SPECK
Associate Professors:
T. A. BELL, D. FROMM, F. G. WARREN
Assistant Professors:
H. B. CRAIG, M. E. GREGORY, V. A. JONES
Instructor:
C. W. DILL
EXTENSION
Professor:
J. A. CHRISTIAN
Associate Professor:
F. B. THOMAS
Instructor:
J. F. WILES

The Department of Food Science has the objectives of providing undergraduate and graduate programs for the application and coordination of basic training in the physical and biological sciences, economics and engineering to the development, processing, packaging, quality control, distribution and utilization of foods.

The department maintains modern and fully-equipped laboratories for teaching and research programs in dairy, fruit, meat, poultry, seafood, and vegetable products.

The department head and several staff members of the Department of Food Science are housed in Polk Hall. Other staff members and teaching and research facilities are housed in Kilgore and Scott Halls.

Opportunities

The increasing consumer demands for greater varieties and quantities of highly nutritious and convenience foods of uniformly high quality create many and varied career opportunities in the food and allied industries for qualified personnel.

Specific job opportunities in the food industries are procurement, processing, management, quality control, research and development, distribution, sales and merchandising. Some of the job opportunities in allied industries include sales and service representatives of companies manufacturing equipment and supplies for the food industries, consulting activities and trade association promotional and educational services.

Food scientists hold educational and regulatory positions in extension service, inspection, grading, research and development and quality control of foods with various State and Federal governmental agencies. Food scientists are in demand for teaching and research positions with colleges and universities.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in food science and processing can be earned under any of the three curricula in the School of Agriculture.

For the freshman year and basic requirements see pages 54-56.

Agricultural Business—The requirements of the Agricultural Business curriculum are as follows:

Group A Courses (8 Credits)

	Credits
BO 412, General Bacteriology	4
CH 103, General Chemistry II	4

Group B Courses (24 Credits)

Electives	24

Departmental Requirements and Electives (23 Credits)

FS 301, Food Composition	3
FS 331, Food Engineering	3
FS 505, Food Microbiology	3
FS 511, Food Science Seminar	1
Electives	13

Agricultural Science—The requirements of the Agricultural Science curriculum are as follows:

Group A Courses (25 Credits)

	Credits
BO 412, General Bacteriology	4
CH 221, Organic Chemistry I	4
CH 215, Quantitative Analysis	4
CH 351, Introductory Biochemistry	3
Electives	10

Departmental Requirements and Electives (26 Credits)

FS 331, Food Engineering	3
FS 502, Food Chemistry	3
FS 505, Food Microbiology	3
FS 511, Food Science Seminar	1
Electives	16

Agricultural Technology—The requirements of the Agricultural Technology curriculum are as follows:

Group A Courses (12 Credits)

BO 412, General Bacteriology	4
CH 221, Organic Chemistry I	4
CH 215, Quantitative Analysis	4

Group C Courses (9 Credits)

Electives	9

Departmental Requirements and Electives (26 Credits)

CH 351, Introductory Biochemistry	3
FS 331, Food Engineering	3
FS 502, Food Chemistry	3
FS 505, Microbiology	3
FS 511, Food Science Seminar	1
Electives	13

Graduate Study

The Department of Food Science offers graduate programs of study leading to the Master of Science and Doctor of Philosophy degrees. Corollary instruction is provided in the biological and physical sciences. Areas of study and research include: (1) food chemistry; (2) food microbiology, and (3) food process and product development. These areas comprise all foods including dairy, fruit, meat, poultry, seafood, and vegetable products.

Department of Genetics

Professor H. F. ROBINSON, *Head of the Department*
TEACHING AND RESEARCH
Professors:
C. H. BOSTIAN, D. S. GROSCH, W. D. HANSON, BEN W. SMITH, S. G. STEPHENS
Associate Professors:
KEN-ICHI KOJIMA, D. F. MATZINGER, R. H. MOLL
Assistant Professors:
F. B. ARMSTRONG, L. E. METTLER
Associate Geneticist:
M. PFLUGE GREGORY
Research Assistant Professor:
WILFRED SHUTZ
Cooperating with the following associate members of the faculty:
Animal Science:
D. U. DILLARD, J. E. LEGATES, O. W. ROBISON, H. A. STEWART
Botany:
E. O. BEAL, J. W. HARDIN
Crop Science:
P. H. HARVEY, C. A. BRIM, W. A. COPE, J. W. DUDLEY, D. A. EMERY, D. U. GERSTEL, W. C. GREGORY, G. L. JONES, K. R. KELLER, J. A. LEE, W. M. LEWIS, T. J. MANN, P. A. MILLER, L. L. PHILLIPS, D. L. THOMPSON, D. H. TIMOTHY
Horticultural Science:
F. D. COCHRAN, G. J. GALLETTA, F. L. HAYNES, W. R. HENDERSON, D. T. POPE
Plant Pathology:
J. L. APPLE, RICHARD GWYN, T. T. HEBERT, E. L. MOORE, R. R. NELSON, N. N. WINSTEAD
Poultry Science:
E. W. GLAZENER, W. L. BLOW, G. A. MARTIN
Forestry:
T. O. PERRY, B. J. ZOBEL
Statistics:
C. CLARK COCKERHAM, J. O. RAWLINGS

The genetics faculty offers instruction at advanced undergraduate and graduate levels. The undergraduate courses are designed to support the other departments of the institution, giving students a background in the science of genetics. The graduate program is designed to train scientists for research and teaching careers in basic genetics and in its applications in plant and animal breeding.

The Department of Genetics is housed in Gardner Hall.

Undergraduate Curriculum

The department does not have a program leading to a Bachelor of Science degree.

Graduate Study

Graduate study is carried out under the direction of the members of the genetics faculty and enables the student to qualify for the Master of Science or the Doctor of Philosophy degree. A candidate for the master's degree must acquire a thorough understanding of genetics and its relation to other biological disciplines and must present a thesis based upon his own research. In addition to a comprehensive knowledge of his field, a candidate for the doctorate must demonstrate his capacity for independent investigation and scholarship in genetics.

The basic aspects of quantitative genetics, cytogenetics, physiological genetics and mutation genetics as related to past and future evolution of organisms is the central theme of the training program and research. Programs of research in biochemical genetics utilize microorganisms in the basic studies of genetic phenomena and gene action. The varied but coordinated interests of the genetics faculty with their research programs offer a variety of opportunities for graduate student training that is found at few other institutions. Experimental studies utilize organisms ranging from microbes, mice and drosophila to trees and economic farm animals.

Department of Horticultural Science

Professor FRED D. COCHRAN, *Head of the Department*
TEACHING AND RESEARCH
Professors:
M. E. GARDNER, F. L. HAYNES, JR., J. M. JENKINS, JR., D. T. POPE, G. O. RANDALL
Associate Professors:
W. E. BALLINGER, L. K. KUSHMAN, C. L. MCCOMBS, C. H. MILLER
Assistant Professors:
T. F. CANNON, F. E. CORRELL, A. S. FISH, G. J. GALLETTA, W. R. HENDERSON, T. R. KONSLER, R. A. LARSON, D. C. ZEIGER
Instructor:
V. H. UNDERWOOD
EXTENSION
Professor J. H. HARRIS, *In Charge*
Professors:
A. A. BANADYGA, H. M. COVINGTON, M. H. KOLBE
Associate Professor:
B. L. JAMES

The undergraduate programs in horticultural science offer broad training in the physical and biological sciences and business, as well as a sound cultural background, to prepare students for graduate study or for diverse professional services in the fruit and vegetable crops field, in floriculture, and in nursery management and landscape horticulture.

The varied climatic conditions in North Carolina make possible the production of a wide variety of horticultural crops commercially, as well as in parks and gardens. While these crops now represent an important segment of agriculture in North Carolina, further expansion will be realized with the development of adapted varieties, mechanization and intensification of cultural practices, improvement of handling and marketing methods, and development of the food processing industry.

Opportunities

Graduates in horticulture will find numerous opportunities in a wide variety of positions in production, processing, sales, and service. Among these are county extension agents; landscaping and landscape contracting; farm operators; orchard, nursery, greenhouse and flower shop managers; research, production, and promotional specialists with commercial seed, floral, fertilizer, chemical, and food companies; inspectors and quality control technologists; USDA specialists; and as leaders in other phases of agricultural and industrial developments. In addition, the student may prepare himself for one of the many opportunities for graduate study.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in horticultural science can be earned in either of the three curricula . . . business, science, or technology . . . offered by the School of Agriculture. Under these curricula, specialized training is offered for horticultural science majors in fruit and vegetable crops, and in floriculture, nursery management, and landscape horticulture.

For the freshman year and basic requirements see pages 51-56.

Agricultural Business—The requirements of the agricultural business curriculum are as follows:

Group B Courses (24 Credits)

	Credits
Electives	24

Group A and C Courses (6 Credits)

ENT 312, Economic Entomology	3
PP 315, Plant Diseases	3

Departmental Requirements and Electives (26 Credits)

SSC 200, Soils	4

For majors in Fruit and Vegetable Crops

HS 421, Fruit Production	3
HS 432, Vegetable Production	3
HS 562, Post-Harvest Physiology	3
Electives	13

For majors in Floriculture, Nursery Management and Landscape Horticulture

	Credits
HS 211, 212, Ornamental Plants	6
HS 301, Plant Propagation	3
HS 351, 441, 442, Greenhouse Management, Floriculture I and II or HS 342, 411, 471, Landscape Gardening, Nursery Management, Arboriculture	9
Electives	4

Agricultural Science—The requirements of the agricultural science curriculum are as follows for specialization in fruit and vegetable crops and ornamental crops:

Group A Courses (26 Credits)

	Credits
BO 412, General Bacteriology	4
BO 421, Plant Physiology	4
CH 103, General and Qualitative Chemistry	4
GN 411, Principles of Genetics	3
SSC 200, Soils	4
Electives	7

Departmental Requirements and Electives (26 Credits)

	Credits
ENT 312, Economic Entomology	3
PP 315, Plant Diseases	3

For majors in Fruit and Vegetable Crops

	Credits
HS 421, Fruit Production	3
HS 432, Vegtable Production	3
HS 552, Growth of Horticultural Plants	3
HS 562, Post-Harvest Physiology	3
Electives	8

For majors in Floriculture, Nursery Management, and Landscape Horticulture

	Credits
HS 211, 212, Ornamental Plants	6
HS 441, 442, Floriculture I and II	6
or	
HS 411, 471, Nursery Management; Arboriculture	6
Electives	8

Agricultural Technology—The requirements of the agricultural technology curriculum are as follows:

Group A and B Courses (10 Credits)

	Credits
BO 421, Plant Physiology	4
GN 411, Genetics	3
PP 315, Plant Diseases	3

Group C Courses (11 Credits)

	Credits
SSC 341, Soil Fertility and Fertilizers	3
HS 481, Breeding of Horticultural Plants	3
Electives	5

Departmental Requirements and Electives (27 Credits)

	Credits
ENT 312, Economic Entomology	3
Electives	6

For Majors in Fruit and Vegetable Crops

	Credits
AGC 364, Marketing of Fruits and Vegetables	3
HS 421, Fruit Production	3
HS 432, Vegetable Production	3
HS 552, Growth of Horticultural Plants	3
HS 562, Post-Harvest Physiology	3
Electives	3

'or majors in Floriculture, Nursery Management, and Landscape Horti-ulture

	Credits
IS 211, 212, Ornamental Plants	6
IS 301, Plant Propagation	3
IS 351, 441, 442, Greenhouse Management; Floriculture I and II	3
or	
IS 342, 411, 471, Landscape Gardening, Nursery Management, Arboriculture	9

ıiraduate Study

The Department of Horticultural Science offers the Master of Science de-ree and the professional degree, Master of Horticulture.

The professional degree is designed for those interested in application f current knowledge, while the Master of Science degree places emphasis n research and provides a basis for later study on the Doctor of Philosophy egree.

Department of Plant Pathology

rofessor D. E. ELLIS, *Head of the Department*

EACHING AND RESEARCH

rofessors:

ROBERT AYCOCK, C. N. CLAYTON, F. A. HAASIS, T. T. HEBERT, A. KELMAN, E. L. MOORE, L. W. NIELSEN, C. J. NUSBAUM, N. N. WINSTEAD

ssociate Professors:

J. L. APPLE, W. E. COOPER, D. M. KLINE, G. B. LUCAS, R. R. NELSON, L. H. PERSON, N. T. POWELL, J. P. ROSS, J. N. SASSER, R. T. SHERWOOD, HEDWIG TRIANTAPHYLLOU

ssistant Professors:

C. S. HODGES, D. L. STRIDER

XTENSION

rofessor HOWARD R. GARRISS, *In Charge*

rofessors:

FURNEY A. TODD, J. C. WELLS

Undergraduate instruction in plant pathology is designed to provide in-roductory and advanced courses in the nature and control of plant diseases o students majoring in crop science, horticultural science, plant protec-ion, agricultural education, and forestry, and to provide students with he fundamental training necessary for graduate study in plant pathology.

Opportunities

Many opportunities for employment in research, extension and teaching ıre available to men with advanced degrees in the field of plant pathology. Openings are available for qualified men in research in the USDA, state experiment stations, and in industry. The rapid development of agricul-ural chemicals and other methods for disease control offers numerous opportunities. See plant protection curriculum.

Undergraduate Curriculum

The Plant Pathology Department cooperates in the training of plar protection majors (see below), but does not offer a major in plant patho ogy at the undergraduate level.

Graduate Study

The Department of Plant Pathology offers graduate training in a phases of plant pathology leading to the degrees of Master of Science an Doctor of Philosophy.

PLANT PROTECTION MAJOR

The major in plant protection is a joint major in the Departments Entomology, Crop Science, and Plant Pathology.

Students in plant protection will be trained in the application of chem cal and biological principles for the control of plant diseases, insects, ar weeds. Crop losses from insects, weeds, and diseases for the past sever years have been estimated in excess of 10 billion dollars annually in th United States. A knowledge of the organisms to be controlled, the produc to be used and the crops to be grown is basic to any control or regulato program.

Opportunities

Opportunities in plant protection basically involve improving farm ef ciency to meet our ever-growing need for food and fiber. About 340 chem cal companies are concerned with manufacturing and formulating produc for pest control. Technically trained men are needed for sales developmen and promotion of agricultural chemicals. Graduates are also trained to fi positions as county extension agents or as state and Federal regulator agents. This major is primarily intended for the Bachelor of Science degre. However, qualified students can go on to graduate school from this curr ulum.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in plant protection s offered under the agricultural technology curriculum of the School f Agriculture.

For the freshman year and basic requirements see pages 54-56.

Agricultural Technology—The requirements of the agricultural tec nology curriculum are as follows:

Group A and B Courses (9-12 Credits)

	Cred
CH 425, Organic Chemistry	
CH 426, Organic Chemistry	
or	
CH 351, Introductory Biochemistry	
GN 411, The Principles of Genetics	
Electives	0-

Group C Courses (9-12 Credits)

CS 211, Crop Science	3
HS 201, Principles of Horticulture	3
Electives	3-6

Departmental Requirements and Electives (27 Credits)

	Credits
BO 421, Plant Physiology	4
BO 412, General Bacteriology	4
ENT 312, Economic Entomology	3
Entomology Elective	3
PP 315, Plant Diseases	3
Plant Pathology Elective	3
CS 414, Weeds and Their Control	3
Electives	4

Department of Poultry Science

Professor H. W. GARREN, *Head of the Department*

TEACHING AND RESEARCH

Professors:

C. W. BARBER, F. R. CRAIG, E. W. GLAZENER, C. H. HILL, M. R. KARE

Associate Professors:

T. T. BROWN, W. L. BLOW, J. W. KELLY

Assistant Professors:

E. E. BERNARD, F. W. COOK, W. E. DONALDSON, G. A. MARTIN

EXTENSION

Professor C. F. PARRISH, *In Charge*

Professor:

J. R. HARRIS

Associate Professors:

W. G. ANDREWS, H. L. BUMGARDNER, W. C. MILLS, JR., T. B. MORRIS

The Department of Poultry Science provides training in the principles of poultry husbandry and in such related scientific fields as nutrition, genetics and physiology.

Through teaching, research, and extension the department serves students, poultrymen, and allied industries. The production of poultry has expanded rapidly in recent years to become one of the most important commodities in North Carolina.

The Department of Poultry Science is located in Scott Hall.

Opportunities

The expanding poultry industry in North Carolina and elsewhere has created more specialized positions than can be filled with the available poultry graduates. Job opportunities are varied, enabling the student to select the type of position having the greatest appeal to him. Graduates hold positions as managers and field representatives for feed manufacturers, processors, hatcheries, equipment companies, biological supply houses, banks, and other allied industries. They also work in communications and public relations and as teaching, extension and research specialists. A number of graduates have established their own successful poultry businesses.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in poultry science can be obtained in any of the three curricula offered by the School of Agriculture.

For the freshman year and basic requirements see pages 54-56.

Agricultural Business—The requirements of the agricultural business curriculum are as follows:

Group A and C Courses (8 Credits)

	Credits
CH 103, General Chemistry II	4
CH 220, Introductory Organic Chemistry	4

Group B Courses (24 Credits)

Electives	24

Departmental Requirements and Electives (27 Credits)

	Credits
PO 201, Poultry Production	4
PO 301, Poultry Quality Evaluations	2
PO 401, Poultry Diseases	4
PO 402, Commercial Poultry Enterprises	4
PO 403, Poultry Seminar	1+1
PO 404, Poultry Products	3
PO 521, Poultry Nutrition	3
ZO 301, Animal Physiology	4

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Group A Courses (26 Credits)

	Credits
BO 412, General Bacteriology	4
CH 221, Organic Chemistry	4
GN 411, The Principles of Genetics	3
ZO 301, Animal Physiology	4
*Electives	11

Departmental Requirements and Electives (26 Credits)

	Credits
PO 201, Poultry Production	4
PO 401, Poultry Diseases	4
PO 403, Poultry Seminar	1+1
PO 404, Poultry Products	3
PO 520, Poultry Breeding	3
PO 521, Poultry Nutrition	3
PO 522, Endocrinology of the Fowl	3
ZO 561, Animal Embryology	4

Agricultural Technology—The requirements of the agricultural technology curriculum are as follows:

Group A and B Courses (15 Credits)

	Credits
CH 220, Introductory Organic Chemistry or CH 221, Organic Chemistry	4
ZO 301, Animal Physiology	4
GN 411, The Principles of Genetics	3
BO 412, General Bacteriology	4

* Six credits may be elected from Groups B and C.

Group C Courses (10 Credits)

	Credits
Electives	10

Departmental Requirements and Electives (25 Credits)

O 201, Poultry Production	4
O 301, Poultry Quality Evaluations	2
O 401, Poultry Diseases	4
O 402, Commercial Poultry Enterprises	4
O 403, Poultry Seminar	1+1
O 404, Poultry Products	3
O 520, Poultry Breeding	3
O 521, Poultry Nutrition	3

:iraduate Study

An extensive research program is found in the Department of Poultry :cience. Graduate training is available in nutrition, physiology, and gene-}ics. If the student desires, a research problem can be developed in one of hese areas with disease as an additional consideration. This department ıouses one of the foremost laboratories in the country devoted to the ıutritional aspects of disease resistance and susceptibility. In the physiol-ıgy area is found the leading laboratory in this country for studying the nechanism of taste in domestic animals. The genetics area enjoys a na-ional reputation for its outstanding contributions to the science of poultry enetics. Graduate study can be developed in either physiological or ıopulation genetics.

PRE-VETERINARY

A pre-veterinary curriculum is offered as part of a working agreement vith two Southern veterinary colleges. After the completion of the pre-cribed work, eight North Carolina students are selected each year to ttend the University of Georgia and six to attend the Veterinary College t Oklahoma State University at in-state rather than out-of-state tuition ates.

The first year's work (up to 42 credits) at either Georgia or Oklahoma nay be transferred back to North Carolina State College and counted oward graduation requirements for a Bachelor of Science degree from tate College in zoology, animal industry, or poultry science if three years vere spent in pre-veterinary curriculum.

Curriculum

The pre-veterinary program is offered under the agricultural science urriculum of the School of Agriculture.

Agricultural Science—The courses listed below are minimum require-nents for all students applying for entrance to veterinary school under he Southern Regional Education Board contract. Only these students vho complete the required courses successfully (grade C or better on ach) will be considered eligible to apply. An over-all 2.50 scholastic verage or better is mandatory for application to Oklahoma State Uni versity.

Languages (9 Credits)

	Credits
ENG 111, 112, English Composition	6
English Elective	3

Social Sciences and Humanities (6 Credits)

HI 261, The U. S. in Western Civilization	3
PS 201, American Government System	3

Physical and Biological Sciences (41 to 44 Credits)

MA 111, 112, Algebra and Trigonometry; Analytic Geometry and Calculus A	8
CH 101, 103, General Inorganic Chemistry; General and Qualitative Chemistry	8
CH 221, 223, Organic Chemistry I and II	8
PY 211, 212, General Physics	8
or	or
PY 221, College Physics	5
BO 103, General Botany	4
ZO 103, General Zoology	4
ZO 223, Comparative Anatomy	4

Group C Courses (12 Credits)

ANS 201, Elements of Dairy Science	4
ANS 202, Fundamentals of Animal Husbandry	4
PO 201, Poultry Production	4

Department of Rural Sociology

Professor SELZ C. MAYO, *Head of the Department*
TEACHING AND RESEARCH
Reynolds Professor:
C. HORACE HAMILTON
Associate Professor:
GLENN C. MCCANN
Assistant Professor:
JAMES N. YOUNG
EXTENSION
Professor JOHN W. CRAWFORD, *In Charge of Community Development*
Associate Professor:
C. PAUL MARSH
Assistant Professors:
THOMAS N. HOBGOOD, ROBERT W. LONG
Instructors:
JOHN N. COLLINS, JANE U. NORWOOD

The principal aim of this department is to teach students the principles and techniques for understanding human group behavior. More specifically the department seeks: (1) to train students to become leaders in organizing rural groups and communities and in administering their programs; (2) to qualify exceptional students on the undergraduate and graduate levels for rural sociological research, teaching and extension work; (3) to solve problems in human group relations through scientific research; and (4) to extend research results to the people of the State.

The Department of Rural Sociology is housed in the 1911 Building.

Opportunities

Graduates of this department may obtain employment as community organization specialists, county agents, social welfare workers, social statisticians, administrators and managers of both public and private social agencies, college teachers, research workers and many other capacities.

Among the institutions offering employment to graduates are land-grant colleges, agricultural experiment stations, and extension services; the United States Departments of Agriculture, State, and Health Education and Welfare; state departments of welfare, health and education; farm journals and newspapers; voluntary social agencies, such as Red Cross, Community Chest, and Boy Scouts; and rural fraternal organizations, and cooperatives. The range of vocational pursuits open to rural sociology graduates is constantly widening.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in rural sociology is offered under the agricultural science curriculum of the School of Agriculture.

For the freshman year and basic requirements see pages 51-55.

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Group A Courses (26 Credits)

	Credits
ST 311, Introduction to Statistics	3
GN 411, Principles of Genetics	
or	
GN 301, Genetics in Human Affairs	3
MIG 120, Physical Geology	3
*Electives	17

Departmental Requirements and Electives (26 Credits)

	Credits
SOC 202, Principles of Sociology	3
RS 301, Sociology of Rural Life	3
SOC 301, Human Behavior	3
ANT 252, Cultural Anthropology	3
RS 321, Introduction to Social Research	
or	
SOC 416, Research Methods	3
RS 442, Rural Social Structure	
or	
SOC 511, Social Theory	3
Electives	8

Graduate Study

The Master of Science and the Doctor of Philosophy degrees are offered by this department. Graduate students studying for the Doctor of Philoso-

* Six credits may be elected from Groups B and C. Additional electives may be chosen from Group D.

phy degree are required to take approximately 15 semester hours in the Department of Sociology at the University of North Carolina, Chapel Hill. Students seeking the Master of Science degree may take courses at Chapel Hill, but normally will be able to complete their entire programs at State College.

Advanced work in rural sociology provides training in a number of social sciences and prepares the graduate student for a wide variety of positions.

Department of Soil Science

Professor JAMES WALTER FITTS, *Head of the Department*
TEACHING AND RESEARCH
Professors:
WILLIAM VICTOR BARTHOLOMEW, JAMES FULTON LUTZ, RALPH JOSEPH MCCRACKEN, WILLIE GARLAND WOLTZ, WILLIAM WALTON WOODHOUSE, JR.
Associate Professors:
CHARLES B. DAVEY, HOMER CLIFTON FOLKS, WILLIAM ADDISON JACKSON, EUGENE JOHN KAMPRATH, CHARLES BERNARD MCCANTS, JAMES RODNEY PILAND, PRESTON HARDING REID, JAMES MAURICE SPAIN, RICHARD JAMES VOLK, STERLING BARG WEED, SANFORD EUGENE YOUNTS
Assistant Professors:
MAURICE GAYLE COOK, FREDERICK RUSSELL COX, DORIS LEE CRAIG, GEORGE AUGUST CUMMINGS, EUGENE FRIZZELLE GOLDSTON, ROBERT EDMUND MCCOLLUM, RAYMOND J. MILLER, JAMES EDWARD SHELTON
Instructors:
CARLOS PAUL BICKFORD, CHARLES BENNETT ENGLAND, RALPH AVERY LEONARD
EXTENSION
Professor EMERSON R. COLLINS, *In Charge of Agronomy*
Assistant Professor:
WILLIAM CALVIN WHITE
Assistant Professors:
J. FRANK DOGGETT, CLIFFORD K. MARTIN

The primary objective of the Department of Soil Science is to train students in the fundamental principles of soils, their utilization and management. Soils constitute one of the largest capital investments in farming and proper soil management is essential for efficient production. Therefore, the demand by educational, research and service agencies and by industry for men trained in soils should continue to be great.

The Department of Soil Science is housed in Williams Hall.

Opportunities

Soil Science graduates are trained to fill positions of leadership in many areas of agricultural work, such as county extension agents; farm operators and managers; soil conservation service representatives; technicians or salesmen in fertilizer companies. Provision is also made for those students who wish to obtain a more thorough training in mathematics, chemistry, physics, and biological sciences in anticipation of graduate study. Students with advanced degrees have unlimited opportunities in teaching, research, and extension with state and federal institutions as well as increasing opportunities with commercial concerns.

Undergraduate Curriculum

The degree of Bachelor of Science with a major in soil science is offered under all three of the curricula in the School of Agriculture.

For the freshman year and basic requirements see pages 54 56.

Agricultural Business—The requirements of the agricultural business curriculum are as follows:

Group B Courses (24 Credits)

	Credits
Electives	24

Group A and C Courses (6 Credits)

Electives	6

Departmental Requirements and Electives (26 Credits)

MIG 120, Physical Geology	3
SSC 200, Soils	4
SSC 341, Soil Fertility and Fertilizers	3
SSC 302, Soils and Plant Growth	3
SSC 480, Senior Seminar	1
SSC 461, Soil Conservation and Management	3
SSC 452, Soil Classification	3
Electives	6

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Group A Courses (26 Credits)

	Credits
MA 201, Analytic Geometry and Calculus I	4
MA 202, Analytic Geometry and Calculus II	4
MIG 120, Physical Geology	3
BO 412, General Bacteriology	4
BO 421, Plant Physiology	4
PY 212, General Physics	4
*Elective	3

Departmental Requirements and Electives (26 Credits)

	Credits
CH Chemistry	12
SSC 200, Soils	4
SSC 480, Senior Seminar	1
SSC 341, Soil Fertility and Fertilizers	3
SSC 302, Soils and Plant Growth	3
Select two of the following courses:	
SSC 461, Soils Conservation and Management	3
SSC 452, Soil Classification	3

Agricultural Technology—The requirements of the agricultural technology curriculum are as follows:

Group A and B Courses (9-12 Credits)

	Credits
Electives	9 12

* May be elected from Groups B and C.

Departmental Requirements and Electives (27 Credits)

	Credits
MIG 120, Physical Geology	3
BO 412, General Bacteriology	4
BO 421, Plant Physiology	4
SSC 341, Soil Fertility and Fertilizers	3
SSC 302, Soils and Plant Growth	3
SSC 480, Senior Seminar	1
SSC 461, Soil Conservation and Management	3
SSC 452, Soil Classification	3
Elective From Group A or B	3

Graduate Study

The Department of Soil Science offers training leading to the degrees of Master of Science and Doctor of Philosophy in the following fields: soil chemistry, soil fertility, soil physics, soil genesis and soil microbiology.

Department of Zoology

Professor F. S. BARKALOW, JR., *Head of the Department*
TEACHING AND RESEARCH
Professors:
R. HARKEMA, M. R. KARE, T. L. QUAY, R. W. STACY
Associate Professors:
W. W. HASSLER, G. C. MILLER, J. A. SANTOLUCITO
Assistant Professors:
C. W. ALLISTON, F. E. HESTER
Instructors:
GEORGETTE CAMPBELL, F. L. ROBERTS
EXTENSION
Assistant Professor H. M. FIELDS, *In Charge of Wildlife*

The Department of Zoology at North Carolina State is organized to serve three purposes: (1) it serves the Schools of Agriculture, Forestry, and Education by teaching courses of a fundamental nature essential to a complete understanding and mastery of applied science; (2) it provides training in zoology which prepares students for positions in industrial and governmental laboratories; (3) it provides undergraduate curricula leading to graduate and professional training in dentistry, medicine, veterinary medicine, and advanced zoological sciences; (4) it furnishes potential leaders in the field of wildlife conservation and game management through a curriculum in wildlife biology.

The Department of Zoology is housed in Gardner Hall.

Opportunities

The zoology program is sufficiently flexible to provide the basic training for students who wish to continue their education at the graduate level, or its equivalent.

Five categories of positions are available to wildlife graduates: administrative, law enforcement, refuge, education, and research. Agencies employing the majority of trained men are state game and fish departments

U. S. Fish and Wildlife Service, U. S. Forest Service, U. S. Soil Conservation Service, U. S. National Park Service, Pure Food and Drug Administration, and other Federal land-use departments.

Employment opportunities continue to be good, especially at the graduate level. No excess of wildlife graduates is anticipated in the immediate future.

Unusual advantages are offered by the wide range of natural environments in North Carolina's Coastal Plain, Piedmont, and mountain regions. Close cooperation with the North Carolina Wildlife Resources Commission provides opportunities for observing developments in wildlife management on its 27 wildlife management and refuge areas.

Undergraduate Curriculum—Wildlife Biology

The Department of Zoology offers the degree of Bachelor of Science with a major in wildlife biology under the School of Agriculture's agricultural science curriculum.

For the freshman year and basic requirements see pages 54 55.

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

Language (3 Credits)

ENG 231, Basic Speaking Skills	3

Group A Courses (21-24 Credits)

ZO 205, Invertebrate Zoology	4
ZO 206, Vertebrate Zoology	4
One course in Botany	2 or 3
One course in Entomology	3
One course in Organic Chemistry	3
Electives (from Botany, Chemistry, Soil Science, Geology, Entomology, Genetics, Mathematics and/or Statistics)	2 or 4
*Electives	3

Departmental Requirements and Electives (29 Credits)

ZO 223, Comparative Anatomy	4
ZO 301, Animal Physiology	4
ZO 321, Wildlife and Natural Resource Conservation	3
ZO 522, Animal Ecology	3
ZO 520, Fishery Science	3
ZO 551, Wildlife Science	3
ZO 521, Fishery Science or ZO 552, Wildlife Science	3
Advised Electives	6

Undergraduate Curriculum—Zoology

The degree of Bachelor of Science with a major in zoology is offered under the agricultural science curriculum.

For the freshman year and basic requirements see pages 54 and 55.

Agricultural Science—The requirements of the agricultural science curriculum are as follows:

* May be elected from Groups B and C.

Languages (3 Credits)

	Credits
ENG 231, Basic Speaking Skills	3

Group A Courses (26 Credits)

ZO 301, Animal Physiology	4
ZO 223, Comparative Anatomy	4
Restricted Electives from Group A	12
Restricted Electives from Groups A, B, and/or C	6

Departmental Requirements and Electives (26 Credits)

Advised electives (two courses must be in Zoology)	26

Graduate Study

The Master of Science and the Doctor of Philosophy degrees are offered in animal ecology and wildlife biology. Graduate programs leading to advanced degrees in the areas of animal parasitology and physiology can be arranged in cooperation with the Department of Zoology of the University of North Carolina at Chapel Hill. Graduate programs are offered which include course work at Duke University and at the Duke Marine Laboratory.

The North Carolina Agricultural Institute

H. BROOKS JAMES, Dean of Agriculture
EDWARD W. GLAZENER, Director of Instruction
HOMER C. FOLKS, Assistant Director of Instruction and Director of the Agricultural Institute

A two year program in agriculture was approved and money was appropriated for this purpose by the 1959 General Assembly. Through action of the Board of Trustees of the Greater University, this two year program was named the North Carolina Agricultural Institute and was approved for operation on the North Carolina State College campus.

The major objective of the Agricultural Institute is to provide technical training to the individual so that he may become more productive in our agricultural society. Specifically, instruction offered by the Agricultural Institute is designed to train men and women for those jobs in agriculture that require technicians with education beyond the high school level. An individual with this type of training should have a better income, assume a more prominent role of leadership, and become an asset to agriculture and to his community.

The instructional programs of the Agricultural Institute are organized and conducted as part of the School of Agriculture's over all resident instruction program. The Institute is an addition to, and not a substitute for, the regular degree-granting program of the School of Agriculture. However, in order to provide students enrolled in the Institute with the best possible technical training, the faculty in residence for the four year program is responsible for organizing and teaching courses offered by the Institute.

People who have training similar to that which can be obtained in the courses offered in the Agricultural Institute are in great demand by agricultural industries. As this demand changes, new courses of study will be organized. Also, programs no longer needed will be dropped. Only through such a system of addition and deletion can the Agricultural Institute meet the needs for technically trained people in North Carolina.

Opportunities for Graduates

Rapid technical advancement has been extremely important in changing agriculture from a small production industry to one of the largest industries in the nation. Today the farmer uses scientifically developed seed, feed, fertilizer; does most of his work with machinery and has scientific testing to back up his management decisions. Increased production has allowed him to sell much of his production rather than just the surplus above home consumption. Farms have become larger due to these technological advances and large amounts of capital are needed to operate successfully. All of these factors bring about dependence on outside sources of information and capital for success in a modern agricultural business.

Not only the person who farms, but the hundreds of related businesses that are a vital part of agriculture today can not operate successfully without men trained in technical skills.

Entrance Requirements

Any individual who has received a diploma from an accredited high school or has passed the high school equivalency examination administered by the State Department of Public Instruction is eligible for entry into the Agricultural Institute. Each application will be reviewed and evaluated by the Institute director before an applicant will be accepted.

Program of Study

The seven programs of study offered are farm machinery sales and service, general agriculture, livestock management and technology, poultry technology, pest control, ornamental crops technology, and field crop technology.

The Agricultural Experiment Station

H. BROOKS JAMES, Dean of Agriculture
R. L. LOVVORN, Director of Research

The Agricultural Experiment Station was established in accordance with an act of the General Assembly of 1877 and amended in 1955. The North Carolina General Assembly has allocated to the Station, annually, certain funds from the General Fund.

The purpose of the Agricultural Experiment Station is to study the basic laws of nature underlying agricultural enterprises and to develop methods

for economic production of the highest grades of livestock, poultry, and plants on the many soil types and under the varied conditions existing in North Carolina; to study methods for the control of parasitic insects and organisms that cause serious economic losses of animals, poultry, and plants; to find and develop varieties of animals, poultry, and plants new and resistant to diseases and the changeable conditions prevailing in the State; and to perfect better marketing for all agricultural products.

The staff of the Experiment Station conducts experiments in the greenhouse and laboratories of the College and throughout the State on areas owned by farmers on 16 strategically located experimental farms and on farms rented for short periods.

The agricultural research aims, through the discovery of new facts, to improve the well being of farmers throughout the State; to strengthen the regulatory work of the State Department of Agriculture; to develop new and necessary facts for the teaching of sound agricultural principles by vocational agricultural instructors, agricultural extension agents, and agricultural instructors in the College.

The Agricultural Experiment Station staff brings to the College many experts, whose teaching in many specialized fields of agriculture assures the maintenance of curricula of high standards. It contributes much to the advanced training of students who are destined to become the leaders, teachers, and investigators necessary in the maintenance of agriculture on sound and economic planes.

Publications

The Agricultural Experiment Station publishes many bulletins and scientific papers on results of research conducted by the staff. These are free and are sent upon request to anyone in the State.

Services

The staff diagnoses and interprets many problems for the farmers of North Carolina. It holds council with farmers and others interested in the agricultural industry, presents radio programs devoted to the discussion of farming procedures, and writes many letters on more specific problems of agriculture at the request of farmers, members of garden clubs, and manufacturers of fertilizer, fungicides and insecticides. It also takes part in many of the administrative functions of the College.

Cooperative Agricultural Extension Work

H. BROOKS JAMES, Dean of Agriculture
R. W. SHOFFNER, Director of Extension
I. O. SCHAUB, Director Emeritus of Extension
DAVID S. WEAVER, Director Emeritus of Extension

The Agricultural Extension Service of State College is conducted cooperatively with the United States Department of Agriculture and with the one hundred counties in North Carolina. Its work is supported by

federal funds derived from the Smith-Lever Act of 1914, the Capper-Ketcham Act of 1928, the Bankhead-Jones Act of 1935, the Bankhead-Flannagan Act of 1945, and by State and county appropriations. Federal and State appropriations are used to maintain an administrative and specialist staff and to supplement salaries and travel expenses of county extension agents, who are located at each county seat in the State.

Objectives

The purpose of the Extension Service is to take to the rural people of North Carolina the latest and best information obtainable for building a more prosperous and satisfying life on the farm. In carrying out this purpose, the College maintains a staff of trained specialists, a system of county agents and assistants, and home economics agents who work with the farmer and his family and who administer a state-wide educational program. Work is also done with firms which furnish the tools and supplies for farm production and which market and process agricultural commodities. In these programs the Extension Service employs a variety of methods and devices. These include method and result demonstrations for group meetings, a training program for farm leaders within the community, and close contact with organized clubs of men, women, and young people. The service also publishes a great number of pamphlets, bulletins and circulars which it distributes free of charge. In addition, it holds a number of short courses, both on the College campus and elsewhere throughout the State, to offer rural leaders advice and training in creating better homes and farms and in using more efficient farming practices.

School Of Design

HENRY L. KAMPHOEFNER, Dean

The School of Design in its teaching recognizes the dangers inherent in a materialist-mechanistic civilization where there may be an over-reliance on the machine and the mechanical devices available for use in the construction of shelter. Therefore, the school gives attention to the larger responsibility of architecture, the art of humanizing the environment. Also, the school seeks to integrate the architect as a social human being and the architect as scientist-engineer, and encourages and nurtures the architect-engineer as the coordinator of the structural dynamics in the over-all pattern of life.

While the School of Design's first aim is to serve North Carolina and the regions of the South, the students are well equipped, through the teaching of the school, to work in any region.

Because character, a profound devotion, and an absolute professional commitment are prime ingredients of any creative activity where the social responsibilities are as vital as in architecture and design, the school fosters and cultivates the integrity of the individual.

The School of Design emphasizes individual creative expression and at the same time teamwork is encouraged and developed.

The faculty members of the School of Design have been selected for their individual and diverse personal philosophies and their individual yet divergent professional qualifications. The school has brought together creative personalities willing in their teaching to subordinate their own professional interests to the interests of their students. Each School of Design faculty member gives the young student the benefit of his professional knowledge, his technical training, and his experience as a citizen.

To combat the dangers of over-specialization the school seeks to develop the personality and character of the student as a whole. The goal in the growth of the student is not only the mastery of the architectural techniques of the profession; but through the stimulation and development of the intellectual and emotional capacities together, a readiness is developed to meet the challenge of any environment.

The School of Design is intended to act as an educational center which unifies different design professions in the fundamental knowledge and methods which they share; its further intention is the education of men who will be competent within the specific demands and limitations of a particular field of design. The existence of contemporary design is considered to be a requirement of contemporary man, and the greatest purpose of contemporary design is considered to be the solution of those re-

quirements through full use of the ingenuity and knowledge of contemporary man. Through this point of view the technical and factual aspects of design present no conflict with its philosophical and aesthetic standards.

The School of Design is comprised of the Departments of Architecture, Landscape Architecture, and Product Design.

The three professional fields have been grouped under one broad and unified study of the methods and values which are common to all designers, and they are separated only in the study of their application in the work of a single profession. Many classes throughout the curricula will include students in these professional fields; and for all students the course of study is the same during the first year in order that, having become more familiar with the whole scope of activity in design, they may then select the design profession in which they are most interested.

Training in drawing, painting, sculpture and other visual arts is conducted by specialists within the staff of the School of Design; the essential knowledge of techniques and materials is taught by this faculty and other departments of the College; and the past and present of the professions are taught by this faculty. These ingredients of design training are assimilated through their application in the design courses. Thus the student is required to increasingly combine these studies as he advances through the course so that he may achieve that comprehensive combination which is a necessity in the designer. Much of the student's work will be done in laboratory courses since design is a matter of the application of knowledge rather than its mere accumulation. From his first day in class to his last the student is asked to design, and he is counseled so that he may become a responsible professional in the broadest sense.

Curricula

The School of Design offers professional instruction to the undergraduate in architecture, landscape architecture, and product design. A graduate program in all three departments is projected for the future.

Degrees

The five-year curricula offer courses of study leading to the Bachelor of Architecture, Bachelor of Landscape Architecture, and the Bachelor of Product Design.

Facilities

The School of Design moved to Brooks Hall in January, 1956. Brooks Hall is the former Hill Library, built in 1928. The new Brooks Hall is a remodeling of 28,000 square feet of floor space and a new addition of 20,000 square feet. All of the facilities of the school are now in modern, especially designed quarters under one roof.

Opportunities

State law now requires the graduate architect to work not less than three years in the offices of registered architects and to pass the four day written

examination given by the North Carolina Board of Architecture before he is ready to begin his own practice. The great national boom in building construction since World War II has brought a tremendous volume of work into the offices of the South, offering many attractive positions for the architectural graduate. The architectural graduate is also qualified for positions in certain branches of engineering, building research and teaching.

The accelerated urban growth of the twentieth century has created an unprecedented demand for landscape architects that far exceeds the production of schools. These positions exist in both public and private organizations, encompassing a range of interests from city and regional planning to residential developments. For the competent graduate advancement is rapid, and remuneration above average.

Evidence of the soundness of the course of study and the programs in design at North Carolina State College is reflected by two of the school's recent graduates who have been awarded the Fellowship in Landscape Architecture to the American Academy in Rome—a prize awarded annually to any design graduate in the United States and affording two years of advanced study in Europe, providing all expenses and residence at the American Academy in Rome. Four graduates of the school have won the top academic award in Architecture, the Paris Prize, which is a scholarship worth $5,000 for a year's study in Europe.

The Department of Product Design, which took its first students in September 1958, prepares graduates to work as resident designers with the furniture manufacturers and other essential and important industries of the State. Graduates of the department will also be qualified to establish offices as professional industrial designers in the major cities of the State.

Department of Architecture

Professors:
HARWELL H. HARRIS, DUNCAN R. STUART
Associate Professors:
JOSEPH N. BOAZ, JOSEPH H. COX, JERZY GLOWCZEWSKI, CHARLES H. KAHN, EDWARD W WAUGH
Assistant Professors:
GEORGE L. BIRELINE, PAUL BUISSON, JOHN HERTZMAN, CHARLES M. SAPPENFIELD, VERNON SHOGREN, BRIAN SHAWCROFT, E. WAYNE TAYLOR, RICHARD S. WURMAN
Instructors:
D. GRANT JOSLIN, WILLIAM C. NICHOLS
Librarian:
MRS. JAMES A. LYONS

Architecture demands a fusion of the artist's decision with competent technical judgments. If it is good architecture, the design must be the product of creative insight into the meaning of the building as an object defining spaces, and must also embody an artistic declaration of the building's meaning to men and to their advancement. At the same time architecture must be technologically feasible and economically sound, and the form and spirit of the design must survive and be strengthened by the

lengthy and complicated methods by which it is transformed into a building. Good architecture does not acknowledge that the conception of a design and its execution are opposed to each other. Instead, it joins the two so that they are realized in a single act, and subjective and conceptual choices are based on a clear and complete understanding of reality.

The training of architects must stir in them the realization that technical skill is meaningless without a guiding purpose and that practical problems they face need not be opposed to their dreams and ambitions. In arts and letters the student must learn and value the purpose of architecture; in science and engineering he must learn the principles that challenge or limit him; and in his study of architecture he must learn the fusion of science and art in buildings. Four parallel programs (architecture, art, humanities and social sciences, and science and engineering) occupy the student throughout his program of study. After its completion the student is not merely ready for the apprenticeship that precedes his becoming a qualified architect. He is prepared to ponder and evaluate the things he learns during his apprenticeship and the things he learns as his self-education continues. Thus, he can combine the practical reguirements of the working profession of architecture with the even more practical desire to realize the full meaning of his profession.

Architecture Curriculum

First Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DN 101, Design I	3	DN 102, Design II	3
DN 111, Descriptive Drawing I	2	DN 112, Descriptive Drawing II	2
DN 121, Technical Drawing I	3	DN 122, Technical Drawing II	3
ENG 111, Composition	3	ENG 112, Composition	3
MA 101, Algebra and Trigonometry	5	MA 102, Analytic Geometry and Calculus I	4
MS 101, Military Science I		MS 102, Military Science I	
or		or	
AS 121, Air Science I	1	AS 122, Air Science I	1
PE 101, Physical Education	1	PE 102, Physical Education	1
	18		17

Second Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ARC 201, Architectural Design I	4	ARC 202, Architectural Design II	4
DN 211, Descriptive Drawing III	2	DN 212, Descriptive Drawing IV	2
HI 245, European Civilization	3	EM 200, Introduction to Mechanics	3
MA 201, Analytic Geometry and Calculus II	4	HI 246, European Civilization	3
PY 211, General Physics	4	PY 212, General Physics	4
MS 201, Military Science II		MS 202, Military Science II	
or		or	
AS 221, Air Science II	1	AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	19		18

Summer Requirement

Two weeks on Historic Architecture Research—Field Work

Third Year

Fall Semester	*Credits*	*Fall Semester*	*Credits*
ARC 301, Architectural Design III	6	ARC 300, Historic Architecture Research	2
CE 338, Structures I	4	ARC 302, Architectural Design IV	6
DN 311, Advanced Descriptive Drawing I	2	ARC 312, Materials and Specifications	3
DN 321, History of Architecture I	3	CE 339, Structures II	4
EM 301, Solid Mechanics I	3	DN 312, Advanced Descriptive Drawing II	2
*Elective	3	DN 322, History of Architecture II	3
	21		20

Summer Requirement

Ten weeks on approved construction or office project experience.

Fourth Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ARC 377, Environmental Factors	3	ARC 378, Environmental Factors	3
ARC 401, Architectural Design V	6	ARC 402, Architectural Design VI	6
ARC 421, Structural Design I	3	ARC 422, Structural Design II	3
DN 411, Advanced Descriptive Drawing III	2	DN 412, Advanced Descriptive Drawing IV	2
DN 421, History of Design I	3	DN 422, History of Design II	3
*Elective	3	*Elective	3
	20		20

Fifth Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ARC 501, Architectural Design VII	7	ARC 502, Architectural Design VIII	9
ARC 511, Professional Practice	2	ARC 532, Structural Design IV	2
ARC 531, Structural Design III	2	PHI 306, Philosophy of Art	3
DN 541, Seminar on Ideas in Design	2	*Elective	4
*Elective	6		18
	19		

* Six credits of elective will be required in the literature of English and three in the social sciences. The remaining 10 hours shall be free electives. (Total credits for Bachelor of Architecture—190.)

Department of Landscape Architecture

Associate Professor RICHARD A. MOORE, *Head of the Department*
Professors:
LEWIS J. CLARKE, EDWIN G. THURLOW, DUNCAN R. STUART
Associate Professor:
JOSEPH H. COX
Assistant Professors:
GEORGE L. BIRELINE, JOHN HERTZMAN
Instructor:
D. GRANT JOSLIN

Landscape architecture, beginning in ancient times, is now defined as the design of outdoor space for the benefit, protection, use and enjoyment of people. Never before have the challenges to this profession been so great, diverse, and complex. It is to their solutions that this department is directed. One such challenge is the design of landscapes with architectural character and scale, such as those associated with the city, town, park, and garden. Another challenge is the designed development of the earth's resources in landscapes of varying character, from coast to mountain, from desert to pasture. Unlike many art forms time is an essence of the design, and long periods are often necessary before it has grown to completion. Architectural and engineering materials are used together with plants and trees. These latter materials have a continuous cycle of growth and movement, closely coupled with the forces of nature. The profession is both an art and a science, depending at the same time upon logic and technology.

A student in the department is associated with allied fields such as architecture, engineering, painting, sculpture, horticulture, botany, geology, and ecology. In spite of the necessity for assimilation of such specialized requirements, he must possess a background from which to design. For this reason he is given a sound and thorough analysis of the past through the study of historical examples. With the rapid growth of the world's population and the increasingly intensive use of land, it is imperative that the student have both ability and clarity of purpose if he is to develop and design landscape solutions that are beautiful, useful, productive, and of continuing value.

Landscape Architecture Curriculum

First Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DN 101, Design I	3	DN 102, Design II	3
DN 111, Descriptive Drawing I	2	DN 112, Descriptive Drawing II	2
DN 121, Technical Drawing I	3	DN 122, Technical Drawing II	3
ENG 111, Composition	3	ENG 112, Composition	3
MA 101, Algebra and Trigonometry	5	MA 102, Analytic Geometry and Calculus I	4
MS 101, Military Science I		MS 102, Military Science I	
or		or	
AS 121, Air Science I	1	AS 122, Air Science I	1
PE 101, Physical Education	1	PE 102, Physical Education	1
	18		17

Second Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ARC 201, Architectural Design I	4	ARC 202, Architectural Design II	4
BO 103, General Botany	4	DN 212, Descriptive Drawing IV	2
DN 211, Descriptive Drawing III	2	HI 246, European Civilization	3
HI 245, European Civilization	3	MIG 120, Physical Geology	3
PY 211, General Physics	4	PY 212, General Physics	4
MS 201, Military Science II or		MS 202, Military Science II or	
AS 221, Air Science II	1	AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	19		18

Summer Requirement

Two weeks Historic Architecture or Landscape Architecture Research—Field Work.

Third Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DN 311, Advanced Descriptive Drawing I	2	ARC 300, Historic Architecture Research	2
DN 321, History of Architecture I	3	DN 312, Advanced Descriptive Drawing II	2
HS 211, Ornamental Plants	3	DN 322, History of Architecture II	3
LA 301, Landscape Design I	5	HS 212, Ornamental Plants	3
LA 311, Landscape Construction	4	LA 302, Landscape Design II	5
*Elective	3	LA 312, Landscape Construction	4
	20		19

Summer Requirement

Ten weeks on approved construction or office project experience.

Fourth Year

		Spring Semester	*Credits*
BO 441, Plant Ecology	3	DN 412, Advanced Descriptive Drawing IV	2
DN 411, Advanced Descriptive Drawing III	2	DN 422, History of Design II	3
DN 421, History of Design I	3	LA 402, Landscape Design IV	6
LA 401, Landscape Design III	6	LA 422, Planting Design	4
LA 421, Planting Design	4	*Electives	6
*Elective	3		
	21		21

Fifth Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DN 511, Advanced Descriptive Drawing V	2	DN 512, Advanced Descriptive Drawing VI	2
DN 541, Seminar on Ideas in Design	2	LA 502, Landscape Design VI	8
LA 501, Landscape Design V	6	PHI 306, Philosophy of Art	3
LA 511, Landscape Construction and Professional Practice	4	*Electives	6
*Electives	4		19
	18		

* Six credits will be required in the literature of English and six in the social sciences. The remaining 10 hours shall be free electives. (Total credits for the Bachelor of Landscape Architecture—190.)

Department of Product Design

Associate Professor VICTOR J. PAPANEK, *Head of the Department*
Professor:
DUNCAN R. STUART
Associate Professor:
JOSEPH H. COX
Assistant Professors:
WILLIAM J. BARON, GEORGE L. BIRELINE, JOHN HERTZMAN, CLARK MACOMBER
Instructor:
D. GRANT JOSLIN

Product design (or industrial design) has most often been associated with the appearance value and other sensory attributes of mass-produced products of every description. It is relatively new as a profession, dating back to the early thirties, when early attempts at "styling" helped to sell consumer goods in a depressed market. Today the designer's influence has spread to almost every object we buy or use in daily life, from transportation and farm machinery to household appliances, furniture, office equipment, hardware, and toys.

Students in the Department of Product Design search for new ways to solve product problems, questioning prosaic solutions, and employing their understanding of materials and techniques at a high level of creative activity. New products and functional improvements are developed in the design laboratory and described in models, sketches, and engineering drawings. The student includes a summary of production requirements, cost estimates, distribution methods, packaging ideas and other pertinent information required to make his reports inclusive of all the skills developed at the school, in simulation of the product problem. The profession requires exceptional creative ability, coupled with sound judgment for the responsibilities implicit in design for large scale consumption. There are few areas more rewarding economically, or in the personal satisfaction of design for human need.

Product Design Curriculum

First Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DN 101, Design I	3	DN 102, Design II	3
DN 111, Descriptive Drawing I	2	DN 112, Descriptive Drawing II	2
DN 121, Technical Drawing I	3	DN 122, Technical Drawing II	3
ENG 111, Composition	3	ENG 112, Composition	3
MA 101, Algebra and Trigonometry	5	MA 102, Analytic Geometry and Calculus I	4
MS 101, Military Science I		MS 102, Military Science I	
or		or	
AS 121, Air Science I	1	AS 122, Air Science I	1
PE 101, Physical Education	1	PE 102, Physical Education	1
	18		17

Second Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DN 211, Descriptive Drawing III	2	DN 212, Descriptive Drawing IV	2
HI 245, European Civilization	3	HI 246, European Civilization	3
IE 217, Machine Tools	1	IE 218, Metal Forming	1
MA 201, Analytic Geometry and Calculus II	4	PD 202, Product Design and Orientation	4
PD 201, Product Design and Orientation	4	PSY 200, Introduction to Psychology	3
PY 211, General Physics	4	PY 212, General Physics	4
MS 201, Military Science II or AS 122, Air Science II	1	MS 202, Military Science II or AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	20		19

Third Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101, General Chemistry I	4	CH 103, General Chemistry II	4
DN 311, Advanced Descriptive Drawing I	2	DN 312, Advanced Descriptive Drawing II	2
EC 425, Industrial Management	3	EM 301, Solid Mechanics	3
EM 200, Introduction To Mechanics	3	PD 302, Product Design	6
PD 301, Product Design	6	PD 332, Materials and Processes	3
PD 331, Materials and Processes	3	Elective	3
	21		21

Fourth Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DN 411, Advanced Descriptive Drawing III	2	DN 412, Advanced Descriptive Drawing IV	2
IE 301, Engineering Economy	2	IE 425, Sales and Distribution Methods	2
PD 401, Advanced Product Design	6	PD 402, Advanced Product Design	6
PD 441, Design Analysis	2	PD 422, Office and Industrial Practice	2
*Electives	7	PD 442, Design Analysis	2
	19	*Electives	6
			20

Fifth Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DN 511, Advanced Descriptive Drawing V	2	DN 512, Advanced Descriptive Drawing VI	2
DN 541, Seminar on Ideas in Design	2	PD 502, Product Design Thesis	9
PD 501, Advanced Product Design	8	PSY 441, Human Factors in Equipment Design	3
PSY 464, Visual Perception	3	*Electives	3
*Electives	3		
	18		17

* Six credits will be required in the literature of English and six in the social sciences. The remaining 10 hours shall be free electives. (Total credits for the Bachelor of Product Design—190.)

School Of Education

I. BRYANT KIRKLAND, Dean

With the current and anticipated increase in the number of secondary school age boys and girls in North Carolina, it is necessary for the educational institutions of the State to prepare a greater number of students to be teachers in the public schools. There is a particular need for teachers in the areas of vocational agriculture, industrial arts, industrial education, mathematics and science.

The School of Education graduates students who are qualified for teaching positions in these areas.

The school includes the Departments of Agricultural Education, Industrial Arts, Industrial Education, Mathematics and Science Education, Occupational Information and Guidance, Psychology, and Recreation and Park Administration.

Objectives

The primary purpose of the Departments of Agricultural Education, Industrial Arts, Industrial Education, Mathematics and Science Education is to prepare students to become teachers in the North Carolina Public Schools. Satisfactory completion of the curriculum requirements in any of these departments qualifies a graduate to receive an A Grade certificate to teach in his chosen area. The curriculum in the Department of Recreation and Park Administration is designed primarily to prepare students to become leaders of recreation programs in industry, institutions, and municipalities.

The Departments of Psychology and Occupational Information and Guidance offer professional instruction at the graduate level for psychologists and vocational counselors. In addition, these departments provide service courses for undergraduate students in the School of Education and the other schools of the College.

Opportunities

Agricultural education graduates find jobs as teachers of vocational agriculture in which they conduct organized instructional programs of vocational agriculture for rural young people and adults.

Public schools employ competent industrial arts and industrial education teachers whose job is to familiarize the young people of the State, particular those in the non-farm areas, with the available occupational opportunities which accompany an industrial expansion and to train these young people for entrance into the industrial occupations of their choice.

Graduates in the Department of Recreation and Park Administration secure jobs as recreational leaders for municipalities, industries and institutions while Department of Mathematics and Science graduates find jobs in public schools and industry. Students trained in the Department of Occupational Information and Guidance are employed by public schools as teachers and vocational counselors.

The Department of Psychology serves the various industries in the State by helping to improve their personnel selection programs and by conducting research designed to ascertain what factors influence efficiency of industrial employees.

Degrees

The Bachelor of Science in Education is awarded to the students who complete the curricula in Agricultural Education, Industrial Arts Education, Industrial Education, Mathematics Education and Science Education.

The School of Education also offers the Bachelor of Science in Recreation and Park Administration and the Bachelor of Science in Industrial Arts for those students pursuing the technical option curriculum.

The degree of Master of Education or the Master of Science in Education is offered to students majoring in Agricultural Education, Industrial Education, Industrial Arts Education and Guidance. The degree of Master of Science in Psychology is also offered.

Department of Agricultural Education

Professor C. C. SCARBOROUGH, *Head of the Department*
Professors Emeriti:
L. O. ARMSTRONG, J. K. COGGIN
Professor:
J. BRYANT KIRKLAND
Adjunct Professor:
G. B. JAMES
Research Associate Professor:
L. W. DRABICK
Assistant Professors:
T. R. MILLER, H. E. BEAM
Instructors:
C. D. BRYANT, C. H. ROGERS

The program in agricultural education is concerned with two large areas of study education and agriculture. It is imperative that the objectives which give major direction to the program be clearly understood. People who produce, market, and/or process agricultural commodities are in a highly technical field. Emphasis is placed upon agriculture, agricultural products and processes. The education of people who plan to educate others in the area of agriculture is somewhat different. The objectives here are educational objectives. Agricultural objectives deal with agriculture—the improvement of crops, livestock, soils, and the like. Educational objectives relate to people—bringing about growth development, and desirable change in people. The primary concern of agricultural education is with educational objectives.

Agricultural education, in its broad sense, should encompass those areas of study and pursuit which would enable one to participate effectively in planning, promoting, and initiating educational programs in agriculture. Therefore, the description of a graduate in agricultural education would be more nearly an "educational leader' than an "agricultural specialist".

Every education leader as a person is a member of a family, a member of a community, a citizen (local, state, national, and international), and a professional worker. The experiences, understandings, and abilities needed by an educational leader are not gained through class work only. His home life, community life, dormitory and social life on the campus, all make contributions to his preparation for his work as an educational leader.

Undergraduate Program

The program in agricultural education includes education for personal development, for community living, for citizenship, for home living, and for educational leadership. These areas in the College program are divided into three groups:

(1) general education
(2) technical or special education
(3) professional education

General education includes the education which everyone should have, namely, preparation for living effectively (1) with one's self, (2) with one's family, (3) in a community, (4) as a local, state, national, and world citizen, and (5) bringing to bear the knowledge of man in solving problems. The education of people should not differ fundamentally and widely in these areas.

Special, or technical education consists of securing an understanding and ability to solve agricultural problems, with emphasis upon managerial aspects. Particular attention is given to a consideration of the impact of these problems upon the people of North Carolina. That is, "facts and figures about agriculture" will not suffice as technical education for the educational leader. A knowledge and understanding of agriculture and the ability to identify agricultural problems, make decisions, and solve problems is essential.

Professional education includes an understanding of human behavior and development. Particular attention is given to an understanding of the learning process—as it occurs and how it can be accelerated. Consideration is also given to understanding how people work together in groups, particularly in rural communities. Ability to do research in the community is essential.

Graduate Program

Qualified graduate students may secure a Master of Science in Education or Master of Education degree. Interested persons should see the Graduate Catalog or write to the Agricultural Education Department.

Facilities and Resources

In addition to the College facilities and resources, the administrative personnel of most of the agricultural agencies and programs have offices in Raleigh. These people often serve as valuable resource people to students in agricultural education.

*Agricultural Education Curriculum

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
AG 103, Introduction to Agriculture	1	AGE 201, Agricultural Construction and Maintenance I	2
BO 103, General Botany	4	Agriculture Elective	3
ED 102, Objectives in Agricultural Education	1	ENG 122, Composition	3
ENG 111, Composition	3	Math Elective	4
MA 111, Algebra and Trigonometry	4	ZO 103, General Zoology	4
MS 101, Military Science I		MS 102, Military Science I	
or		or	
AS 121, Air Science I	1	AS 122, Air Science I	1
PE 101, Physical Education	1	PE 102, Physical Education	1
	15		18

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
AGE 202, Agricultural Construction and Maintenance II	2	AGE 211, Farm Power and Machinery I	3
English Elective	3	AGC 212, Economics of Agriculture	3
CH 101, General Inorganic Chemistry	4	CH 203, General and Organic Chemistry	4
PSY 200, Introduction to Psychology	3	ED 201, Farming Programs and FFA	2
EC 201, Economics	3	PSY 304, Educational Psychology	3
MS 201, Military Science II		MS 202, Military Science II	
or		or	
AS 221, Air Science II	1	AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	17		17

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
AGC 311, Organization and Business Management of Marketing Firms	3	AGC 303, Organization and Business Management of Farms	3
ED 344, Secondary Education	2	Agricultural Engineering Elective	3
History Elective	3	ED 313, Teaching Rural People	2
RS 301, Sociology of Rural Life	3	ED 420, Principles of Guidance	2
SSC 200, Soils	4	English Elective	3
Free Elective	3	PSY 476, Psychology of Adolescence	2
		Free Elective	3
	18		18

* A minimum of 137 semester credits required for graduation.

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
AGE 401, Problems in Farm Mechanics	3	Agriculture Electives	6
**ED 411, Student Teaching	6	Biological Science Elective	3
EED 412, Teaching Adults	2	Political Science Elective	3
EED 413, Teaching Materials	2	Free Electives	6
FRS 321, Introduction to Social Research	3		18
	16		

Department of Industrial Arts

Professor IVAN HOSTETLER, *Head of the Department*
Associate Professor:
TALMAGE B. YOUNG
Assistant Professors:
FRANK B. BRILEY, CARL A. MOELLER, ROBERT T. TROXLER
Instructor:
PAUL R. MEOSKY

Industrial arts comprises that area of education which concerns itself with materials, processes, and products of industry. It is concerned with a study of changes made in materials to make them more useful and with problems related to these changes.

The Department of Industrial Arts at North Carolina State College performs two functions: first, it prepares teachers and supervisors of industrial arts for secondary schools, and second, it provides practical training for students interested in technical jobs in industry, such as industrial work in production, personnel, industrial sales, estimating, job training, maintenance and installation.

Facilities

The Department of Industrial Arts is located in Tompkins Hall. Laboratory facilities are provided in drafting, woods, metals, electricity and electronics, graphic arts, and ceramics. In addition to these, a special experimental laboratory is provided in order to encourage experimentation and research in all of the industrial arts areas at the advanced undergraduate and graduate levels.

Opportunities

The opportunities for employment as industrial arts teachers in North Carolina are greater than ever before. The demand for industrial arts teachers is greater than the supply. The demand for industrial employment is also very great.

Graduate Study

Opportunities are provided for qualified students in Industrial Arts Education to do graduate work leading to the degree of Master of Education or Master of Science in Education. For additional information regarding graduate study, consult the Graduate School Catalog.

** Summer Practice (1 week) is required prior to student teaching.

Industrial Arts Education Curriculum

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111, Composition	3	ENG 112, Composition	3
IA 100, Introduction to Industrial Arts	1	IA 104, Drafting II	3
IA 105, Drafting I	3	IA 108, Woods II	3
IA 107, Woods I	3	MS 102, Military Science I	
MA 111, Algebra and Trigonometry	4	or	
MS 101, Military Science I		AS 122, Air Science I	1
or		PE 102, Physical Education	1
AS 121, Air Science I	1	Mathematics Elective	4
PE 101, Physical Education	1		—
			15
	16		

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101, General Inorganic Chemistry	4	EC 205, Economic Process	3
IA 206, Metal Processing I	3	ENG 231, Basic Speaking Skills	3
PSY 200, Introduction to Psychology	3	IA 207, Metal Processing II	3
PY 211, General Physics	4	PY 212, General Physics	4
MS 201, Military Science II		SOC 202, Principles of Sociology	3
or		MS 201, Military Science II	
AS 221, Air Science II	1	or	
PE 201, Physical Education	1	AS 222, Air Science II	1
	—	PE 202, Physical Education	1
	16		—
			18

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 344, Secondary Education	2	ED 422, Methods of Teaching	
IA 205, Industrial Arts Design	2	Industrial Subjects	4
IA 307, Basic Electricity	3	IA 304, General Shop Organization	2
PSY 304, Educational Psychology	3	IA 308, Basic Electronics	3
English Elective	3	PS 201, The American Governmental System	3
History Elective	3	PSY 476, Psychology of Adolescence	2
*Electives	3	*Electives	4
	—		—
	19		18

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 444, Student Teaching in Industrial Subjects	6	ED 420, Principles of Guidance	2
ED 482, Curriculum Problems in Industrial Arts	2	IA 480, Modern Industries	3
ED 483, Instructional Aids and Devices	2	*Electives	12
IA 465, Independent Study in Industrial Arts	3		—
IA 484, School Shop Planning and Equipment Selection	3		17
*Electives	3		
	—		
	19		

* Twelve hours are to be technical electives; the remaining 10 hours are to be free electives.

Industrial Arts—Technical Option Curriculum

Freshman and sophomore years are the same as in industrial arts education.

Junior Year

Fall Semester	Credits	Spring Semester	Credits
IA 205, Industrial Arts Design	2	IA 308, Basic Electronics	3
IA 307, Basic Electricity	3	PSY 337, Industrial Psychology I	3
IE 310, Industrial Safety	2	SOC 301, Human Behavior	3
IE 332, Motion and Time Study	4	English Elective	3
PS 201, The American Governmental Systems	3	History Elective	3
*Elective	3	*Elective	3
	17		18

Senior Year

Fall Semester	Credits	Spring Semester	Credits
EC 425, Industrial Management	3	EC 426, Personnel Management	3
IA 321, Metalwork Technology	2	EC 432, Industrial Relations	3
IA 480, Modern Industries	3	IE 430, Job Evaluation and Wage Incentives	3
IE 408, Production Control	3	*Electives	10
*Electives	8		
	19		19

Department of Industrial Education

Professor DURWIN M. HANSON, *Head of the Department*
Assistant Professor:
FLOYD P. GEHRES

The Department of Industrial Education offers the only curriculum in the State that prepares teachers of industrial education for the public schools. The main goal is to provide public schools with adequately trained personnel who can, in turn, help to develop a vitally needed reservoir of skilled workers and technical personnel to man established industries as well as prepare for new industries. The curriculum is planned to provide students with broad cultural and professional backgrounds to parallel occupational experience.

Candidates for a degree must have had at least two years of successful trade or technical experience in the occupational area they wish to teach. The student who has not had this experience when he enters must fulfill the requirement before graduation either by working part of the school year or by completing the work experience after finishing the required resident courses.

Opportunities

The student who completes this curriculum will be prepared to teach in the all-day trade schools, area vocational technical schools and the part-time, or evening vocational classes. Graduates have no difficulty in obtaining employment as institutional teachers.

* Twelve hours are to be technical electives; the remaining 12 hours are to be free electives.

Graduate Study

General and specialized professional courses are available to qualified students who wish to pursue graduate study as industrial education teachers, supervisors or coordinators of diversified occupations. The completion of the Master of Education or Master of Science in Education degree in industrial education will also qualify one for a Graduate Certificate in North Carolina.

*Industrial Educational Curriculum

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 100, Introduction to Industrial Education	2	History Elective	3
ENG 111, Composition	3	ENG 112, Composition	3
MA 111, Algebra and Trigonometry	4	MA 112, Analytic Geometry and Calculus	
CH 101, General Inorganic Chemistry	4	or	
IA 103, Drafting I	3	MA 122, Mathematics of Finance and Elementary Statistics	4
MS 101, Military Science I		IA 104, Drafting II	3
or		MS 102, Military Science I	
AS 121, Air Science I	1	or	
PE 101, Physical Education	1	AS 122, Air Science I	1
		PE 102, Physical Education	1
	18		15

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 211, General Physics	4	PY 212, General Physics	4
ENG, English Elective	3	SOC 202, Principles of Sociology	3
PSY 200, Introduction to Psychology	3	EC 205, Economic Process	3
PS 201, American Government System	3	MS 202, Military Science II	
MS 201, Military Science II		or	
or		AS 222, Air Science II	1
AS 221, Air Science II	1	PE 202, Physical Education	1
PE 201, Physical Education	1	**Elective	5
**Elective	3		17
	18		

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 344, Secondary Education	2	PSY 337, Industrial Psychology	
PSY 304, Educational Psychology	3	or	
SOC 401, Human Relations in Industrial Society	3	PSY 476, Psychology of Adolesence	2-3
IE 310, Industrial Safety	2	ED 305, Analysis of Technical Education Programs and Course Constuction	3
ED 327, History and Philosophy of Industrial-Technical Education	3	RPA 333, First Aid and Safety	2
**Elective	5	ED 422, Methods of Teaching Industrial Subjects	4
	18	English Elective	3
		**Elective	3
			17-18

* Minimum of 136 Semester hours required for graduation.
** Fifteen hours of elective courses must be selected in accordance with the student's area of specialization and with approval of the adviser. Remaining hours may be taken from free electives.

Senior Year

'all Semester	*Credits*	*Spring Semester*	*Credits*
D 440, Vocational Education	2	EC 425, Industrial Management	3
_D 483, Instructional Aids and Devices	2	EC 432, Industrial Relations	3
D 405, Industrial and Technical Education Shop and Laboratory Planning	3	ED 420, Principles of Guidance	2
D 444, Student Teaching in Industrial Subjects	6	*Elective	8
*Elective	3-4		16
	16-17		

Department of Mathematics and Science Education

ssociate Professor HERBERT E. SPEECE, *Head of the Department*
ssistant Professor:
HENRY A. SHANNON

'he Department of Mathematics and Science Education offers curricula for udents who wish to become teachers of mathematics or science. Each curculum provides for a well-rounded professional preparation. There is afficient flexibility in each curriculum to enable the student to meet cer fication requirments in both subject matter areas by proper selection of ective courses. This flexibility also enables the student to specialize in ne subject matter area thus opening up job opportunities in related fields equiring a substantial background in mathematics and science, such as search teams in industry, government research projects involving rockets, uided missiles, computers or pure research.

pportunities

The acute shortage of mathematics and science teachers in the secondary hools provides excellent employment opportunities for more graduates this department. Attractive job opportunities are also available for dustrial employment. The rapid technological and scientific developents during the past few years have accentuated the importance of mathnatics and science. Future developments will depend upon the accomishments of persons who have received adequate training in these areas.

fteen hours of elective course must be selected in accordance with the student's area of specation and with approval of the adviser. Remaining hours may be used for free elective

*Mathematics Education Curriculum

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101, General Inorganic Chemistry	4	CH 103, General and Qualitative Chemistry	4
ENG 111, Composition	3	ENG 112, Composition	3
History Elective	3	MA 102, Analytic Geometry and Calculus I	4
MA 101, Algebra and Trigonometry	5	MA 122, Mathematics of Finance and Elementary Statistics	4
MS 101, Military Science I or AS 121, Air Science I	1	MS 102, Military Science I or AS 122, Air Science I	1
PE 101, Physical Education	1	PE 102, Physical Education	1
	17		17

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 203, Introduction to Teaching	2	BO 103, General Botany or ZO 103, General Zoology	4
MA 201, Calculus II	4	MA 202, Calculus III	4
PY 211, Physics	4	PY 212, Physics	4
SOC 202, Principles of Sociology	3	MS 202, Military Science II or AS 222, Air Science II	1
MS 201, Military Science II or AS 221, Air Science II	1	PE 202, Physical Education	1
PE 201, Physical Education	1	Electives	3
PSY 200, Introduction to Psychology	3		
	18		17

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EC 205, Economic Process	3	CE 201, Surveying or PY 223, Astronomy	3
PS 201, The American Governmental System	3	ED 344, Secondary Education	2
PSY 304, Educational Psychology	3	English Elective	3
Electives	10	**Electives	10
	19		18

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 470, Methods of Teaching Math	3	ED 420, Principles of Guidance	2
***ED 471, Student Teaching in Math	6	MA 433, History of Math	3
ED 472, Developing and Selecting Teaching Materials in Math	2	**Electives	9
PSY 476, Psychology of Adolescence	2	English Elective	3
	13		17

* A minimum of 138 semester credits required for graduation. Beginning with the fall semester of 1965, MA 101 will not count toward graduation in mathematics education; however, MA 403 will be required.

** A minimum of 9 semester hour electives in mathematics. All electives must be selected with approval of adviser.

*** During the fall semester of the Senior year 10 weeks will be devoted to full time off campus work at an approved Student Teaching Center and approximately 6 weeks to concentrated courses.

*Science Education Curriculum

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ZO 103, General Zoology	4	ZO 205, Invertebrate Zoology	4
History Elective	3	MA 112, Analytic Geometry and Calculus A	4
MA 111, Algebra and Trigonometry	4	BO 103, General Botany	4
ENG 111, Composition	3	ENG 112, Composition	3
MS 101, Military Science I or AS 121, Air Science I	1	MS 102, Military Science I or AS 122, Air Science I	1
PE 101, Physical Education	1	PE 102, Physical Education	1
	16		17

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
BO 301, General Morphology or BO 403, Systematic Botany	3	MIG 120, Physical Geology	3
CH 101, General Inorganic Chemistry	4	CH 103, General and Qualitative Chemistry	4
PS 201, The American Governmental System	3	ED 203, Introduction to Teaching	2
SOC 202, Principles of Sociology	3	ZO 213, Human Physiology	3
MS 201, Military Science II or AS 221, Air Science II	1	MS 202, Military Science II or AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
**Elective	3	**Electives	3
	18		17

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 203, General and Organic Chemistry	4	PSY 304, Educational Psychology	3
ECC 205, The Economic Process	3	PY 212, Physics	4
ED 344, Secondary Education	2	**Electives	11
PY 211, Physics	4		18
English Elective	3		
**Electives	3		
	19		

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 475, Methods of Teaching in Science	3	PY 223, Astronomy	3
**ED 476, Student Teaching in Science	6	BO 312, General Bacteriology	4
ED 477, Developing and Selecting Teaching Materials in Science	2	ED 420, Principles of Guidance	2
PSY 476, Psychology of Adolescence	2	**Elective	6
		English Elective	3
	13		18

* A minimum of 138 semester credits required for graduation.
** A minimum of 6 semester hour electives in one area of science. All electives must be selected with approval of adviser.
** During the fall semester of the senior year 10 weeks will be devoted to full-time off-campus work at an approved Student Training Center and approximately 6 weeks to concentrated courses.

Department of Occupational Information and Guidance

Professor ROY N. ANDERSON, *Head of the Department*
Associate Professor:
CHARLES G. MOREHEAD

The Department of Occupational Information and Guidance has been training guidance and personnel workers for more than four decades. The first master's degree was awarded in 1926. The programs of graduate study are planned to develop a broad understanding of guidance and personnel services to be applied in various settings. It is most desirable for an applicant who wishes to specialize in guidance and personnel services to have had undergraduate course work in economics, education, psychology, sociology, or social work. Students accepted into the program are those who anticipate devoting full or part time to guidance and personnel work. Teachers, administrators and others who wish to increase their knowledge of guidance and personnel may enroll for courses as a graduate minor or for certification renewal.

Professional opportunities for placement in this field are on the increase. The department prepares students for positions as counselors in secondary schools, industrial education centers, colleges, community agencies; school or county guidance directors, rehabilitation counselors, employment counselors, placement interviewers, and personnel workers in higher education, business or industry, and State and Federal government agencies. The student may specialize in one of several areas depending upon his vocational goals.

The master's program includes a core of guidance and personnel courses to be selected according to the student's vocational goals. Students may select their minor from the following areas—economics, psychology, sociology and anthropology. The master's degree program of the department meets the requirements for the Counselor's Certificate issued by the North Carolina State Department of Public Instruction, as well as counselor certification in many other states.

The Department of Occupational Information and Guidance has had a contract with the Office of Vocational Rehabilitation for the training of rehabilitation counselors, and has been awarded four Counseling and Guidance Training Institutes under contract with the United States Office of Education as authorized by the National Defense Education Act of 1958.

The department also provides service courses in guidance and personnel for undergraduate students in the School of Education.

Department of Psychology

rofessor HOWARD G. MILLER, *Head of the Department*
rofessors:
KEY L. BARKLEY, HAROLD M. CORTER
ssociate Professors:
NORMAN M. CHANSKY, JOHN O. COOK, J. CLYDE JOHNSON, SLATER F. NEWMAN PAUL J RUST
ssistant Professors:
EUGENE E. BERNARD, DONALD W. DREWS
djunct Assistant Professor:
GILBERT GOTTLIEB
nstructor:
JAMES B. GRIER

n general, the courses in psychology are designed to promote a broad nderstanding of behavior as a science and to cultivate the skills which ay be useful in dealing with human beings in social, educational, indus rial or other situations. The department, however, offers courses of interest o students in all schools of the College.

raduate Study

Graduate work is offered in the Department of Psychology leading to he degree of Master of Science in Psychology with options in industrial sychology, experimental psychology and school psychology.

Department of Recreation and Park Administration

rofessor THOMAS I. HINES, *Head of Department*
ssociate Professor:
LATHAM L. MILLER
ssistant Professors:
CHARLES C. STOTT, ALBERT CRAWFORD
structor:
HERBERT BRANTLEY

he Department of Recreation and Park Administration provides training or students who plan to become recreation leaders in industry, municipali es, institutions and rural communities. The recreation profession recog izes the importance of leaders who possess the competence needed to lan and supervise effective recreation programs. Competent leadership is ne major factor affecting the scope, intensity and success of a program of rganized recreation.

All students pursue the same program for the first year after which they eclare an option (employee, public, institutional recreation or park ad inistration) and take courses designed to meet the needs in their respec ve area of interest.

pportunities

The demand of properly trained recreation leadership has increased apidly in recent years. The number of graduates has not been sufficient o meet the demand for recreation leaders.

*Recreation and Park Administration Curriculum

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111, Composition	3	BO 103, General Botany	4
MA 111, Algebra and Trigonometry	4	ENG 112, Composition	3
RPA 152, Introduction to Recreation	3	MA 122, Mathematics of Finance and Elementary Statistics	4
ZO 103, General Zoology	4	RPA 153, Aquatic Program	2
MS 101, Military Science I		SOC 202, Principles of Sociology	3
or		MS 102, Military Science I	
AS 121, Air Science I	1	or	
PE 101, Physical Education	1	AS 122, Air Science I	1
	16	PE 102, Physical Education	1
			18

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
BO 214, Dendrology I		ZO 206, Vertebrate Zoology	
or		or	
ZO 212, Human Anatomy	3	ZO 213, Human Physiology	3
EC 205, The Economic Process	3	ENG 215, Prin. of News Writing	3
History Elective	3	PS 201, American Government System	3
RPA 201, Playground Leadership	3	PSY 200, Introduction to Psychology	3
RPA 255, Social Recreation	4	RPA 253, Principles of Physical Education	3
MS 201, Military Science II		MS 202, Military Science II	
or		or	
AS 221, Air Science II	1	AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	18		17

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 231, Basic Speaking Skills	3	HS 342, Landscape Gardening	3
RPA 333, First Aid and Safety	2	RPA 353, Camp Organization and Leadership	3
RPA 354, Personal and Community Hygiene	3	RPA 355, Sports in Recreation	3
SOC 301, Human Behavior	3	**Electives within Interest Area	
**Electives within Interest Area	3	Free Electives	
Free Electives	3		17
	17		

* A minimum of 139 semester credits required for graduation.
** At the end of the sophomore year, a student must select an area of special interest. At least semester hours of course work must be taken from the list of elective courses in the interest area

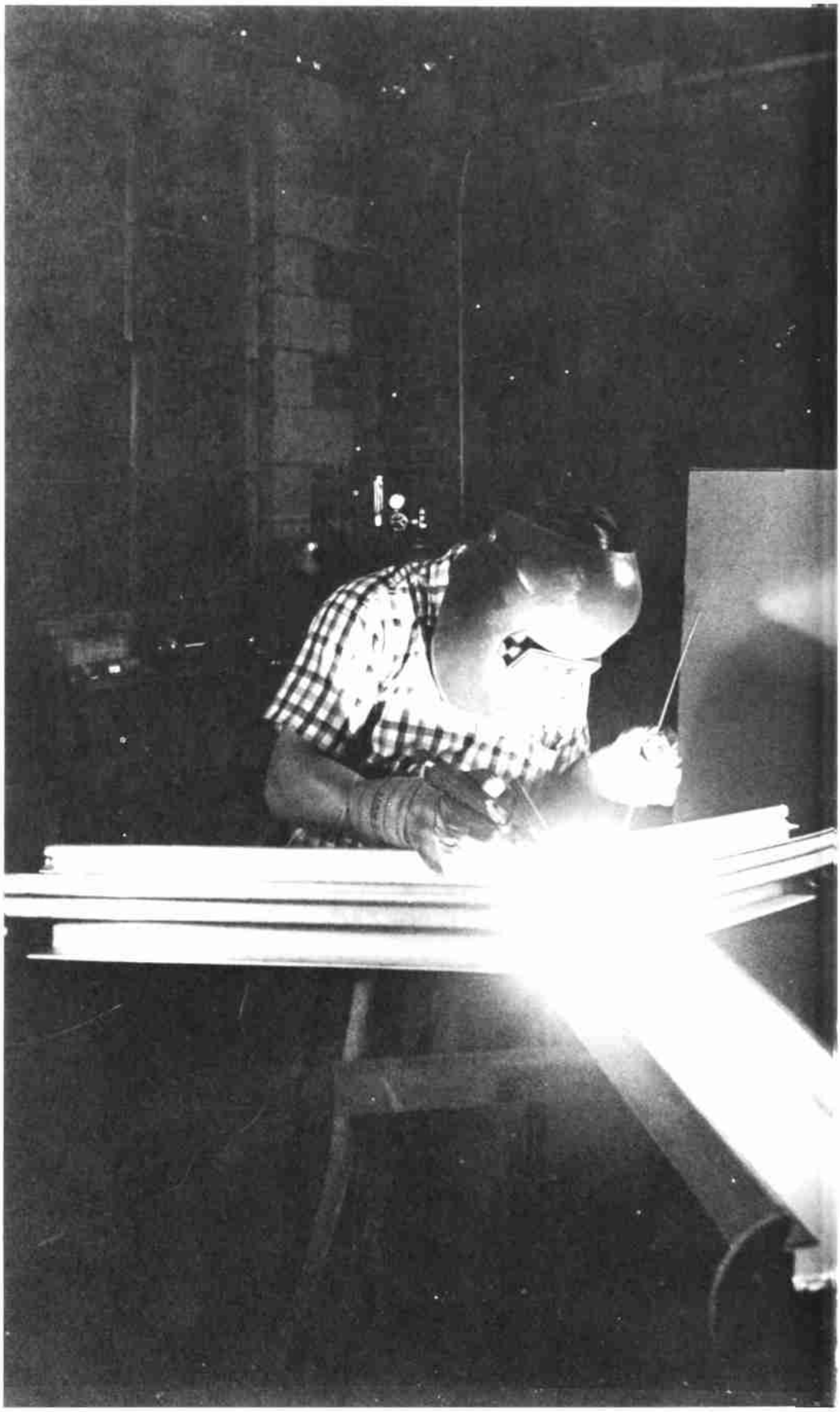
Summer Session (9 weeks)

	Credits
RPA 470, Supervised Practice	6

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
RPA 415, Park Maintenance and and Operation	3	RPA 451, Facility and Site Planning	3
RPA 471, Organizing the Recreation Program	2	RPA 452, Recreation Administration	3
RPA 472, Observation and Field Experience	2	RPA 501, Special Problems in Recreation	3
SOC 416, Research Methods	3	*Electives within Interest Area	3
Electives within Interest Area	3	Free Electives	3
Free Electives	3		15
	16		

*At the end of the sophomore year, a student must select an area of special interest. At least 12 semester hours of course work must be taken from the list of elective courses in the interest area. Field Work: Evidence of at least four months of satisfactory experience in the practice of his profession is required for graduation.



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ingineering

ALPH E. FADUM, Dean
)BERT G. CARSON, Director of Instruction
. E. ADAMS, Coordinator of Student Affairs

The engineer has the responsibility and the obligation to use all newly iscovered knowledge in his field for the benefit of mankind. Today, a ew sense of responsibility has been imposed upon the engineer, by the npact of science and technology.

Engineering studies are of the utmost interest and importance to those oung men and women who look to industry, engineering education, or esearch for a career. These ambitions can well be furthered by the School f Engineering through its undergraduate or graduate programs, whereby udents are offered technical instruction and leadership guidance by an xperienced staff of qualified engineers and educators.

The School of Engineering is organized into nine engineering depart-aents: Chemical, Civil, Electrical, Industrial, Mechanical, Mineral Indus-ries, Nuclear, Mechanics, and Research. Undergraduate degree programs re offered in the first eight departments listed. In addition, a new degree i Engineering Operations has been established. All the teaching depart-aents offer advanced studies leading to a professional degree or to the aaster's degree. The Doctor of Philosophy program is offered in ceramic, iemical, civil, electrical, mechanical and nuclear engineering.

It is the policy of the School of Engineering to have all its curricula more nan meet the standards of the Engineers' Council for Professional Develop-aent. It is the ambition of the school that these curricula and programs aeet the needs of the people and industries of the State and region through ffective instruction, competent research and development, and worthwhile ientific contributions to engineering knowledge.

urricula

The curricula representing the study program in all of the departments re so arranged that the freshman year is common to all. They contain roadening courses in the humanities while emphasizing the basic and ndamental engineering principles essential to an engineering college rogram. Graduates of this program will not only be prepared for engineer-ng responsibilities and positions of trust in industry, but will also have n appreciation and consciousness of human problems in community and ndustrial life. Though an entering student is asked to designate a field of nterest, he can with ease and without any interruption change to some ther field of study within the School of Engineering at the end of the reshman year.

Four-Year Bachelor's Curricula

The four-year program provides education and training to meet the needs of from eighty to eighty-five per cent of the young men of North Carolina who will take their places in industry and industrial life in the fields of production, sales, application, planning and the operation of small industrial units.

Professional (Fifth Year) Study

The fifth-year specialized training leads to a professional degree (CEE CHE, ME, EE, and so forth) in ceramic, chemical, civil, electrical, geological, industrial, and mechanical engineering. The courses of study are especially designed to meet the needs of students desiring intensive specialization in a particular field or additional course work not ordinarily covered in the normal four-year undergraduate curricula.

Graduate Study

The graduate activities are patterned to provide advanced training and experience to young men who have successfully completed a four-year program and who have an interest and ability to continue their education. This elective program trains graduates for positions and activities in teaching, technical design, and research. The Engineering School offers two programs of graduate study. The first represents a year of full-time study and thesis work and leads to a degree of Master of Science in some field of engineering. The second program leads to a doctor's degree in some field of engineering and usually requires three years of full-time study, thesis work and experimental activity.

Research

Research activities in the School of Engineering are based on a program correlated with graduate study in engineering. It is the purpose of this program not only to train future research workers, but also to carry out a program that assures both sound investigations of a fundamental nature in engineering sciences and work devoted to greater uses of the State's natural resources. Through publications, cooperative activity with industry and the operation of our own investigational projects, it is intended that the engineering research activities will be a part of and work effectively with the industrial development of North Carolina.

Degrees

Bachelor of Science in Engineering

The four-year curricula offer programs of study leading to a bachelor's degree in agricultural, ceramic, chemical, civil, electrical, geological, industrial, mechanical, metallurgical, nuclear engineering and engineering mechanics. Aerospace engineering is an option in mechanical engineering, and construction engineering is an option in civil engineering. Graduation requirements are the satisfactory completion of all the

uired courses in any one curriculum and other courses which amount to minimum of 146 semester credit hours. A minimum scholastic record of C average is also required.

Specialized Degree

A specialized Bachelor of Science degree is also offered through a program of study in furniture manufacturing and management. The course is lanned for four years of study. Graduation requirements are the satisictory completion of all the required courses and other courses which mount to a minimum total of 146 semester credit hours. A minimum cholastic record of C average is also required.

Professional Degree in a Specialized Branch of Engineering

The professional degree in a specialized branch of engineering is an arned degree which can be obtained only after the bachelor's degree.

The fifth-year curricula are especially designed to meet the needs of students desiring intensive specialization in a particular field or additional ourse work not ordinarily covered in the normal four-year undergraduate urricula. This professional program of study is offered in ceramic, chemial, civil, electrical, geological, industrial, mechanical, and metallurgical ngineering.

For further information concerning the requirements for the professional egree, applications for admission, etc., write to the dean of engineering : North Carolina State College, Raleigh, North Carolina.

Master of Science in a Specialized Branch of Engineering

The Master of Science in a specialized branch of engineering is an arned graduate degree which can be obtained only after the bachelor's egree. It requires at least one year of graduate work, a reading knowledge f at least one foreign language and a thesis showing ability to pursue independent research. The core of graduate courses taken must emphasize scientific objective. Further information concerning the requirements or this degree may be obtained by writing the dean of the Graduate chool at North Carolina State College, Raleigh, North Carolina.

Doctor of Philosophy Degree

The Doctor of Philosophy degree is an earned graduate degree offered ı ceramic, chemical, civil, electrical, mechanical, and nuclear engineerng. Admission requirements are the same as for the master's degree. It equires at least two years of graduate work in one of these listed major rograms and a minor either in some field of engineering or in an allied cience. The dissertation will deal with some problem in the field of the udent's major interest. Further information concerning the degree may e obtained from the dean of the Graduate School at North Carolina tate College, Raleigh, North Carolina.

Short Courses and Institutes

The School of Engineering offers short courses and institutes both on the campus and at various centers throughout the State for adults and graduate engineers. Such courses vary in length from one day to twelve weeks; each year the courses offered are different and vary according to the public demand. The faculty of the School of Engineering usually furnish a large portion of the instruction offered in these courses, which in the past have been for electrical metermen, gas plant operators, safety engineers, radio engineers, refrigeration and air plumbing contractors and surveyors. Classes are usually held in Raleigh where the School of Engineering has an excellent staff and adequate laboratories and classroom facilities available.

These short courses offer real opportunity to practicing engineering personnel to follow a refresher program in their field of interest, as well as to become acquainted with the latest and most modern engineering procedures and equipment.

Another educational services activity is that being carried out at the Gaston Technical Institute, Gastonia, North Carolina, where a two-year post-high school terminal technician program is sponsored by the School of Engineering and operated by the Extension Division of the College. A separate full-time staff is employed for this educational program which provides an integrated curriculum in English, mathematics, engineering drawing, machine shop, welding, electrical maintenance, and economics. Graduates of this program are trained for industry with the opportunity for rapid acceleration towards positions as foremen, maintenance supervisors, etc.

Each of the engineering curricula is not only well-balanced, but offers a liberal course of study in a technical and professional field. Each conforms to what is regarded by engineering educators as the best modern practice.

Freshman Year in All Engineering Curricula[+]

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101, General Inorganic Chemistry	4	CH 103, General and Qualitative Chemistry	4
ENG 111, Composition	3	ENG 112, Composition	3
E 100, Introduction to Engineering	1	EC 205, The Economic Process	
MA 101, Algebra and Trigonometry	5	or	
ME 101, Engineering Graphics I	2	HI 205, The Modern Western World	3
*MS 101, Military Science I		**MA 102, Analytic Geometry and Calculus I	4
or		ME 102, Engineering Graphics II	2
*AS 121, Air Science I	1	*MS 102, Military Science I	
*PE 101, Physical Education	1	or	
	17	*AS 122, Air Science I	1
		*PE 102, Physical Education	1
			18

* Students excused from military science or air science and/or physical education will schedule equivalent credits in courses outside their department.

** To be eligible to roster courses taught by the School of Engineering above the freshman level, an engineering student must have earned a minimum grade of "C" on MA 102.

+ Except the Department of Agricultural Engineering.

The sophomore, junior, and senior programs of study in the various fields of engineering are shown under the department headings on the pages that follow.

Humanities

Social Studies Programs for Engineering Students—A specially designed sequence of courses comprising 21 credit hours is required of all engineering students and is incorporated in each curriculum. Its primary objective is to broaden the student in the humanities and social sciences and to instill good habits in the use of the English language. Following a broad yet basic consideration of history, economics, and literature, the student progresses to an advanced and integrated study of contemporary civilization and of contemporary problems. The electives in the last year may be chosen from a group of approved courses which are built upon and closely related to the subject matter of the previous three years.

Freshman Year

Spring Semester	*Credits*
HI 205, The Modern Western World	
or	
EC 205, The Economic Process	3

*Sophomore Year

all Semester	*Credits*	*Spring Semester*	*Credits*
HI 205, The Modern Western World		HI 205, The Modern Western World	
or		or	
NG 205, Reading for Discovery		ENG 205, Reading for Discovery	
or		or	
C 205, The Economic Process	3	EC 205, The Economic Process	3

Junior Year

all Semester	*Credits*	*Spring Semester*	*Credits*
S 301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3

**Senior Year

all Semester	*Credits*	*Spring Semester*	*Credits*
S 491, Contemporary Issues I		SS 492, Contemporary Issues II	
or		or	
Approved Elective		Approved Elective	
(see list below) ..	3	(see list below)	3

Senior Electives for Humanities—Social Studies Program

	Credits		*Credits*
S 491, Contemporary Issues .	3	SOC 401, Human Relations in	
S 492, Contemporary Issues II	3	Industrial Society	3
H 412, Recent United States History	3	PHI 305, Philosophy Analysis	3
NG 468, Major American Writers	3	EC 442, Evolution of Economic Ideas	3
S 401, American Parties and		GN 301, Genetics in Human Affairs	3
Pressure Groups .	3		

* History, economics, and literature may be scheduled in any order except that ENG 111, 112, Composition, are prerequisites for ENG 205. Only one course can be scheduled in a given semester without special permission.

** The student must take either SS 491, Contemporary Issues I, or SS 492, Contemporary Issues II. He must select an elective from the senior electives list for the other senior semester.

Courses from the approved list of senior electives will not be credited to the humanities sequence unless taken during the senior year.

Professional Program in Engineering

The School of Engineering offers fifth-year professional curricula leading to the degrees Ceramic Engineer, Civil Engineer, Chemical Engineer, Electrical Engineer, Geological Engineer, Industrial Engineer, Mechanical Engineer, and Metallurgical Engineer. These curricula are tailor-made to fit the particular needs of each student with a view that upon completion of a program the student will be prepared to pursue a professional career in engineering.

It is the intent of the fifth-year program to emphasize professional course work rather than research. To this end, a curriculum is comprised of 30 semester credits of course work requiring of the student a minimum of one academic year in residence. Neither a thesis nor a reading knowledge of a foreign language is required. Samples of curricula that meet the requirements of the fifth-year program may be found under the appropriate departmental curricula. These curricula are to be considered illustrative; the actual program of study will be especially designed to fit the needs of the individual student.

Admission

Applicants who hold the bachelor's degree in engineering from recognized colleges will be admitted to the professional program of the School of Engineering upon presentation of official credentials. For unconditional admission, these credentials must show the completion, with a minimum grade point average of 2.5 (C+), of an amount of undergraduate work in the proposed field of professional study corresponding to that normally required for a bachelor's degree in that field.

Admission on a provisional basis may be granted applicants who do not meet the formal requirements. In case of insufficient preparation, prerequisite courses will be prescribed in addition to the normal fifth-year course requirements.

Applications for admission, accompanied by full credentials in the form of transcripts of academic records, should be filed in the office of the dean of engineering at least 30 days in advance of the semester in which admission is sought.

General Regulations

The following regulations of the School of Engineering will be observed:

1. An undergraduate enrolled at North Carolina State College, who plans to undertake a professional program and who has fulfilled all requirements for the bachelor's degree except one or two courses, may be permitted to enroll in certain courses and later obtain credit toward the professional degree provided the student gives notice of his purpose to

the dean of the School of Engineering. The maximum credit to be obtained in this way is six semester course credits.

2. Credit for professional work to be applied toward the requirements for the professional degree, not to exceed six semester credits, may be transferred to North Carolina State College from recognized institutions of university grade offering advanced work in engineering and related fields. Such a transfer of credit must be recommended by the head of the department in which the student does his major work and it must be approved by the dean of the School of Engineering.

3. Fifth-year students are classified as post-baccalaureate students and are subject to rules and regulations as established and administered by the dean of the School of Engineering.

4. Grades for each completed course are reported to the dean of the School of Engineering and to the Office of Registration. A minimum grade of C must be made in each course to obtain credit. A quality point average of 2.5 (C+) in all course work must be attained to satisfy requirements for a professional degree.

5. Work completed more than six years prior to the date on which the professional degree is to be granted may not be used as credit toward the professional degree, unless approved by the head of the department concerned and the dean of the School of Engineering.

6. Each fifth-year student will be assigned to a committee consisting of his department head and the professor in charge of the work in which he is majoring. The function of this committee is to assist the student in preparing a program of study and to counsel him in his academic work. The student will be required, with the assistance of his committee, to prepare a complete plan of study before mid-semester of his first semester in residence. This program of study is subject to the approval of the dean of the School of Engineering.

Department of Agricultural Engineering

Professor F. J. HASSLER, *Head of the Department*
TEACHING AND RESEARCH
Professors:
H. D. BOWEN, J. M. FORE, W. E. SPLINTER, JAN VAN SCHILFGAARDE, JOHN W. WEAVER, JR.
Associate Professor:
EZRA L. HOWELL
Assistant Professors:
GEORGE B. BLUM, JR., W. H. JOHNSON, K. A. JORDAN, DAVID A. LINK, C. W. SUGGS
Instructors:
E. O. BEASLEY, J. F. BEEMAN, E. G. HUMPHRIES, EDWARD H. WISER, F. SCOTT WRIGHT
Head Mechanic:
RALPH B. GREENE
EXTENSION
Professor H. M. ELLIS, *In Charge*
Associate Professors:
J. C. FERGUSON, R. M. RITCHIE, W. C. WARRICK
Assistant Professor:
J. W. GLOVER
Instructor:
R. E. SNEED

Students in agricultural engineering are educated and trained to deal with the problems of agriculture that are engineering in nature. Involved are the application of scientific and engineering principles to the conservation and utilization of water and soil, the development of power and labor-saving devices for all phases of agricultural production, the design of structures and equipment for housing and handling livestock and field products, and the processing and marketing of farm products.

Undergraduate Curriculum

This curriculum, offered in conjunction with the School of Agriculture, is designed to develop young men capable of engineering leadership in agriculture. Emphasis is placed on basic science courses such as mathematics, physics, mechanics, biology, soils, and thermodynamics, which provide a sound background for engineering and agricultural technology. Courses in agricultural engineering are directed to those methods of thought and techniques whereby science can be applied with understanding and judgment to engineering situations in agricultural operations. General agriculture courses are provided in order that the student can better understand the agricultural industry with which he deals.

Since agricultural engineering involves two distinct technical fields—agriculture and engineering—this curriculum is a joint responsibility of the two schools and is so administered.

Facilities

The Department of Agricultural Engineering is housed in the Agricultural Engineering Building. This building, completed in 1960, embodies the most advanced facilities for education and research in the application of engineering to the production and processing of biological material for food and fiber. Included are offices, classrooms, laboratories, shop facilities, and space for the Agricultural Engineering Extension Service.

Opportunities

Men trained in agricultural engineering are qualified for positions in design, development and research in public institutions and in industry, and for teaching and extension work in institutions of higher education. The curriculum also provides adequate training for postgraduate work leading to advanced degrees. Graduates in this program receive the degree of Bachelor of Science in agricultural engineering.

Agricultural Engineering Curriculum

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111, Composition	3	ENG 112, Composition	3
MA 101, Algebra and Trigonometry	5	*MA 102, Analytic Geometry and Calculus I	4
ME 101, Engineering Graphics I	2	ME 102, Engineering Graphics II	2
AGE 151, Farm Mechanics	2	AGE 152, Farm Mechanics	2
AG 103, Introduction to Agriculture	1	CH 101, General Chemistry I	4
MS 101, Military Science I or		MS 102, Military Science I or	
AS 121, Air Science I	1	AS 122, Air Science I	1
PE 101, Physical Education	1	PE 102, Physical Education	1
	15		17

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 103, General Chemistry II	4	EM 200, Introduction to Mechanics	3
AGE 211, Farm Power and Machinery	3	CE 201, Surveying I	3
MA 201, Analytical Geometry and Calculus II	4	MA 202, Analytical Geometry and Calculus III	4
PY 201, General Physics I	5	PY 202, General Physics II	5
MS 201, Military Science II or		MS 202, Military Science II or	
AS 221, Air Science II	1	AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	18		17

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EE 320, Elements of Electrical Engineering	4	BO 103, General Botany	4
EM 301, Solid Mechanics	3	EC 201, Economics	3
ENG 231, Basic Speaking Skills	3	EM 303, Fluid Mechanics I	3
SSC 200, Soils	4	ME 301, Engineering Thermodynamics I	3
English Elective	3	MA 301, Differential Equations	3
**Elective	3	**Elective	3
	20		19

* To be eligible to roster courses taught by the School of Engineering above the freshman level, an engineering student must have earned a minimum grade of "C" on MA 102.

** ST 361, Introduction to Statistics for Engineers, and PY 407, Introduction to Modern Physics, are recommended for electives.

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
AGE 451, Conditioning Principles for Plant and Animal Systems	2	AGC 212, Economics of Agriculture or AGC 551, Agricultural Production Economics	3
AGE 462, Farm Power and Machinery IIA	4	AGE 371, Soil and Water Conservation Engineering	4
AGE 491, Rural Electrification	4	AGE 481, Agricultural Structures as Production Units	4
AGE 552, Instrumentation for Agricultural Research and Processing	1	AGE 452, Senior Seminar	1
PS 201, The American Governmental System	3	HI 261, The U. S. in Western Civilization	3
RS 301, Sociology of Rural Life	3	Humanities Elective	3
*Elective	3	*Elective	3
	20		21

Graduate Study

The Department of Agricultural Engineering offers advanced study leading to the Doctor of Philosophy degree in any one of five fields of specialization: power and machinery, rural structures, soil and water conservation, rural electrification, or agricultural processing.

The Master of Science program in agricultural engineering provides a broad background in science and engineering through advanced study in mathematics and physics.

For those interested primarily in existing technology, a program of study for the Master of Agricultural Engineering degree permits selections from a variety of advanced application courses. This program provides training appropriate for those engaged in the dissemination of information either as extension workers with public institutions or service representatives for industry. It is not intended as preliminary study to the Doctor of Philosophy degree.

Department of Chemical Engineering

Professor E. M. SCHOENBORN, *Head of the Department*
Reynolds Professor:
K. O. BEATTY, JR.
Professor:
JAMES K. FERRELL
Associate Professors:
R. BRIGHT, J. F. SEELY
Assistant Professors:
D. B. MARSLAND, E. P. STAHEL
Instructors:
T. M. GODBOLD, J. C. MCGEE

Chemical engineering is concerned with the design of processes, equipment and plants in which chemical and physical transformations of matter are carried out. Typical industries relying heavily upon chemical engineering

* ST 361, Introduction to Statistics for Engineers, and PY 407, Introduction to Modern Physics, are recommended for electives.

include those producing chemicals, polymers, metals, drugs, glass, food, gasoline, paper, soap and cement; those producing energy from nuclear fuels; and those processing materials by methods involving chemical reactions. The preparation of men qualified to pursue careers in such industries as these is the purpose of the curriculum in chemical engineering.

Curriculum

The work of the chemical engineer is extremely diversified and consequently his education must be along broad and basic lines. The spirit of research and experimentation is a vital part of the chemical industry and even those in the undergraduate curriculum need to acquire the sound scientific background essential to original thought and independent accomplishment. The undergraduate curriculum emphasizes the engineering, the chemical, and the economic principles involved in chemical processes and operations. The work in chemistry including inorganic, analytical, physical, and organic chemistry is comparable to that usually given to chemists in the first three years with the exception of a reduction of time devoted to laboratory work. The subjects in mechanical and electrical engineering, in mechanics and metallurgy are designed to supply the fundamentals of these branches. The work in the chemical engineering subjects, although distinctly professional in application, is nevertheless basic in character. Since it depends upon a thorough background in the sciences, it is postponed until the third and fourth years. It is designed to develop initiative, sound habits of thought and intellectual curiosity in the student.

Chemical engineers have played the biggest single role in the atomic energy field. The future of production of nuclear fuels, the operation and design of reactors, and the processing of irradiated materials present a multitude of chemical engineering problems. By judicious use of his electives, the student in chemical engineering may obtain specialized knowledge in the area of nuclear engineering.

Facilities

The Chemical Engineering Laboratories are provided with pilot plant-type equipment for studying the principles of fluid flow, heat transfer, distillation, absorption, drying, crushing and grinding, filtration, agitation, etc. Much new equipment has been installed, and new and special apparatus is added from time to time to keep the facilities abreast of recent developments in the field. Special equipment for research and instructional purposes is designed and built in the departmental laboratories. In this way students are given first hand acquaintance with problems relating to the actual design, construction, and operation of typical equipment used in industry.

Opportunities

Opportunities for employment in the chemical, atomic energy, and allied fields upon graduation are numerous and varied. Graduates find employ-

ment in such fields as research and development; production, operation, and maintenance; management and administration; inspection, testing, and process control; technical service and sales; estimation and specification writing; consulting and teaching, and many others. Students desiring to pursue careers in research and development or in teaching and consulting work are strongly advised to consider training. In fact, the need for persons who have had advanced training in the field beyond the regular four-year program is continually increasing.

Chemical Engineering Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CHE 205, Chemical Process Principles	4	CHE 311, Introductory Chemical Engineering	4
*EC 205, The Economic Process or ENG 205, Reading for Discovery	3	*ENG 205, Reading for Discovery or EC 205, The Economic Process	3
MA 201, Analytical Geometry and Calculus II	4	MA 202, Analytical Geometry and Calculus III	4
PY 201, General Physics	5	PY 202, General Physics	5
MS 201, Military Science II or AS 221, Air Science II	1	MS 202, Military Science II or AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	18		18

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 215, Quantitative Analysis	4	CH 532, Physical Chemistry	3
CH 531, Physical Chemistry	3	CHE 412, Unit Operations II	3
CHE 411, Unit Operations I	3	EE 320, Elements of Electrical Engineering	4
EM 341, Engineering Mechanics A	2	EM 342, Engineering Mechanics B	2
SS 301, Contemporary Civilization	3	EM 343, Strength of Materials A	2
Elective	3	SS 302, Contemporary Civilization	3
	18	Elective	3
			20

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 425, Organic Chemistry	3	CH 426, Organic Chemistry	3
CHE 415, Chemical Engineering Thermodynamics	4	CHE 432, Unit Operations Lab II	3
CHE 431, Unit Operations Lab I	3	CHE 525, Process Measurement and Control	3
CHE 460, Seminar	1	MIM 321, Metallurgy	3
CHE 527, Chemical Process Engineering	3	*SS 492, Contemporary Issues II or Elective in Humanities	3
*SS 491, Contemporary Issues I or Elective in Humanities	3	Elective	3
Elective	3		18
	20		

* See page 131 for information concerning the Humanities Sequence.

Professional Curriculum (Typical Program)

Fall Semester	*Credits*
CH 401, Special Topics in Inorganic Chemistry	3
CHE 570, Chemical Engineering Projects	2
CHE 610, Heat Transfer I	3
CHE 660, Chemical Engineering Seminar	1
PY 407, Introduction to Modern Physics	3
Elective	3
	15

Spring Semester	*Credits*
CHE 525, Process Measurement and Control	3
CHE 546, Chemical Reaction Rates	3
CHE 570, Chemical Engineering Projects	2
CHE 613, Distillation	3
CHE 660, Chemical Engineering Seminar	1
Elective	3
	15

Graduate Study

Regulations governing the professional program are shown on pages 132 and 133.

Graduate work is offered in chemical engineering leading to the degrees of Master of Science and Doctor of Philosophy in chemical engineering. Superior students who can do so are strongly encouraged to spend one or more years in advanced study and research since the demand of the chemical industry for persons with training beyond the baccalaureate is continually increasing.

The chemical engineering staff and research facilities provide unusual opportunities for basic and applied work in such important fields as fluid flow, heat transfer, distillation, diffusional operations, plastic technology. Of current interests are special programs in thermal properties of materials at both high and low temperatures, in process measurement and control, the use of radioactive tracers in chemical engineering research, and condensation in a centrifugal force field.

For general regulations, the Graduate School Catalog should be consulted.

Department of Civil Engineering

Professor C. R. BRAMER, *Acting Head of the Department*
Professors:
C. R. MCCULLOUGH, CARROLL L. MANN, JR., C. SMALLWOOD, JR., M. E. UYANIK
Associate Professors:
R. H. BIGELOW*, P. D. CRIBBINS, J. W. HORN, PAUL ZIA
Assistant Professors:
MICHAEL AMEIN, E. P. BRANTLY, C. P. FISHER, DONALD MCDONALD, H. E. WAHLS
Instructors:
N. C. COSTES, G. N. OWEN, JR., J. B. SHULER, OKTAY URAL

Civil engineering is one of the broadest of the various fields of engineering. It deals with the planning, design and construction of buildings, bridges, dams, harbor works, water works, water power facilities, sewage disposal works, nuclear waste facilities, missile launch facilities, and transportation facilities including highways, railways, waterways, airports, and

* On leave.

pipe lines. The civil engineer's services are in demand by public agencies as well as by private enterprise. The activities of the civil engineer are such that opportunities are available for office type as well as field-type employment and for employment in small communities as well as in large industrial centers. The breadth in scope of civil engineering and the variety of types of employment open to the civil engineer are such that a student who does not have a strong predilection for some special branch of engineering may be safely advised to study civil engineering.

Objectives

It is the primary mission of the Civil Engineering Department to offer programs of study designed to provide adequate academic preparation to those contemplating a career in the civil engineering profession. To this end, course work at both the baccalaureate and graduate levels is offered. The undergraduate program is designed to provide a sound general education and at the same time to prepare the student for advanced study in engineering either by the continuation of formal education at the graduate level or by self-study.

Facilities

The Department of Civil Engineering is located in Mann Hall. This building provides offices, drafting rooms, and classrooms, as well as laboratory facilities for testing structural materials, soils and bituminous products; for hydraulic experiments; for studies in airphoto interpretation and photogrammetry; for analysis of structural models; for chemical and biological tests pertaining to sanitary engineering; and for the investigation of transportation problems. In addition, the facilities of Mann Hall include a student study room, an auditorium and a departmental library. All of these facilities have been designed to provide for effective teaching and laboratory instruction and to create a scholarly environment.

Undergraduate Curriculum

The Department of Civil Engineering offers two four-year undergraduate curricula: the one, leading to the degree of Bachelor of Science in civil engineering; the other, to the degree of Bachelor of Science in civil engineering, construction option.

The civil engineering curriculum has been accredited by the Engineers' Council for Professional Development. It is a well-balanced program of study providing academic discipline in the pure and applied physical sciences, the humanities and social sciences, and the professional aspects of civil engineering including structural, transportation, and sanitary engineering, and soil mechanics and foundations.

Civil Engineering Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	Credits	Spring Semester	Credits
CE 201, Surveying I	3	CE 202, Surveying II	3
MA 201, Analytical Geometry and Calculus II	4	EM 200, Introduction to Mechanics	3
PY 201, General Physics	5	MA 202, Analytical Geometry and Calculus III	4
EC 205, The Economic Process or		PY 202, General Physics	5
ENG 205, Reading for Discovery	3	*ENG 205, Reading for Discovery or	
MS 201, Military Science II or		EC 205, The Economic Process	3
AS 221, Air Science II	1	MS 202, Military Science II or	
PE 201, Physical Education	1	AS 222, Air Science II	1
	17	PE 202, Physical Education	1
			20

Junior Year

Fall Semester	Credits	Spring Semester	Credits
CE 305, Transportation Engineering I	3	CE 306, Transportation Engineering II	3
CE 321, Materials Testing Lab I	2	CE 322, Materials Testing Lab II	2
CE 382, Hydraulics	3	CE 324, Structural Analysis I	3
EM 301, Solid Mechanics I	3	EM 302, Solid Mechanics II	3
MA 301, Differential Equations I	3	ME 301, Engineering Thermodynamics I	3
SS 301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
Elective	3	Elective	3
	20		20

Senior Year

Fall Semester	Credits	Spring Semester	Credits
CE 425, Structural Analysis II	3	CE 428, Structural Design II	3
CE 427, Structural Design I	4	CE 482, Water and Sewage Works	3
CE 442, Soil Mechanics	3	CE 493, Professional Practice II	1
CE 481, Hydrology and Drainage	2	EE 320, Elements of Electrical Engineering	4
CE 492, Professional Practice I	1	*SS 492, Contemporary Issues II or	
*SS 491, Contemporary Issues I or		Elective in Humanities	3
Elective in Humanities	3	Elective	3
Elective	3		17
	19		

CONSTRUCTION OPTION

Professor CARROLL L. MANN, JR., *In Charge*

The curriculum in civil engineering construction option is designed to suit the needs of students who are especially interested in the construction phases of civil engineering. It includes the core course requirements

* See page 131 for information about the Humanities Sequence.

in the physical sciences and the social sciences and humanities as established for all engineering curricula offered at North Carolina State College. It differs from the civil engineering curriculum in that special emphasis is given to the construction aspects of civil engineering. To this end the curriculum includes a four-semester sequence of courses in estimates and costs and construction planning and organization. The courses unique to this curriculum are designed to provide academic discipline in the engineering, planning, and management aspects of construction.

Construction Option Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 201, Surveying I	3	CE 202, Surveying II	3
MA 201, Analytical Geometry and Calculus II	4	EM 200, Introduction to Mechanics	3
PY 201, General Physics	5	MA 202, Analytical Geometry and Calculus III	4
*EC 205, The Economic Process or ENG 205, Reading for Discovery	3	PY 202, General Physics	5
MS 201, Military Science II or AS 221, Air Science II	1	*ENG 205, Reading for Discovery or EC 205, The Economic Process	3
PE 201, Physical Education	1	MS 202, Military Science II or AS 222, Air Science II	1
		PE 202, Physical Education	1
	17		20

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 321, Materials Testing Laboratory I	2	CE 322, Materials Testing Laboratory II	2
CE 361, Estimates and Costs I	3	CE 324, Structural Analysis I	3
EC 312, Accounting for Engineers	3	CE 362, Estimates and Costs II	3
EE 320, Elements of Electrical Engineering	4	EM 302, Solid Mechanics II	3
EM 301, Solid Mechanics I	3	ME 301, Engineering Thermodynamics I	3
SS 301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
Elective	3	Elective	3
	21		20

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 427, Structural Design I	4	CE 429, Structural Design III	3
CE 461, Project Planning and Control I	3	CE 443, Foundations	3
CE 485, Elements of Hydraulics and Hydrology	3	CE 462, Project Planning and Control II	3
CE 492, Professional Practice I	1	CE 464, Legal Aspects of Contracting	3
*SS 491, Contemporary Issues I or Elective in Humanities	3	*SS 492, Contemporary Issues II or Elective in Humanities	3
Elective	3	Elective	3
	17		18

* See page 131 for information about the Humanities Sequence.

Professional Study in Civil Engineering

Fifth-year programs of study leading to the professional degree of Civil Engineer are offered in the following specialty fields: sanitary engineering, soil mechanics and foundation engineering, structural engineering and transportation engineering. The fifth-year curricula, which are made up of advanced course work, are offered as a continuation of the four-year undergraduate program and are designed for students who are desirous of becoming technically proficient in one of the specialty fields of civil engineering. The following curricula are illustrative of the fifth-year programs of study. It is to be understood, however, that a curriculum for a given student is designed in consultation with his adviser to suit his particular interests.

Regulations governing the professional program are shown on pages 132 and 133.

Sanitary Engineering Curriculum

Professional

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 571, Theory of Water and Sewage Treatment	3	CE 572, Unit Operations and Processes in Sanitary Engineering	3
CE 573, Analysis of Water and Sewage	3	CE 598, Civil Engineering Projects	2
CE 598, Civil Engineering Projects	2	CE 672, Advanced Water and Sewage Treatment	4
CE 671, Advanced Water Supply and Sewerage	4	Electives	6
Elective	3		15
	15		

Soil Mechanics and Foundation Engineering Curriculum

Professional

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 525, Advanced Structural Analysis I	3	CE 524, Analysis and Design of Masonry Structures	3
CE 548, Engineering Properties of Soils I	3	CE 544, Foundation Engineering	3
CE 641, Advanced Soil Mechanics	3	CE 549, Engineering Properties of Soils II	3
MA 405, Introduction to Determinants and Matrices	3	CE 642, Advanced Soil Mechanics	3
Elective	3	Elective	3
	15		15

Structural Engineering Curriculum

Professional

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 525, Advanced Structural Analysis I	3	CE 544, Foundation Engineering	3
CE 625, Advanced Structural Design I	3	CE 626, Advanced Structural Design II	3
EM 551, Advanced Strength of Materials	3	CE 526, Advanced Structural Analysis II	3
MA 405, Introduction to Determinants and Matrices	3	EM 602, Elastic Stability	3
Elective	3	Elective	3
	15		15

Transportation Engineering Curriculum

Professional

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 515, Transportation Operations	3	CE 601, Transportation Planning	3
CE 516, Transportation Design	3	CE 602, Advanced Transportation Design	3
CE 603, Airport Planning and Design	3	CE 604, Urban Transportation Planning	3
Electives	6	Electives	6
	15		15

Graduate Study in Civil Engineering

The graduate degrees offered by the Civil Engineering Department are the Master of Science in civil engineering and the Doctor of Philosophy. At North Carolina State College, facilities for research and graduate instruction are available in the areas of sanitary engineering, soil mechanics and foundation engineering, structural engineering and transportation engineering. For additional information concerning graduate study opportunities in civil engineering, the current issue of the Graduate School Catalog should be consulted.

Post-Baccalaureate Study in Civil Engineering Related to Other Fields

Transportation Engineering and City and Regional Planning

There exists a growing need for the coordination of transportation facilities and land planning and for individuals with competence in both fields. To fulfill this need, an advanced program leading to a post-baccalaureate degree in engineering, majoring in transportation engineering, and to the degree of Master of Regional Planning is offered through the combined resources of the Department of Civil Engineering at North Carolina State College and the Department of City and Regional Planning at the University of North Carolina. Qualified students have the opportunity to schedule

their courses of instruction to enable them to qualify for both advanced degrees.

The program is designed for students who are desirous of becoming technically proficient in both the fields of transportation engineering and city and regional planning. The minimum residence requirements include two academic years plus a summer internship. The curriculum includes the major core courses for both the advanced transportation engineering program and the city and regional planning program, plus supplementary courses important to both endeavors and a thesis. A bachelor's degree in engineering, including a knowledge of transportation engineering, from an institution of recognized standing is required for admission to the program. Applicants who do not meet these requirements in full may submit their credentials for examination and consideration.

Further information concerning the joint program may be obtained from the Department of Civil Engineering at North Carolina State College or from the Department of City and Regional Planning at the University of North Carolina.

Water Supply and Waste Treatment

In recognition of the need by industry for personnel with training in water supply and the abatement of water pollution, the Civil Engineering Department suggests that students in the many curricula leading to positions in industry (food processing, textile chemistry, pulp and paper technology, chemical engineering, zoology and others) consider courses of instruction in sanitary engineering for advanced undergraduate electives, and minor sequences for advanced degrees. Among the courses appropriate for such students are the following: CE 482, Water and Sewage Works; CE 571, Theory of Water and Sewage Treatment; CE 573, Analysis of Water and Sewage; CE 673, Industrial Water Supply and Waste Disposal; and CE 674, Stream Sanitation.

Department of Electrical Engineering

Professor G. B. HOADLEY, *Head of the Department*
Professors:
W. J. BARCLAY, A. R. ECKELS, G. E. SCHAFER, W. D. STEVENSON, JR.
Associate Professors:
N. R. BELL, K. B. GLENN, A. J. GOETZE, E. G. MANNING, W. C. PETERSON, E. W. WINKLER
Assistant Professor:
F. L. THURSTONE
Instructors:
D. I. FAIRBANKS, P. B. JOHNSON, F. S. KEBLAWI, T. E. MCENALLY, P. N. MARINOS, J. PENG, W. P. SEAGRAVES, T. B. SMILEY

The purpose of the undergraduate curriculum is to train young people, either for active work in a challenging and diversified field, or for further study on the graduate level. To achieve this a thorough grounding is given in engineering science, followed by a solid foundation in fundamental electrical theory, and by advanced subject matter of sufficient breadth to

insure adequate preparation for a dynamic profession. This background is essential for success, whether the particular field be automatic control, computers, communications, telemetering, electronics, the design of electrical equipment, the manufacture of electrical equipment, electric power production, the utilization of electric power, electronics in medicine, instrumentation or any other one of the vital fast developing fields using electricity either as muscles or as nerves.

Curriculum

The curriculum in electrical engineering includes comprehensive training in mathematics and physics—the fundamental sciences—and adequate training in allied branches of engineering. Most courses are accompanied by coordinated work in the laboratory and drill in the application of theory by means of carefully planned problems.

Each student has a choice of at least two out of eight senior elective courses in the department, and also has a choice of four courses from any of the offerings at State College. Near the end of the sophomore year, each student is asked to consider his electives and to plan a coordinated program of courses suited to his particular needs and interests.

Examinations are given each week to sophomore students in the electrical engineering course. In the junior year, examinations are given every three weeks, and in the senior year, they are given about every five weeks. This decreasing frequency of examinations is intended to encourage the student to assume more and more responsibility for the success of his own program.

Facilities

The Electrical Engineering Department is housed in Daniels Hall. In addition to offices and classrooms this building provides laboratories for the study of servomechanisms and control, electronics and communications, circuits, instrumentation, illumination, computers, and electrical machinery. There are also a student study room, a shop, and a number of research laboratories.

Also available to the student are the services of an IBM 650 computer for research.

Graduation Requirements

Requirements for graduation are passing grades in the courses listed in the electrical engineering curriculum, passing of 147 credit hours, a grade point average of 2.00 or better, demonstration of proficiency in written English, tested in the junior year. Students receiving D grades in both ENG 111 and ENG 112 will be required to repeat ENG 111.

Attendance at two professional electrical engineering society meetings of state-wide or larger scope, once in the spring of the junior year and once in the fall of the senior year, is required. Attendance at the three

ıbsection meetings is considered the equivalent of one state-wide meet-ıg, in meeting this requirement.

Also a minimum of six continuous weeks of gainful employment is :quired. This employment may be as laborer, sub-professional, or profes-onal assistant in any of the following fields: industrial manufacturing, :pair service, or sales; industrial engineering or scientific research; engi--eering or architectural design and drafting; engineering exploration, ırveying, or reconnaissance; construction of engineering works. Techni-ıl work while in military service or for a school does not satisfy this :quirement.

The student is responsible for obtaining his employment and supplying ıtisfactory evidence thereof to the department. This evidence will consist f a letter from the employer to the head of the department setting forth ıclusive dates of employment; character of work performed; and an evalu-ıion of the student's work.

ıudent Activities

Close coordination with the work of the professional electrical engineer-ıg societies is maintained through the AIEE-IRE Joint Student Branch hich meets twice a month. Faculty advisers assist the students in bring-ıg to these meetings practicing engineers. The Joint Student Branch also ɔonsors departmental activities such as picnics for new students and de-ıartmental participation in the Engineers' Fair.

An active chapter of Eta Kappa Nu, the national honorary electrical ıgineering fraternity, undertakes numerous important projects in addi-on to holding two initiation banquets yearly.

ɛectrical Engineering Curriculum

ır the freshman year see page 130.

Sophomore Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
EC 205, The Economic Process	3	**ENG 205, Reading for Discovery	3
: 201, Elementary Circuits and Fields	4	EE 202, Elementary Circuits and Fields	4
⁴ 201, Analytic Geometry and Calculus II	4	MA 202, Analytic Geometry and Calculus III	4
' 201, General Physics	5	PY 202, General Physics	5
⁴S 201, Military Science II or		*MS 202, Military Science II or	
⁴S 221, Air Science II	1	*AS 222, Air Science II	1
'E 201, Physical Education	1	*PE 202, Physical Education	1
	18		18

Students excused from mil'tary or air science and/or physical education will schedule equivalent credits outside their departments.

See page 131 for information about the Humanities Sequence.

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EE 301, Intermediate Circuits and Fields	4	EE 302, Intermediate Circuits and Fields	3
EE 305, Electrical Machinery	4	EE 314, Electronics	4
EM 200, Introduction to Mechanics	3	EM 301, Mechanics I (Solids)	3
MA 301, Differential Equations	3	**PS and AM Elective	3
SS 301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
		Elective	3
	17		19

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EE 411, Electrical Engineering Senior Seminar	1	EE 402, Advanced Circuits and Fields	3
EE 401, Advanced Circuits and Fields	3	EM 321, Strength of Materials I	3
ME 301, Engineering Thermodynamics I	3	ME 303, Engineering Thermodynamics III	3
*Senior Humanities	3	*Senior Humanities	3
Departmental Elective	3	Departmental Elective	3
***PS and AM Elective	3	Elective	3
Elective	3		18
	19		

Professional Degree

A fifth, or professional, year of study is offered in electrical engineerin as a continuation of the four-year undergraduate program. This fifth yea of study offers specialized and advanced course work leading to the degre of electrical engineer. Each student taking this fifth year work has h program of courses planned to meet his individual needs. Regulatior governing the professional degree are shown on pages 132 and 133.

Graduate Study

The Department of Electrical Engineering offers the Master of Scien and the Doctor of Philosophy degrees. Graduate work in electrical eng neering at the first-year or master's level is limited to one or two areas specialization. In the more advanced study for the doctorate a comprehe sive understanding of all fields of electrical engineering is required, a specialization appears in the research problem undertaken.

Advanced courses of a general and fundamental nature, such as elect network synthesis and electromagnetic waves, are recommended for graduate students in electrical engineering, and are required of those w plan to carry their advanced studies to the level of the doctorate. Mir sequences of study in advanced mathematics or physics are planned to the needs of individual students.

* See page 131 for information about the Humanities Sequence.
** To be chosen from MA 302, 401, 405, 511 or 522 or PY 407 or ST 361, PY 552.
*** To be chosen from MA 302, 401, 405, 511 or 522 or ST 361, PY 552.

Recipients of graduate degrees in electrical engineering at North Carona State College are in continual demand. Alumni hold important posions in the research laboratories of industry, government, and universies, in the teaching profession, and in the administrative and engineering epartments of manufacturing corporations, utility companies, and govrnment agencies.

For further information concerning graduate study in electrical engieering, the current Graduate School Catalog should be consulted.

Department of Engineering Mechanics

ofessor P. H. McDONALD, *Head of the Department*
ofessor:
ADOLPHUS MITCHELL
sociate Professors:
M. H. CLAYTON, R. A. DOUGLAS, JOHN E. GRIFFITH
siting Associate Professor:
SHOU-LING WANG
sistant Professors:
J. A. EDWARDS, J. P. LAMB, G. W. MIDDLETON
structors:
JAMES U. CROWDER, JR., JOE W. REECE*

n a large portion of the contemporary engineering world there is a distinct equirement for persons whose educational background encompasses conntrated study within the broad domain of engineering science, persons ith the ability to analyze as well as synthesize across-the-board modernge complexes. Such a diversified background—which demands vigorous reparation in those disciplines concerned with macroscopic as well as icroscopic behavior of matter—is provided in the curriculum administred by the Department of Engineering Mechanics.

Graduates of this interdisciplinary engineering sciences program will iscover wide vistas of professional opportunity including teaching, fundaental engineering research, and applied research-development. In addion, those who desire to pursue their formal education to the master and octoral level will find that the engineering mechanics program provides very sound foundation for graduate study in engineering.

Aside from its own undergraduate program the department fulfills an nportant service function in the engineering school as a whole by proding a core of fundamental courses—in solid and fluid mechanics—for ther undergraduate engineering curricula.

On the graduate level the department offers a full slate of courses coverng the basic principles of generalized continuum mechanics along with ne more specialized areas of solid and fluid mechanics. These courses have een designed to be useful to those who desire to concentrate in mechanics s well as those whose primary field of study requires a rigorous background in some phase of mechanics.

* On leave

Curriculum

The undergraduate program in engineering mechanics provides concentration in solid and fluid mechanics, microscopic behavior of materials, thermodynamics and transport phenomena, electric-magnetic circuits and fields in addition to a foundation of classical and modern physics, mathematics, chemistry, and humanities-social studies.

In the senior year these diverse studies are brought to bear on typical contemporary engineering systems in which interactions of many physical phenomena must be considered. Senior elective sequences in space mechanics and systems analysis-synthesis are also available.

Facilities

The Engineering Mechanics Department is housed in Riddick Laboratories Building. The department's laboratories include instruments and apparatus for studying the prime variables of mechanics and the phenomena in which they occur. Special emphasis is placed on the theory of transducers and sensors such as accelerometers, hot wire anemometer, load cells, pressure probes, electric resistance gages, and the associated recording apparatus. Equipment is available to analyze the behavior of gyroscopes; the stress and strain optic tensors, yielding experiments, and the propagation of wave motion in solids; streamline patterns, pressure distributions; shock wave configurations, and boundary layer profiles.

*Engineering Mechanics Curriculum

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101, General Inorganic Chemistry	4	CH 103, General and Qualitative Chemistry	4
HI 205, The Modern Western World	3	ENG 112, Composition	3
ENG 111, Composition	3	MA 201, Analytic Geometry and Calculus II	4
E 100, Introduction to Engineering	1	PY 201, General Physics	5
MA 102, Analytic Geometry and Calculus I	4	MS 102, Military Science I	
ME 102, Engineering Graphics II	2	or	
MS 101, Military Science I		AS 122, Air Science I	1
or		PE 102, Physical Education	1
AS 121, Air Science I	1		18
PE 101, Physical Education	1		
	19		

* This curriculum is effective beginning September, 1963. Prior to then, the curriculum employ a transitional freshman year in common with all engineering curricula as found page 130.

Sophomore Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
, 201, Elementary Circuits and Fields	4	EE 202, Elementary Circuits and Fields	4
JG 205, Reading for Discovery	3	EC 205, The Economic Process	3
A 202, Analytic Geometry and Calculus III	4	MA 301, Differential Equations	3
202, General Physics	5	MIM 201, Structure and Properties of Engineering Materials	3
201, Military Science II or		EM 200, Introduction to Mechanics	3
221, Air Science II	1	MS 202, Military Science II or	
201, Physical Education	1	AS 222, Air Science II	1
	18	PE 202, Physical Education	1
			18

Junior Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
414, Electronics	3	EM 302, Solid Mechanics II	3
M 301, Solid Mechanics I	3	EM 304, Fluid Mechanics II	3
M 303, Fluid Mechanics I	3	MA 511, Advanced Calculus I or	
A 405, Introduction to Determinants and Matrices	3	ST 361, Statistics for Engineers	3
E 301, Engineering Thermodynamics I	3	ME 302, Engineering Thermodynamics II	3
301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
	18	Elective	3
			18

Senior Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
M 401, Experimental Mechanics I	3	EM 402, Experimental Mechanics II	3
urricula Elective (Mechanics)	3	Curricula Elective (Mechanics)	3
A 512, Advanced Calculus II or		SS 491, Contemporary Issues	3
T 362, Statistics for Engineers	3	Electives	6
E 502, Heat Transfer	3		15
Elective	3		
	15		

raduate Study

The Department of Engineering Mechanics offers graduate studies leading to the degree of Master of Science.

Studies in mechanics at the graduate level normally will include initial courses in the areas of both solids and fluids to augment contemporary offerings in continuum mechanics. These courses provide a background suitable for subsequent specialization in such fields as elasticity, plasticity, or vibrations in solid mechanics; ideal viscous, or compressible fluid flow; as well as in the more generalized behavior of matter encountered in the study of rheology.

Recipients of advanced degrees in mechanics are in demand for research and development endeavors in the engineering field, in the establishment of both private industry and government. Increasing numbers of these men are choosing the opportunities afforded as members of the faculties of engineering schools and colleges.

Department of Engineering Research

N. W. CONNER, *Director*
Research Professors:
R. F. STOOPS, H. H. STADELMAIER
Research Associate Professors:
F. M. RICHARDSON, HAYNE PALMOUR III
Research Associates:
K. R. BROSI, S. W. DERBYSHIRE, A. E. LUCIER
Visiting Research Associate:
J. D. SCHOBEL
Research Assistants:
V. C. DUNKER, J. V. HAMME, G. E. SCOTT, R. B. MOFFITT, J. SINGLETARY, JR., ERNEST HARRISON, JR.
INDUSTRIAL EXTENSION SERVICE
Research Professor and Head:
W. C. BELL
Research Engineers:
J. R. OGBURN, W. G. YAMAMOTO
Research Associates:
S. D. COWARD, L. B. McGEE, J. R. HART
Chemical Engineer:
J. A. MACON
Industrial Specialist:
F. I. EARGLE
MINERALS RESEARCH LABORATORY
Chief Engineer:
W. T. McDANIEL
Ore Dressing Engineers:
I. REDIKER, T. J. WRIGHT
Chemical Engineer:
P. N. SALES

The Department of Engineering Research gives strong support and encouragement to the many research programs conducted within the School of Engineering. The establishment and maintenance of the top rate Department of Engineering Research is a true sign that the College and the School of Engineering are fully aware of the contributions research makes to effective teaching.

The School of Engineering, a part of North Carolina's Land-Grant College, serves the industrial life of the State by offering a broad program of service and experimental aid through its Department of Engineering Research. Many State industries bring problems to the school and the association between the department and the State industries is being strengthened constantly. The department's service is further strengthened through its close cooperation with the North Carolina Department of Conservation and Development. Particular encouragement and assistance are granted investigations that give promise to new North Carolina industries

Facilities

The Department of Engineering Research, established originally in 1923 as the Engineering Experiment Station, maintains laboratories and a fulltime staff which devotes its time exclusively to experimental work. The department's operations are carried out in close cooperation with the administration and faculties of the teaching departments. The abilities of the various departments of engineering are combined through the department so that the complete research capacity of the School of Engineering is available for experimental work in any field. The department also acts as the administrator for the school in negotiations involving research programs done for private industry and for governmental agencies.

The Minerals Research Laboratory in Asheville is engaged in the expansion of North Carolina mineral production through facilities for the development of improved processes of mineral concentration, or examination and appraisal, and chemical analysis.

The Industrial Extension Service was created by the 1955 General Assembly. Its objective is to provide technical assistance to the State's small industry and to promote utilization of its natural resources.

Research Programs

The research capacity of the nation is being used for national security. Research facilities of colleges and universities are utilized for defense work. The School of Engineering at North Carolina State College is playing a leading roll in the area of national security. Several research programs sponsored by the government agencies have been in progress for several years; the school's capacity for expanded service is large.

Research in progress includes work being done for the Air Material Command of the U. S. Air Force, the Office of Ordnance Research, the Bureau of Ships, the Wright Air Development Center, Redstone Arsenal, and the Texas Company. Work is included in the fields of structural clay products, radiant heating, stress analysis, rotational speed deviation measurements, tannin extraction, recovery from fish waste, erosion of plastics, fuel oils, precipitation hardening and diffusion in alloys and electronics.

Upon their conclusions, results of the engineering investigations are published as bulletins so that the information obtained is available to the public and is contributed to the total field of technical knowledge. A complete list of the bulletins published to date or any other information pertaining to the operation or availability of the facilities of the department will be furnished upon request.

Research Fellowships

To assure wider benefits for both graduate and undergraduate students from the engineering research activities, the department offers several research fellowships and employs some of the more promising and deserving students as assistants in the laboratory on a part-time basis.

Department of Industrial Engineering

Professor CLIFTON A. ANDERSON, *Head of the Department*
Professors:
R. G. CARSON, JR., R. W. LLEWELLYN
Visiting Professor:
R. WILLARD
Assistant Professors:
•R. ALVAREZ, R. L. COPE, C. E. HUNTER
Instructors:
BIMAN DAS, •H. A. KNAPPENBERGER, A. L. PRAK, G. E. TUCKER, W. WOO

Industrial engineering is a relatively new branch of the engineering profession. It has seen its greatest growth beginning with the industrial expansion in the war years. As a college curriculum, industrial engineering is the result of a demand by industry for graduates who are trained in the fundamentals of engineering and who have acquired a knowledge of the principles involved in planning, operating, and controlling the operation of an industrial enterprise.

Curriculum

It is the industrial engineer's job to transform plans, specifications and blueprints into plant, equipment and personnel to create the product. He is concerned also with controls and plans for the profitable and continued operation of an existing plant.

The industrial engineering program at North Carolina State College has been planned with this viewpoint in mind. After the first year, which is common with all other branches of engineering, the curriculum includes subject matter in industrial organization and management, motion and time study, plant layout, quality control, job evaluation, accounting personnel and labor relations and production control together with other specialized courses which help develop a background and technique for understanding our modern industrial system.

The industrial engineering curriculum has been inspected and accredited by the Engineers' Council for Professional Development.

Graduation Requirements

A minimum of six weeks of continuous, gainful employment is required. This employment may be any level from laborer to supervisor. The work performed should be related to industrial activities concerned primarily with production and manufacturing, maintenance, or management control functions. The student assumes responsibility for obtaining his own employment and making arrangements with his employer to provide evidence thereof to the head the Industrial Engineering Department. A letter from the employer stating the extent and dates of employment, a description of work performed, and an evaluation of the student's performance is suitable evidence. In general the student should plan to take such employment between his junior and senior years.

• On leave

tudent Activities

Student organizations within the department include a chapter of the merican Institute of Industrial Engineers. This student function has emonstrated its calibre by ranking high in the Annual Student Award very year in competition with the AIIE chapters at other institutions. Departmental and student activities of a professional and a social character re sponsored by the organization.

An active chapter of Alpha Pi Mu, the industrial engineering honor ociety, gives recognition to the outstanding students in the junior and enior classes. The membership annually undertakes projects of value to ndustrial engineering students and the department.

ndustrial Engineering Curriculum

or the freshman year see page 130.

Sophomore Year

all Semester	*Credits*	*Spring Semester*	*Credits*
HI 205, The Modern Western World		*ENG 205, Reading for Discovery	
or		or	
NG 205, Reading for Discovery	3	HI 205, Modern Western World	3
E 201, Industrial Engineering I	3	IE 202, Industrial Engineering II	3
E 217, Machine Tools	1	MA 202, Analytical Geometry and Calculus III	4
E 218, Metal Forming	1	PY 202, General Physics	5
IA 201, Analytical Geometry and Calculus II	4	PSY 200, Introduction to Psychology	3
Y 201, General Physics	5	MS 202, Military Science II	
IS 201, Military Science II		or	
or		AS 222, Air Science II	1
S 221, Air Science II	1	PE 202, Physical Education	1
E 201, Physical Education	1		20
	19		

**Junior Year

all Semester	*Credits*	*Spring Semester*	*Credits*
C 312, Accounting for Engineers	3	EM 342, Mechanics B (Dynamics)	2
M 341, Mechanics A (Statics)	2	IE 303, Industrial Engineering IV	4
E 303, Industrial Engineering III	4	***MA 405, Introduction to Determinants and Matrices	3
MA 301, Differential Equations I	3	SS 302, Contemporary Civilization	3
S 301, Contemporary Civilization	3	***ST 362, Statistics for Engineers	3
T 361, Statistics for Engineers	3	Elective	3
Elective	3		18
	21		

* See page 131 for information about the Humanities Sequence.

** Proficiency in written expression to be demonstrated at the beginning of the junior year. Students who fail this test are required to take additional work in the English Department as recommended by the Industrial Engineering Department head.

*** At the end of the sophomore year, students in the Industrial Engineering curriculum will be permitted to choose between two sequences of four courses each in their junior and senior years. The sequences are (1) Math 405, ST 362, IE 401, and IE 402; and (2) MIM 201, IE 350, IE 404, IE 515. The first sequence is designed to emphasize mathematical techniques in management decision making. The second series emphasizes work relating to production and manufacturing engineering. More active participation in the technical aspects of planning, tooling, and improving manufacturing operations will be expected from graduates who take the latter sequence. At least one of the above sequences must be completed to fulfill graduation requirements.

Senior Year

Fall Semester	*Credits*
EE 331, Principles of Electrical Engineering	4
EM 343, Strength of Materials A	2
**IE 401, Industrial Engineering Analysis	3
IE 451, Seminar	1
ME 301, Engineering Thermodynamics	3
*SS 491, Contemporary Issues I	
or	
Humanities Elective	3
Elective	3
	19

Spring Semester	*Credits*
EE 332, Principles of Electrical Engineering	4
**IE 402, Industrial Engineering Analysis	3
*SS 492, Contemporary Issues II	
or	
Humanities Elective	3
Technical Elective	3
Elective	3
	16

Professional Study

A fifth, or professional year of study is offered in industrial engineering by means of specialized and advanced course work. A student may elect a speciality area in consultation with his adviser and then develop a program of study which suits his interests. A student may specialize in production engineering, in decision-making processes as related to industrial engineering, or in administrative engineering. Typical programs in each of these areas are presented below. This fifth year of study leads to the professional degree in industrial engineering. Regulations concerning the professional program are shown on pages 132 and 133.

Production Engineering

Fall Semester	*Credits*
IE 515, Process Engineering	3
IE 517, Automatic Processes	3
ST 515, Experimental Statistics for Engineers	4
Elective	3
IE 581, Project Work	2
	15

Spring Semester	*Credits*
IE 404, Introduction to Tool Engineering	3
IE 543, Standard Data	3
IE 546, Advanced Quality Control	3
IE 581, Project Work	3
ST 516, Experimental Statistics for Engineers	3
	15

* See page 131 for information about the Humanities Sequence.

** At the end of the sophomore year, students in the Industrial Engineering curriculum will be permitted to choose between two sequences of four courses each in their junior and senior years. The sequences are (1) Math 405, ST 362, IE 401, and IE 402· and (2) MIM 201, IE 350, IE 404, IE 515. The first sequence is designed to emphasize mathematical techniques in management decision making. The second series emphasizes work relating to production and manufacturing engineering. More active participation in the technical aspects of planning, tooling, and improving manufacturing operations will be expected from graduates who take the latter sequence. At least one of the above sequences must be completed to fulfill graduation requirements.

Industrial Engineering

:all Semester	*Credits*	*Spring Semester*	*Credits*
. E 521, Control Systems and Data Processing	3	IE 546, Advanced Quality Control	3
:E 651, Special Studies in Industrial Engineering	3	IE 621, Inventory Control Methods	3
:T 515, Experimental Statistics for Engineers	4	IE 651, Special Studies in Industrial Engineering	3
Electives	5	ST 516, Experimental Statistics for Engineers	3
		Elective	3
	15		15

Administrative Engineering

:all Semester	*Credits*	*Spring Semester*	*Credits*
:C 504, Principles of Cost Accounting	3	EC 505, Principles of Cost Accounting	3
:C 525, Management Policy and Decision Making	3	IE 531, Quantitative Job Evaluation Methods	3
:C 531, Management of Industrial Relations	3	IE 546, Advanced Quality Control	3
:T 515, Experimental Statistics for Engineers	3	IE 551, Standard Costs for Manufacturing	3
Elective	3	ST 516, Experimental Statistics for Engineers	3
	15		15

Graduate Study

For general regulations, the Graduate School Catalog should be consulted. Graduate work is offered in industrial engineering leading to the degree of Master of Science in industrial engineering.

FURNITURE MANUFACTURING AND MANAGEMENT

Any curriculum in the School of Engineering has as an aim the preparation of men capable of handling the technical problems arising in the jobs which they undertake. Where industry is already equipped with qualified engineers, the new employee with a basic engineering education can be given on-the-job training in analyzing and solving the special problems peculiar to the particular plant or industry.

In the case of the furniture industry, practically no experienced engineers exist. To be of service, the College must emphasize to a greater extent the application of engineering principles to the problems of the furniture industry. This can be done effectively only if the instructional staff is aware of the problems of the industry from direct contact and not merely from the academic discussion and the available literature. Consequently, the program has been worked out in conjunction with representatives of the manufacturers. Their viewpoint is based on a survey made among the entire membership of the Southern Furniture Manufacturers' Association. Results of the survey indicate an overwhelming interest in college training to prepare men for work in this industry.

Curriculum

It is the purpose of the curriculum offering the degree of Bachelor of Science in furniture manufacturing to prepare graduates for technical and, eventually, executive positions in the furniture industry. The curriculum emphasizes the application of engineering to furniture manufacturing. Related subjects covering management, labor relations, accounting, marketing and sales stress the technical as well as the human side of modern production methods and techniques.

Graduation Requirements

A minimum of six weeks of continuous, gainful employment is required. This employment may be at any level from laborer to supervisor. The work performed should be related to industrial activities concerned primarily with production and manufacturing, maintenance, or management control functions in a furniture manufacturing plant. The student assumes responsibility for obtaining his own employment and making arrangements with his employer to provide evidence thereof to the head of the Industrial Engineering Department or the professor in charge of the Furniture Manufacturing and Management curriculum. A letter from the employer stating the extent and dates of employment, a description of work performed, and an evaluation of the student's performance is suitable evidence. In general the student should plan to take such employment between his junior and senior years.

Student Activities

The Industrial Engineering Department sponsors the Furniture Club, which is operated by the students. All students in the curriculum are eligible for membership in the organization. The club brings in speakers from industry and holds social gatherings for the students.

Furniture Manufacturing and Management Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credit*
ENG 231, Basic Speaking Skills	3	ENG 205, Reading for Discovery	3
HI 205, The Modern Western World	3	IA 203, Technical Sketching	2
PH 201, Logic	3	FOR 201, Wood Properties	3
PSY 200, Introduction to Psychology	3	IE 224, Wood Working Equipment	3
PY 211, General Physics	4	PY 212, General Physics	4
MS 201, Military Science II		MS 202, Military Science II	
or		or	
AS 211, Air Science II	1	AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	18		17

Summer Practicum

)R 205-s, 206-s, 207-s, 208-s, 209-s

***Junior Year**

ll Semester	*Credits*	*Spring Semester*	*Credits*
⁴R 301, Wood Processes I	4	EC 312, Accounting for Engineers	3
322, Furniture Design and Construction	2	IE 301, Engineering Economy	3
332, Motion and Time Study	4	IE 326, Furniture Manufacturing and Processing	4
301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
Electives	3	TX 271, Upholstery Fabrics	2
		Electives	3
	16		18

Senior Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
341, Furniture Plant Layout and Design	3	EC 432, Industrial Relations	3
420, Manufacturing Controls	3	IE 443, Quality Control	3
451, Seminar	1	IE 452, Seminar	1
SS 491, Contemporary Issues I	3	Technical Elective	3
361, Introduction to Statistics for Engineers	3	Humanities Elective	3
Elective	3	Elective	3
	16		16

Department of Mechanical Engineering

rofessor R. W. TRUITT, *Head of the Department*

rofessors:

N. W. CONNER, J. S. DOOLITTLE, K. P. HANSON, H. A. HASSAN, R. B. KNIGHT, R. M. PINKERTON, J. WOODBURN

ssociate Professors:

W. E. ADAMS, M. R. EL SADEN, B. H. GARCIA, R. S. LEE, F. O. SMETANA, J. K. WHITFIELD***, J. C. WILLIAMS III, J. T. YEN, C. F. ZOROWSKI

ssistant Professor:

T. B. LEDBETTER

ıstructors:

R. F. BARRETT, D. G. BASSETT, N. M. BEATTY, T. CEBECI, K. R. CRUMP, A. H. ERASLAN, J. MANZO, P. S. NYE, L. J. PAVAGADHI, C. S. RUDISILL, E. H. STINSON, C. O. TAYLOR, B. D. WEBB

:ngineers are motivated by a desire to satisfy human needs through the 'pplication of scientific principles in such a manner as to place the fruits f their work within the economic reach of vast segments of humanity. To dentify and evaluate human needs, modern engineers must have a sound ducation in the basic sciences, mathematics, and the humanities. The gap)etween the discoveries of basic science and their application in the satisaction of human needs is provided by an area of science known as the

* Proficiency in written expression to be demonstrated at the beginning of the junior year. Students who fail this test are required to take additional work in the English Department as recommended by the Industrial Engineering Department head.

** See page 131 for information about the Humanities Sequence.

*** On leave

engineering sciences. It is with education in the engineering sciences and the development of talent in applying the principles of the engineering sciences that departments of engineering are principally concerned.

Mechanical engineering covers a broad spectrum of engineering responsibility in such areas as nuclear and conventional power generation, missiles, rockets, jet engines, propulsion systems for land, sea, and air vehicles, refrigeration, air conditioning, combustion of fuels, instrumentation of industrial processes, solar energy, and the design of a wide variety of technical systems. Aerospace engineering shares responsibility with mechanical engineering for many of the areas described above but is principally concerned with the structural design and analysis of air and space vehicles and with the phenomena of air and space flight.

Because of the close relationship between mechanical and aerospace engineering, both curricula are administered by the Department of Mechanical Engineering at North Carolina State College. There is close cooperation between the faculties of the two disciplines in which responsibility for such engineering sciences as thermodynamics, heat transfer, mass transfer, gas dynamics, aeroelasticity, vibrations, lubrication, fluid mechanics, magnetohydrodynamics, aerodynamics, and instrumentation theory are shared.

In cooperation with other departments in the School of Engineering the Department of Mechanical Engineering is prepared to offer work leading to a degree in nuclear engineering. Particular emphasis in the work of this department is placed on nuclear power, reactor heat transfer and the dynamics of reactor fluids.

Curriculum

The curriculum in mechanical engineering is based on a firm foundation in mathematics, physics, chemistry, humanities and social sciences. The student's knowledge in the basic engineering sciences germane to mechanical engineering is carefully developed in the courses offered in this department and other departments of the School of Engineering. Finally, the curriculum provides an active experience in which the student's creative talents and imagination are challenged in several areas of application. This experience is gained through a choice of courses in the senior year and required courses in experimental mechanical engineering.

The curriculum in aerospace engineering is administered as an option in mechanical engineering. Generally speaking, the curricula in mechanical and aerospace engineering differ slightly in the first three years. The point of departure occurs in the fourth year where the emphasis in the aerospace engineering curriculum is placed on air and space structures and the aerodynamics of air and space vehicles.

The four-year undergraduate curricula in both mechanical and aerospace engineering prepares graduates who are equipped to profit from their experiences in the practice of engineering and to become early contributors in the solution of engineering problems of scientific and economic complexity. Both curricula offer a firm basis for further advance study in graduate schools.

Mechanical Engineering Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 205, Reading for Discovery or		EM 200, Introduction to Mechanics	3
EC 205, The Economic Process	3	*EC 205, The Economic Process or	
IE 217, Machine Tools	1	ENG 205, Reading for Discovery	3
MA 201, Analytical Geometry and Calculus II	4	IE 218, Metal Forming	1
PY 201, General Physics I	5	MA 202, Analytical Geometry and Calculus III	4
MS 201, Military Science II or		PY 202, General Physics II	5
AS 221, Air Science II or	1	MS 202, Military Science II or	
PE 201, Physical Education	1	AS 222, Air Science II	1
Elective	3	PE 202, Physical Education	1
	18		18

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EM 301, Solid Mechanics I	3	EM 303, Fluid Mechanics I	3
MA 301, Differential Equations I	3	ME 302, Engineering Thermodynamics II	3
ME 301, Engineering Thermodynamics I	3	ME 306, Mechanical Engineering Laboratory II	1
ME 305, Mechanical Engineering Laboratory I	1	ME 312, Dynamic Analysis	3
ME 311, Kinematics	3	SS 302, Contemporary Civilization	3
SS 301, Contemporary Civilization	3	Elective	5
Elective	3		
	19		18

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EE 331, Principles of Electrical Engineering	4	EE 332, Principles of Electrical Engineering	4
ME 401, Power Plants	3	ME 406, Mechanical Engineering Laboratory IV	1
ME 405, Mechanical Engineering Laboratory III	1	ME 412, Machine Design II	3
ME 411, Machine Design I	3	ME 502, Heat Transfer	3
ME 441, Technical Seminar	1	MIM 422, Metallurgy II	2
MIM 421, Metallurgy I	2	MIM 423, Metallurgy Laboratory	1
*SS 491, Contemporary Issues I or		*SS 492, Contemporary Issues II or	
Elective in Humanities	3	Elective in Humanities	3
Elective	3	Elective	3
	20		20

* See page 131 for information about the Humanities Sequence.

Aerospace Engineering Option Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	*Credits*
*ENG 205, Reading for Discovery	
or	
EC 205, The Economic Process	3
IE 217, Machine Tools	1
MA 201, Analytical Geometry and Calculus II	4
PY 201, General Physics I	5
MS 201, Military Science II	
or	
AS 221, Air Science II	1
PE 201, Physical Education	1
Elective	3
	18

Spring Semester	*Credits*
EM 200, Introduction to Mechanics	3
*EC 205, The Economic Process	
or	
ENG 205, Reading for Discovery	3
IE 218, Metal Forming	1
MA 202, Analytical Geometry and Calculus III	4
PY 202, General Physics II	5
MS 202, Military Science II	
or	
AS 222, Air Science II	1
PE 202, Physical Education	1
	18

Junior Year

Fall Semester	*Credits*
EM 301, Solid Mechanics	3
MA 301, Differential Equations	3
ME 301, Engineering Thermodynamics I	3
ME 305, Mechanical Engineering Laboratory I	1
ME 311, Kinematics	3
SS 301, Contemporary Civilization	3
Elective	3
	19

Spring Semester	*Credits*
ME 361, Aerospace Technology	3
ME 302, Engineering Thermodynamics II	3
ME 306, Mechanical Engineering Laboratory II	1
ME 352, Aerodynamics	3
SS 302, Contemporary Civilization	3
Elective	6
	19

Senior Year

Fall Semester	*Credits*
EE 320, Elements of Electrical Engineering	4
ME 441, Technical Seminar	1
ME 465, Aerospace Engineering Laboratory	1
ME 469, Spacecraft Structures	3
ME 471, Aircraft and Missile Design	3
MIM 421, Metallurgy I	2
*SS 491, Contemporary Issues I	
or	
Elective in Humanities	3
Elective	3
	20

Spring Semester	*Credits*
ME 421, Aerospace Propulsion Systems	3
ME 446, Performance of Hypervelocity Vehicles	3
ME 466, Aerospace Engineering Laboratory	1
ME 472, Spacecraft Design	3
MIM 422, Metallurgy II	2
MIM 423, Metallurgy Laboratory	1
*SS 492, Contemporary Issues II	
or	
Elective in Humanities	3
Elective	3
	19

* See page 131 for information about the Humanities Sequence.

Professional Study

A fifth, or professional year of study is offered in mechanical engineering for graduates who desire to return to the university for a program of concentrated study in a selected area. This program is intended primarily for practitioners and is, in no sense, a graduate program leading to the usual advanced degrees. The degree of mechanical engineer is conferred upon graduates of the fifth-year program. Typical programs are listed below.

Heat-Power

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ME 501, Steam and Gas Turbines	3	ME 521, Aerothermodynamics	3
ME 545, Project Work in Mechanical Engineering I	2	ME 546, Project Work in Mechanical Engineering II	2
ME 601, Advanced Engineering Thermodynamics I	3	ME 604, Nuclear Power Plants	3
ME 603, Advanced Power Plants	3	ME 642, Mechanical Engineering Seminar II	1
ME 641, Mechanical Engineering Seminar I	1	Approved Electives	6
Approved Elective	3		15
	15		

Design

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 411, Introduction to Applied Mathematics	3	EM 554, Vibration Problems	3
ME 515, Experimental Stress Analysis	3	ME 517, Lubrication	3
MIM 521, Advanced Physical Metallurgy I	3	MIM 522, Advanced Physical Metallurgy II	3
ME 545, Project Work in Mechanical Engineering I	2	ME 546, Project Work in Mechanical Engineering II	2
ME 611, Advanced Machine Design I	3	ME 612, Advanced Machine Design III	3
ME 641, Mechanical Engineering Seminar I	1	ME 642, Mechanical Engineering Seminar II	1
	15		15

Aerospace

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ME 453, Applied Aerodynamics	3	ME 502, Heat Transfer	3
ME 502, Heat Transfer	3	ME 554, Advanced Aerodynamic Theory	3
ME 552, Aircraft Applied Loads	3	ME 546, Project Work in Mechanical Engineering II	2
ME 545, Project Work in Mechanical Engineering I	2	ME 562, Advanced Aircraft Structures	3
ME 641, Mechanical Engineering Seminar I	1	ME 642, Mechanical Engineering Seminar II	1
Approved Elective	3	Approved Elective	3
	15		15

Graduate Study

The purpose of graduate study in mechanical engineering is to prepare students for a career in research, development, and teaching. Hence, in addition to advanced study, research is an essential part of the graduate program. At present the Department of Mechanical Engineering offers the Master of Science degree in mechanical and aerospace engineering and the Doctor of Philosophy degree in mechanical engineering. Since all graduate programs are administered by the Graduate School, prospective applicants should consult the Graduate School Catalog.

Department of Mineral Industries

Professor W. W. AUSTIN, *Head of the Department*
Professors:
W. C. BELL, W. W. KRIEGEL, J. M. PARKER, III, H. H. STADELMAIER, R. F. STOOPS
Associate Professors:
H. C. BROWN, W. C. HACKLER, C. J. LEITH, HAYNE PALMOUR, III
Visiting Research Associate:
J. D. SCHOBEL
Instructors:
G. O. HARRELL, L. E. POTEAT, J. M. WALLER

The primary objectives of the Department of Mineral Industries are the training and professional development of qualified technical and administrative leaders for those industries concerned with the location and utilization of mineral resources. Included within this scope of operation are the fields of geological, ceramic, and metallurgical engineering.

Curricula

Complete four-year undergraduate curricula in geological, ceramic, and metallurgical engineering are available in the department. Fifth year professional programs also are available for advanced work and specialization in each of these fields, and graduate programs leading to the master's and doctor's degree in ceramic engineering, and to the master's degree in geological engineering and metallurgical engineering are offered.

Facilities

The facilities of the Department of Mineral Industries are housed in Page Hall and the Ceramic Building. Located in Page Hall are departmental offices, drawing rooms, classrooms and extensive laboratory facilities for instructional work and research in the three areas of study covered by the department. Typical of the numerous well equipped laboratories in the building are those established for instruction in the following areas of study—ceramic operations and processes, dielectric measurements, ceramic microscopy, physical geology, mineralogy, mineral dressing, petrology, physical metallurgy, and metallography. Other laboratory facilities, particularly kilns and furnaces, are housed in the Ceramic Building next door. Important additional facilities for instruction and research are located in the Engineering Research Department's Ceramic and Metallurgi-

cal Research Laboratories. Here equipment and instrumentation are available for advanced work in high temperature technology, X-Ray diffraction, differential thermal analysis, thermogravimetric analysis, radiography, electron microscopy, and photomicrography.

Student Activities

The student branches of the American Ceramic Society, American Society for Metals, and the American Institute of Mining, Metallurgical and Petroleum Engineers through their monthly meetings provide an effective medium for the professional growth of the student engineers. Programs include presentation of student papers, guest speakers and social contact between student and staff. Participation acquaints the student with parliamentary and organizational procedures which are of great importance to professional, industrial and civic life. Students are encouraged to attend local section and national meetings of their respective societies. Keramos, the oldest professional engineering fraternity and Alpha Sigma Mu, honorary metallurgical fraternity, have active chapters in the department. These fraternities are dedicated to the promotion of scholarship, mental achievement and general service to ceramic and metallurgical engineering students.

CERAMIC ENGINEERING

The undergraduate curriculum in ceramic engineering is the result of years of study and development and is designed to meet the challenges of modern civilization. The program of study encompasses a thorough grounding in the basic physical sciences and the fundamental disciplines of engineering. Processes and operations peculiar to ceramic engineering are developed from the viewpoint of interpreting and applying the underlying scientific laws, rather than empirical methods of procedure. The phenomena studied include crushing, grinding, classification and pack states of particle aggregations, rheological properties and plastic and non-plastic masses, suspensions and slurries, drying of solids, combustion, heat transfer, and high temperature chemical reactions. Production at lowest possible cost and design and improvement of processes and operations are emphasized throughout the program. Attitudes of research, experimentation and originality of thought are fostered.

Because the department is dedicated to training young men for leadership, and because of the recognition that responsible leadership should be vested in thinking, well-oriented men, the curriculum includes a planned program of social and humanistic studies. This program is designed to prepare the student for an understanding and appreciation of his responsibilities to society, his profession, and himself, to the end that he will lead a fuller, more productive and satisfying life.

Opportunities

Professional training in ceramic engineering provides opportunities for employment in an industry producing a wide variety of essential products

including glass in all its forms, enamels and protective coatings for metals, structural clay products such as brick and tile, refractories for furnace linings, thermal insulators, electrical insulators, dielectric components, Portland cement, gypsum products, abrasives, dinnerware, art pottery, bath fixtures, and hundreds of other items. In addition to these "end products" ceramics are finding ever increasing applications in the electronic, aerospace, automotive and atomic energy fields. A continuing shortage of qualified personnel in ceramic engineering has resulted in far more employment offers than there are graduates. Initial employment upon graduation may be in the fields of research and development, in plant operation and control, and in technical sales and service. Such employment may lead to positions as directors of research, consulting and design engineers, sales directors, plant superintendents, production managers, and finally administrative officers.

GEOLOGICAL ENGINEERING

Geological engineering is a technical field in which geological facts are combined with engineering techniques for the solution of problems concerned mainly with mineral raw material supply and with engineering projects. Many major engineering undertakings, such as construction of large dams and reservoirs, tunnels, and large buildings, depend for success in part on an exact knowledge of their geological setting. On the other hand, such geological problems as the economical development of mineral resources require the use of the precise methods of engineering. In the field of geological engineering, then, geology contributes data concerning the constitution, structure and history of the earth; engineering supplies quantitative, analytical methods whereby physical and chemical laws may be controlled for mankind's benefit. The geological engineering curriculum combines those fundamental disciplines regarded as basic to all engineering with training in the aspects of geology that are of most practical application to human affairs.

Opportunities

A graduate in this curriculum may follow one of two broad fields of engineering, either in the United States or in foreign countries: one, the application of geology to engineering work: the other, the application of geology in the mineral industries. Geological engineers are currently employed by oil companies and quarrying concerns; exploration companies; construction firms; railroads, public utilities, banks and insurance companies; iron, steel and other metal producers; manufacturers using nonmetallic mineral raw materials, as for ceramics, cement, and abrasives; municipal, state and federal government agencies; schools, colleges, museums and research institutes. The Southeastern United States offers excellent opportunities for geological engineers. There is a growing need for the application of geological science to engineering construction in connection with highways, foundations, excavations, and in water supply problems. The mineral industry of the Southeast has expanded substanti-

ally in the last decade; known deposits in the region, as yet only partially developed, include iron, nickel, copper, chromite, molybdenite, feldspar, mica, kaolin, kyanite, sillimanite, pyropyhllite, talc, barite, spodumene, sulphur (pyrite), coal, phosphate, granite, limestone, and marl.

METALLURGICAL ENGINEERING

The undergraduate curriculum in metallurgical engineering is a standard four-year program designed to produce technically trained leaders for those industries and agencies associated with the development, production, and fabrication of metals and alloys. The major emphasis is on the application of the principles of physical and mechanical metallurgy to engineering problems encountered in these industries. Major sequence courses for the development of this emphasis are offered during the third and fourth years of the curriculum and are preceded by a well rounded program of basic and engineering sciences, and humanities. Because of this arrangement it is possible for a student to complete the first two years of his training at a suitably qualified liberal arts college and to transfer to North Carolina State College for the final two years. While such an arrangement is encouraged it is nevertheless advisable for the prospective transfer student to seek the guidance and counsel of the Engineering School administration at the beginning of his college career in order to minimize difficulties associated with the transfer of credits. The metallurgical engineering curriculum is unique in the School of Engineering in that it provides a minor sequence of 12 credits in a related field of engineering or science to be elected by the student with his adviser.

Opportunities

Opportunities open to graduates in metallurgical engineering are virtually unlimited. Each year the demand for men with metallurgical training becomes more urgent, and the number of positions presently available is several times greater than the number of graduates. A graduate metallurgical engineer may thus choose from a wide selection of companies, locations and types of work. Among the more important job opportunities open to metallurgical engineers are those in research and development of new alloys so desperately needed as materials of construction in the rapidly expanding fields of chemical, mechanical, aero-space and nuclear technology. With the rapid industrialization of the South and particularly the State of North Carolina, new opportunities are constantly developing for metallurgical engineers who will play a vital role in maintaining the forward progress of the State and region.

Ceramic Engineering Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
**HI 205, Modern Western World or ENG 205, Reading for Discovery	3	**HI 205, Modern Western World or ENG 205, Reading for Discovery	3
MA 201, Analytical Geometry and Calculus II	4	MA 202, Analytical Geometry and Calculus II	4
PY 201, General Physics	5	PY 202, General Physics	5
*MIN 201, Structure and Properties of Engineering Materials	3	CH 215, Quantitative Analysis	4
MS 201, Military Science II or AS 211, Air Science II	1	MS 202, Military Science II or AS 212, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
	17		18

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 341, Physical Chemistry	3	CH 342, Physical Chemistry	3
EM 341, Mechanics A (Statics)	2	EM 342, Mechanics B (Dynamics)	2
MIC 301, Ceramic Operations I	4	EM 343, Strength of Materials A	2
MIG 120, Physical Geology	3	MIC 302, Ceramic Operations II	3
MIG 330, Mineralogy	3	MIC 312, Ceramic Process Principles I	4
SS 301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
Elective	3	Elective	3
	21		20

Summer Requirement

Six weeks' industrial employment

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MIC 413, Ceramic Process Principles II	4	EE 320, Elements of Electrical Engineering	4
MIC 415, Ceramic Engineering Design	2	MIC 414, Senior Thesis	3
MIC 420, Industrial Ceramics	3	MIC 416, Ceramic Engineering Design	2
MIC 425, Seminar	1	MIC 505, Research and Control Methods	3
MIG 531, Optical Mineralogy	3	**SS 492, Contemporary Issues II or Humanities Elective	3
**SS 491, Contemporary Issues or Humanities Elective	3	Elective	3
Elective	3		
	19		18

* Transfer students who have satisfactorily completed the equivalent of all first and second year courses except MIM 201, and who can present acceptable electives in lieu of this course will be admitted as third year students in ceramic engineering. They will be permitted to take this course in addition to the regular third year program, substituting it for three credits of elective permitted in the third year.

** See page 131 for information about the Humanities Sequence.

Professional Year

A fifth, or professional year of study is offered in ceramic engineering as a continuation of the four-year undergraduate program. This professional year of study offers specialized advanced course work leading to the degree of Ceramic Engineer, and is especially designed for those planning careers in industrial production activities and technical service and sales. Each program of study is designed to suit the needs of the individual student. The curriculum shown below is typical of these programs.
Regulations covering professional study are shown on pages 132 and 133.

Typical Professional Program in Ceramic Engineering

Fall Semester	*Credits*	*Spring Semester*	*Credits*
IE 408, Production Control	3	IE 332, Motion and Time Study	4
MIC 507, Advanced Ceramic Experiments	3	MIC 508, Advanced Ceramic Experiments	3
MIC 511, Advanced Studies in Firing	3	MIC 527, Refractories in Service	3
Electives	6	Electives	5
	15		15

Geological Engineering Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 201, Analytical Geometry and Calculus II	4	MA 202, Analytical Geometry and Calculus III	4
PY 201, General Physics	5	PY 202, General Physics	5
MIG 220, Physical Historical Geology	4	EM 200, Mechanics I	3
EC 205, Economic Process	3	ENG 205, Reading for Discovery	3
PE 201, Physical Education	1	PE 202, Physical Education	1
MS 201, Military Science II or AS 221, Air Science II	1	MS 202, Military Science II or PE 212, Physical Education	1
	18		17

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 431, Physical Chemistry I	3	CH 433, Physical Chemistry II	3
EM 301, Solid Mechanics I	3	EE 320, Elements of Electrical Engineering	4
SS 301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
MIG 331, Crystallography & Optical Microscopy	4	MIG 440, Endogenic Materials and Processes	4
CE 201, Surveying I	3	Elective	3
	16		17

Summer Session

MIG 456, Geological Field Procedures

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 382, Hydraulics	3	Humanities Elective	3
SS 491, Contemporary Issues	3	*MIG 415, Mineral Exploration and Evaluation	3
MIG 351, Tectonic Structures	3	*MIG 552, Exploratory Geophysics	3
MIG 452, Exogenic Materials and Processes	4	Electives	6
Elective	3		15
	16		

Professional Study

A fifth or professional year of study is offered in geological engineering as a continuation of the fourth-year undergraduate program. This fifth year of study offers specialized and advanced work leading to the degree of Geological Engineer. Regulations covering professional study are shown on pages 132 and 133.

Typical Professional Program in Geological Engineering

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MIG 461, Engineering Geology	3	MIG 522, Petroleum Geology	3
MIG 571, Mining and Mineral Dressing	3	MIG 552, Exploratory Geophysics	3
MIG 581, Geomorphology	3	MIG 572, Mining and Mineral Dressing	3
MIG 611, Advanced Economic Geology	3	MIG 612, Advanced Economic Geology	3
Elective	3	Elective	3
	15		15

Metallurgical Engineering Curriculum

For the freshman year see page 130.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
**HI 205, Modern Western World or ENG 205, Reading for Discovery	3	**HI 205, Modern Western World or ENG 205, Reading for Discovery	3
MA 202, Analytical Geometry and Calculus II	4	MA 202, Analytical Geometry and Calculus III	4
PY 201, General Physics	5	PY 202, General Physics	5
***MIM 201, Structure and Properties of Engineering Materials I	3	MS 202, Military Science II or AS 222, Air Science II	1
MS 201, Military Science II or AS 221, Air Science II	1	PE 202, Physical Education	1
PE 201, Physical Education	1	Elective	3
	17		17

* Specialization in engineering geology or in geology of mineral deposits may be achieved by an approved substitution of the following courses: CE 547 Fundamentals of Soil Mechanics; MIG 461 Engineering Geology; MIG 472 Elements of Mining Engineering.

** See page 131 for information about Humanities Sequence.

*** Transfer students who have satisfactorily completed the equivalent of all first and second year courses except MIM 201, and who can present acceptable electives in lieu of this course will be admitted as third year students in metallurgical engineering. They will be permitted to take this course in addition to the regular third year program, substituting it for three credits of electives permitted in the third year.

Junior Year

all Semester	*Credits*	*Spring Semester*	*Credits*
H 431, Physical Chemistry	3	CH 432, Physical Chemistry	3
M 341, Mechanics A (Statics)	2	EM 342, Mechanics B (Dynamics)	2
: 217, Machine Tools	1	EM 343, Strength of Materials	2
: 218, Metal Forming	1	MIM 332, Physical Metallurgy II	3
'IM 331, Physical Metallurgy I	3	SS 302, Contemporary Civilization	3
; 301, Contemporary Civilization	3	Minor Sequence Courses	3
Minor Sequence Courses	3	Elective	3
Elective	3		19
	19		

Summer Requirement

Six weeks' industrial employment

Senior Year

all Semester	*Credits*	*Spring Semester*	*Credits*
.M 430, Fluid Mechanics	2	EE 320, Electrical Engineering	4
fIM 401, Metallurgical Operations	4	MIM 402, Metallurgical Operations	4
fIM 431, Metallography	3	MIM 432, Metallography	3
fIM 451, Seminar	1	MIM 452, Seminar	1
SS 491, Contemporary Issues I		*SS 492, Contemporary Issues II	
or		or	
Humanities Elective	3	Humanities Elective	3
Minor Sequence Course	3	Minor Sequence Course	3
Elective	3		18
	19		

Professional Study

A fifth, or professional year of study is offered in metallurgical engineering as a continuation of the four-year undergraduate program. This professional year of study offers specialized advanced course work leading to the degree of Metallurgical Engineer, and is especially designed for those planning careers in industrial production activities and technical service and sales. Each program of study is designed to suit the needs of the individual student. The curriculum shown below is typical of these programs.

Regulations covering professional study are shown on pages 132 and 133.

* See page 131 for information about Humanities Sequence.

Typical Professional Program in Metallurgical Engineering

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MIM 521, Advanced Physical Metallurgy	3	MIM 522, Advanced Physical Metallurgy	3
MIM 523, Metallurgical Factors in Design	3	MIM 524, Metallurgical Factors in Design	3
MIM 445, Experimental Engineering	3	MIM 446, Experimental Engineering	3
PY 407, Modern Physics	3	CHE 502, Electrochemical Engineering	3
ME 502, Heat Transfer	3	ME 515, Experimental Stress Analysis	3
	15		15

Department of Nuclear Engineering

Professor H. A. LAMONDS, *Head of the Department*

The field of nuclear engineering is concerned with the engineering aspects of the control, release and utilization of nuclear energy. Many of the benefits which mankind stands to receive from the peaceful applications of nuclear power are already clear. These include improved medical diagnosis through the use of radioisotopes, superior plant development by radiation induced mutations, rapid and precise measurement techniques using radiation and perhaps best known, production of electrical power from nuclear energy. It is the aim of the department to educate individuals in the scientific and engineering principles essential to the nuclear engineering field and to prepare them to contribute to the efficient and productive use of nuclear energy through their work in the field.

Curriculum

Nuclear engineers are called upon to participate in a wide variety of highly sophisticated work, generally of an interdisciplinary nature. The curriculum is designed to provide training in the fundamentals of nuclear engineering with particular emphasis on the reactor field. The fact that an unusually high percentage of nuclear engineers continue or return to graduate study suggests that the program be aimed at a fifth year of study leading to the Master of Science degree. Minor adjustments are incorporated, however, to facilitate the student's terminating his work at four years with a Bachelor of Science degree. When one considers that nuclear engineers may be involved with every phase of the reactor field including research, development, functional design, production design, manufacturing, installation and marketing, it becomes clear that a single engineer cannot be trained to be proficient in all of these areas. On the other hand many fundamentals are common to most phases of the reactor field and certain general areas may be identified as basic.

Fundamental course work is provided in four such areas: reactor theory, reactor energy transfer, electronics, and materials. In addition to the broad basic study, the students will be required to select an area of specialization providing further study in the following areas: energy transfer

:uclear instrumentation and nuclear materials. Once a student has chosen ·is specialized area, he will be expected to complete a series of technical :ective courses covering twelve credit hours. The three sequences offered re as follows:

Energy Transfer

:eat transfer, fluid mechanics and thermodynamics as applied to removing energy from a :uclear reactor.

	Credits
:E 503, Elements of Nuclear Power Generation I	3
:E 504, Elements of Nuclear Power Generation II	3
HE 551, Thermal Problems in Nuclear Engineering	3
Free technical elective	3

Nuclear Instrumentation

udy of the special problems and techniques used in controlling and instrumenting reactors.

	Credits
E 430, Essentials of Electrical Engineering	4
E 511, Electrical Engineering	
or	
E 515, Elements of Control	3
E 518, Instrumentation and Control in Nuclear Technology	3
Free technical elective	2

Nuclear Materials

election and control of properties of materials used in the radiation environment.

	Credits
IM 331, Physical Metallurgy I	3
IM 332, Physical Metallurgy II	3
IM 431, Metallography I	3
IM 562, Materials Problems in Nuclear Engineering	3

At the end of the sophomore year, all students are required to select heir area of emphasis. The technical elective sequence specified for each rea of emphasis assures that the stated objectives will be met once the hoice is made. In addition to the technical sequence, students receive a horough foundation in basic science and mathematics, followed by courses n reactor theory and engineering.

acilities

Facilities available on campus for nuclear training at the undergradu- te level as well as the graduate level include:

A 10 KW heterogeneous reactor
A 100 watt homogeneous reactor
Analog and digital computers
A sub-critical assembly
Single and multi-channel pulse height analyzers
Neutron Diffraction equipment
A slow chopper
Radiation counting laboratories

Opportunities

Although the nuclear industry is relatively young, it already represents a major national effort. Reactor development and construction has proceeded at a remarkable pace and will continue to grow as we become more and more dependent on nuclear energy as a substitute for energy from fossil fuels. Industrial applications of radiation will accelerate as the economic potential of such methods becomes more firmly established. There is at present a substantial need for nuclear engineers and prospects for the future are promising.

Nuclear Engineering Curriculum

For the freshman year see page 150.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 201, General Physics	5	PY 202, General Physics	5
MA 201, Analytical Geometry and Calculus II	4	MA 202, Analytical Geometry and Calculus III	4
MS 201, Military Science II or		MS 202, Military Science II or	
AS 221, Air Science II	1	AS 222, Air Science II	1
PE 201, Physical Education	1	PE 202, Physical Education	1
ENG 205, Reading for Discovery	3	HI 205, The Modern Western World	3
MIM 201, Structures and Properties of Engineering Materials	3	EM 200, Introduction to Mechanics	3
SS 301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
	20		20

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 407, Introduction to Modern Physics	3	PY 410, Nuclear Physics I	4
EM 301, Mechanics I	3	EE 332, Principles of EE	4
MA 301, Differential Equations	3	CHE 422, Reactor Energy Transfer II	3
EE 331, Principles of Electrical Engineering	4	Technical Elective	3
CHE 421, Reactory Energy Transfer I	3	Elective	3
Elective	3		17
	19		

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
SS 491, Contemporary Issues	3	**Humanities Elective	3
NE 501, Nuclear Engineering Systems I	3	NE 502, Nuclear Engineering Systems II	3
*MA 511, Advanced Calculus I	3	NE 503, Nuclear Reactor Theory I	3
Technical Electives	6	NE 531, Elementary Nuclear Reactor Laboratory	1
Elective	3	Technical Elective	3
	18	Elective	3
			16

* Students with less than "B" average in mathematics should register for MA 401.
** See page 131 for information about the Humanities Sequence.

CURRICULUM IN ENGINEERING OPERATIONS

rofessor R. G. Carson, Jr., *Coordinator*

The Bachelor of Science program in Engineering Operations is for students with talents and motivations in the directions of the engineering functions f production, plant operations, technical sales and the other jobs needed o support the modern day economy in an industrial society. The program has essentially the same freshman year as the other engineering curricula, ollowed by a concentration of mathematics and physical science, the humanities-social studies stem included in all other engineering programs, a grounding in the basic engineering sciences and a specialization sequence. The specialization sequence will consist of eighteen semester hours in the unior and senior years. The plan is to develop several specialization sequences oriented toward specific industries or careers. Thus, the student need not make a final choice of his specialization sequence until his junior ear. Two sequences—industrial metallurgy and production control—are ow available. Additional sequences are expected to be developed in other reas by the 1964-65 school year. Since this program is directed more toward industry than some of the other engineering programs, it includes nore courses on economics, materials, processes and manufacturing controls. The freshman and sophomore years are offered now with the junior ear to be added in 1964-65 and the senior year in 1965-66. The student is o choose one of the technical elective sequences listed on page 76. The hoice should be made by the junior year.

Engineering Operations Curriculum

or the freshman year see page 130.

Sophomore Year

all Semester	*Credits*	*Spring Semester*	*Credits*
C 205, Economic Process	3	ENG 205, Reading for Discovery	3
Y 212, or 208, General Physics	4 (5)	EC 310, Economics of the Firm	3
MM 201, Introduction to Engineering Materials	3	ME 207, Graphical Communications	2
M 211, Introduction to Applied Mechanics	3	EM 212, Mechanics of Engineering Materials	3
MS 201, Military Science or		MS 202, Military Science or	
S 221, Air Science	1	AS 221, Air Science	1
E 201, Physical Education	1	PE 202, Physical Education	1
	15		13

roficiency in written expression is to be demonstrated at the beginning of the junior year. students who fail this test are to be required to take additional work in the English Department and to repeat the tests.

Junior Year Required Courses (Tentative)

all Semester	*Credits*	*Spring Semester*	*Credits*
ME 307, Energy & Energy Transform.	3	IE 328, Manufacturing Processes	3
EE 350, Electrical Applications	3	SS 302, Science & Civilization	3
SS 301, Science & Civilization	3	EC 426, Personnel Management or	
ST 361, Introduction to Statistics for Engineers I	3	EC 441, Labor Problems	3
EC 312, Accounting for Engineers	3		9
	15		

Senior Year Required Courses (Tentative)

Fall Semester	*Credits*	*Spring Semester*	*Credits*
IE 301, Engineering Economy	3	IE 420, Manufacturing Controls	3
SS 191 or 492, Contemporary Issues	3	Humanities Elective	3
EC 425, Industrial Management	3		6
	9		

Electives: (Part of junior and senior years)

Free Electives 9 credits (one of the sequences listed below)
Technical Electives 18 credits
Total credits required: 130

Industrial Metallurgy (Junior Year)

		Fall	*Spring*
Physical Metallurgy	MIM 331, 332	3	3
Metallurgy Laboratory	MIM 423	0	1
		3	4

Industrial Metallurgy (Senior Year)

Metallurgical Operations	MIM 401, 402	4	4
Technical Elective		3	0
		7	4

Production Control (Junior Year)

Motion and Time Study	IE 332	0	4
Industrial Safety	IE 310	0	2

Production Control (Senior Year)

Quality Control	IE 443	3	0
Industrial Relations	EC 432	3	0
Plant Layout and Materials Handling	IE 343	0	3
Technical Electives		0	3
		6	6


BROUGHTON

chool
if
orestry

HARD J. PRESTON, Dean

hile forestry has been recognized and practiced for centuries in Europe, s profession is relatively new in the United States, dating from about : beginning of the 20th Century. During the period of rapid expansion d development of the United States, the forests were badly neglected d abused. Now, however, with the timber supplies depleted and the ue of timber products increasing, sound forest practices have been ac- ɔted as economically desirable and feasible. Increasing the productivity d quality of our forests is basic to the welfare of the Southeast. The im rtance of the forest resource in the economy of North Carolina is ɔught out by the fact that 62 per cent of the land area is in forest, with od products industries ranking next to textiles as a source of industrial ployment.

Through a program which offers a broad training in the physical and ɔlogical sciences, as well as a sound cultural background, the School of restry prepares students for service in the professional fields of forest nagement, pulp and paper technology, and wood technology.

rricula

The school, through its departments of Forest Management and Wood ence and Technology, offers undergraduate instruction leading to the gree of Bachelor of Science in the professional fields of forest manage- nt, wood technology, and pulp and paper technology. All curricula have ommon freshman year thus enabling the student to postpone selection a major field until he has had an opportunity to become acquainted with scope and possibilities.

Forest management deals with all phases of the management of wild ds and includes such related subjects as water-shed protection, wild- : management and recreation. In order that the student may be ade- ately prepared for work of such diverse nature, the curriculum provides ining in such subjects as silviculture, timber estimating, management, : prevention and control, forest pathology, insect control, forest soils, nomics, and other aspects of land use.

The course of study in wood technology, which is concerned with the hnical aspects of utilization, includes training in all types of wood ng and wood manufacturing industries. It incorporates technical and ctical principles of logging, milling, seasoning, gluing, preserving, fin- ing, fabricating, and machining, and includes the fundamentals of nd business administration.

Pulp and paper technology trains men for work in pulp and paper mill Students are given thorough training in chemistry, mathematics, physic wood structure and properties, pulping processes and engineering subjec related to pulp and paper manufacturing.

Degrees

The Bachelor of Science degree is conferred upon the satisfactory cor pletion of any of the four-year curricula in the areas mentioned above.

Professional preparation beyond the four-year curricula is desirable, an qualified students are urged to plan a five-year program leading to t master's degree. The degree of Master of Science is offered for those des ing specialization in the fields of scientific research. For students desiri a thorough professional background, the school offers the degree of Mas of Forestry or Master of Wood Technology.

The degree of Doctor of Philosophy is offered in several fields of for try and wood technology.

Further information regarding graduate study is contained in the Gr uate School Catalog which may be obtained from the dean of the Grac ate School.

Facilities and Laboratories

The School of Forestry is now housed in three modernly equipp buildings on the west side of the campus. Faculty offices, classrooms, laboratories are now located in Kilgore Hall, the main forestry build In addition, two buildings house specialized programs which are uni in the South.

Wood Products Laboratory

The Brandon P. Hodges Wood Products Laboratory is one of the lar and best equipped laboratories in existence for the conduct of rese and training in wood technology. Staff offices, research facilities, w structure, chemistry and physical properties laboratories are located the forestry building. In addition, the Brandon P. Hodges Labora building houses the wood machining, finishing, gluing and preserving oratories, as well as the sawmill, dry kilns, and veneer plant. The lab tory provides service to the wood using industries in the developmen methods of quality control, production control, operations analysis, market analysis. Graduate students in wood technology participate in laboratory's research program as a part of their advanced training.

Reuben B. Robertson Laboratory of Pulp and Paper Technology

The curriculum in pulp and paper technology is approved as the gional program to serve the Southeast. The Robertson Laboratory vides unique and outstanding facilities for instruction and research. cated in the building are wood preparation, chemical, pulping, pulp paper testing, and colorful laboratories, as well as digesters, and a

:er machine. Space and equipment are adequate to handle 40 seniors 10 graduate students.

School Forests

'he School of Forestry, with more than 82,000 acres of forest land and -e permanent field camps, has facilities unexcelled in many respects :field instruction and research.

'he Hofmann Forest, owned and operated by the North Carolina For- y Foundation for the benefit of the School of Forestry, consists of ap- ximately 78,000 acres located in Jones and Onslow counties in the heastern portion of the State. Pond and loblolly pine together with lwood and cypress swamps characterize this tract.

he George Watts Hill Demonstration Forest is a tract of 1,500 acres ted 16 miles north of Durham. This typically Piedmont forest of roll- terrain contains stands of loblolly, shortleaf, and Virginia pines along numerous hardwoods. The permanent summer camp of sophomores cated in this area. This Piedmont area is supplemented by the 1,750 Hope Valley Forest near Chapel Hill.

he Wayah Recreational Area on the North Carolina National Forest · Franklin is located in a typical mountain forest. Facilities at this area : been leased from the Government and portions of the spring semes- of the senior year and of the sophomore summer camp are held in nanent quarters of this mountain tract.

he Carl Alwin Schenck Memorial Forest of 250 acres located four s northwest of the campus is being developed into a model farm forest is used for field instruction near the campus.

he school nursery is equipped for instructional purposes and the pro- ion of planting stock.

l Instruction and Experience

ll students are required to present a minimum of one summer of ac- able work experience in order to meet the graduation requirements. ents are required to consult with their advisers as to what type of loyment will be acceptable.

he 10-week sophomore summer camp is a requirement for students in it management. This camp is prerequisite for junior standing. Perma- , well equipped camps are maintained on these coastal, Piedmont, and ntain forests. A "C" average is required for admission to these camps.

'ood technology students are required to attend a 10-week practicum wing the sophomore year. This practicum is prerequisite for junior ding. The first half of this period is devoted to laboratory exercises achining, gluing, drying and finishing wood; preparation of particle d; operation safety and maintenance of equipment; and plant inspec- s. The second half covers experience in logging, milling, cruising, and hic methods.

dditional field instruction and scheduled trips to representative wood istries are required of all students as a part of their class assignments.

To cover the costs of chemical supplies and off-campus training all stu dents enrolled in the School of Forestry pay a field laboratory fee of $1 each year at the time they first register during a school year. A maint nance and supply fee of $20 is charged for both the summer camp ar practicum.

Opportunities

A wide and rapidly expanding field of employment possibilities is ava able in the Southeast to young men trained in forestry. Until recent ye most job opportunities were with government agencies in managing pub forests, and this still constitutes a major source of employment. The agencies include State and Federal forest services, extension services, a other groups such as the Soil Conservation Service and the Tennes Valley Authority.

In recent years job opportunities with private industries have expand greatly. Increasing numbers of technically trained young men are ent ing a wide variety of professional positions in the fields of forest la management, water-shed management, logging, sawmilling, veneer a plywood manufacturing, pulp and paper making, kiln drying, wo preservation and the manufacture of wood products such as furniture, mension stock and various prefabricated items.

The merchandising of lumber and lumber products offers numer opportunities for students qualified for sales, business administration small building construction. Sawmills and lumber yards, plywood paper manufacturers, and flooring, wallboard, and other forest prod plants need trained men.

Exceptional students will find opportunities for employment in resea or teaching. This type of work ordinarily requires a graduate deg There has been an increasing demand for well-trained woodlands m agers and wood technologists, as well as for research workers in gov ment experiment stations and laboratories.

More than 80 per cent of the graduates of the School of Forestry now employed in some field of forest or wood products work. The students who have not followed the forestry profession have found t college education sufficiently broad to provide a sound basis for a v variety of work.

Extension Programs

The Forestry Extension Program of the Agricultural Extension Ser is a vital part of the school's forestry activities. This program serves landowners and wood industries of the State. It is responsible for understanding, acceptance, and application of new ideas and techni developed through research and experience. The two major fields of gram emphasis are forest management, where extension specialists and work through the county agents; and wood products, where the cialists work more or less directly with wood industry owners and agers.

In cooperation with the College Extension Division, short courses are ·ered in a number of fields to provide men in industry an opportunity . keep abreast of modern developments in techniques and equipment.

llowships, Scholarships, and Loan Funds

A number of undergraduate scholarships, research assistantships and ıining fellowships are available to qualified students. Students interested : applying should write to the dean of the School of Forestry.

The Hofmann Loan Fund was established by alumni of the School of ɔrestry to honor Dr. J. V. Hofmann, the first director of the Division. ɒans to worthy students are available through the Student Loan Fund ɕablished by the State College Alumni Association.

Many students help pay their expenses through part-time work at the ollege or in town. The College Counseling Center assists in locating ɜployment.

onors Program

Students making exceptional academic records during their freshman d sophomore years may, with the approval of the faculty, elect to follow ı honors program. These students are required to enroll in the core ɯrses in the several curricula but are otherwise free to utilize their ɔctives to develop individual courses of study designed to meet their ɐeds and satisfy their interests, subject only to the approval of the honors ʍiser.

eshman Year in All Forestry Curricula

l Semester	*Credits*	*Spring Semester*	*Credits*
3 103, General Botany	4	*BO 214, Dendrology	4
:H 101, General Inorganic Chemistry or		*EC 201, General Economics and	3
:H 105, General Inorganic Chemistry	4	*ME 101, Engineering Graphics	2
G 111, Composition	3	**CH 103, General and Qualitative Chemistry or	
R 101, Introduction to Forestry	1	**CH 107, General and Qualitative Chemistry	4
'MA 111, Algebra, Trigonometry	4	ENG 112, Composition	3
101, Military Science I or		***MA 112, Analytic Geometry and Calculus A	4
121, Air Science I	1	MS 102, Military Science I or	
101, Physical Education and Hygiene	1	AS 122, Air Science I	1
	18	PE 102, Physical Education and Hygiene	1
			17 or 18

* Forest Management and Wood Technology students take BO 214, Pulp and Paper students take ME 101 and EC 201.
** Forest Management and Wood Technology students take CH 101 and 103, Pulp and Paper students take CH 105 and 107.
*** Students with adequate backgrounds should take MA 101, 102.

Department of Forest Management

Professor T. E. MAKI, *Head of the Department*
Professors:
R. C. BRYANT, J. W. DUFFIELD, ARTHUR KELMAN, J. O. LAMMI, W. D. MILLER, B. J. ZOBEL
Associate Professors:
C. B. DAVEY, M. H. FARRIER, T. O. PERRY
Assistant Professors:
C. S. HODGES, L. C. SAYLOR
Instructors:
P. J. DYSON, R. L. MCELWEE

Forest management is the application of business methods and technic forestry principles to the operation of forest properties. This field requir a knowledge of individual trees and timber stands, of different forest typ and entire forest areas, as well as of the basic biological relationships wit in the forests. It also requires a knowledge of land surveying, timb cruising, measurement of forest products, and of the economic facto involved in the business of growing wood crops.

Curriculum

The curriculum in forest management is organized to provide a bro basic training and also to permit limited specialization. To accomplish latter goal, the curriculum includes 24 elective credits. At the beginnr of his junior year, the student selects one of the five areas of specializati listed and chooses courses listed under this field for his elective credi

The curriculum leads to the degree of Bachelor of Science in for management. A minimum of 152 credits is required for graduation.

Opportunities

Students who complete the curriculum are trained for positions v pulp companies, lumber companies, and other private landowners; fed and state forest services; agricultural extension; and for private enter as consultants, forest landowners or sawmill operators.

Forest Management Curriculum

For the freshman year see page 181.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	Cr
EC 201, General Economics	3	CH 220, Organic Chemistry	
ENG 205, Reading for Discovery	3	FOR 219, Forest Economy and Its Operation	
FOR 202, Wood Structure and Properties	3	PY 212, General Physics	
MA 211, Analytic Geometry and Calculus	3	SSC 200, Soils	
PY 211, General Physics	4	MS 202, Military Science II	
MS 201, Military Science II		or	
or		AS 222, Air Science II	
AS 221, Air Science II	1	PE 202, Physical Education	
PE 201, Physical Education	1		
	18		

Summer Camp

	Credits
S204, Silviculture	3
S264, Protection	3
S274, Mapping and Mensuration	3
S284, Utilization	1
	10

Junior Year

Semester	Credits		Spring Semester	Credits
361, Silvics	3		FOR 362, Silvics	3
11, Statistics	3		FOR 372, Mensuration	3
T 301, Forest Insects	3	or	*PP 318, Forest Tree Diseases	3
glish Elective	3	or	**English Elective	3
ption Requirement and lectives	9		***Option Requirement and Electives	9
	18			18

Senior Year

Semester	Credits	Spring Semester	Credits
531, Forest Management	3	FOR 511, Silviculture	3
***Option Requirement and Electives	15	FOR 532, Forest Management	3
		***Option Requirement and Elective	12
	18		18

est Management Fields of Specialization

. student selects one of the following fields of specialization and must e those courses listed under that field.

Forest Management

	Credits
BO 421, Plant Physiology	4
CE 201, Surveying	3
FOR 404, Management Analysis	3
FOR 405, Forest Inventory	3
FOR 512, Forest Economics	3
FOR 553, Photogrammetry	2
FIR 571, Advanced Mensuration	3
ST 312, Statistics	3
	24

Either ENT 301 or PP 318 is required of all students. English elective is scheduled for alternate semester.

Students not making better than "C" average in ENG 111, 112, or presenting transfer credits for ENG 111, 112 will schedule ENG 321, Scientific Writing.

Electives must include at least 9 credits in humanities or social science.

Forest Management Science

	Credits
EC 301, Production & Prices	3
EC 302, Nat'l Income & Ec. Welfare	3
EC 401, Prin. Accounting	3
FOR 512, Forest Economics	3
FOR 572, Forest Policy	3
MA 212, Calculus	3
MA 215, or 405—Finite Math or Matrix Algebra	3
ST 312, Statistics	3
	24

Forest Mensuration

	Credits
BO 421, Plant Physiology	4
CE 201, Surveying	3
CE 510, Advanced Surveying	3
FOR 553, Photogrammetry	2
FOR 571, Advanced Mensuration	3
MA 212, Analytics & Calculus	3
MA 215, Finite Math	3
ST 312, Statistics	3
	24

Watershed Management

	Credits
AGE 371, Soil and Water Conservation Engineering	4
CE 201, Surveying	3
FOR 553, Photogrammetry	2
MA 212, Calculus	3
MIG 120, Physical Geology	3
PY 322, Descriptive Meteorology	2
PY 333, Applied Meteorology	2
SSC 511, Soil Physics	4
	23

Forest Biology

	Credits
BO 421, Plant Physiology	4
BO 441, Plant Ecology	3
CE 201, Surveying	3
ENT 301 or PP 318, Insects or Disease	3
MA 212, or MA 215	3
ZO 103, Zoology	4
ZO 551, Wildlife Science	3
	23

Forest Recreation and Parks

	Credits
BO 441, Plant Ecology	3
ENT 301, Insects	
or	
PP 318, Diseases	3
MIG 120, Physical Geology	3
PSY 200, Psychology	3
RS 301, Rural Sociology	3
SOC 202, Sociology	3
ZO 103, Zoology	4
ZO 551, Wildlife Science	3
	25

Forest Wildlife Management

	Credits
ZO 103, Zoology (Soph Year)	4
ZO 206, Vertebrate Zoology	4
ZO 301, Animal Physiology	4
ZO 520, Fishery Science	3
ZO 522, Animal Ecology	3
ZO 551, Wildlife Science	3
ZO 552, Wildlife Science	3
	24

Department of Wood Science and Technology

Professor E. L. ELLWOOD, *Head of the Department*
Professors:
R. M. CARTER, B. A. JAYNE, A. J. STAMM
Associate Professors:
A. C. BAREFOOT, C. A. HART, R. G. HITCHINGS
Assistant Professors:
H. D. COOK, C. G. LANDES, R. J. THOMAS
Instructors:
P. J. DYSON, R. C. GILMORE, J. T. RICE

The wood industries have been a vital part of the economy of North Carolina for over 300 years. North Carolina ranks first in the nation in the manufacture of hardwood, plywood and wooden furniture, first in the South in lumber production and among the leaders in the manufacture of pulp and paper. The value of forest products produced annually in the State exceed $1,125,000,000. Seventeen per cent of the State's labor force is employed in the wood industries.

The Department of Wood Science and Technology offers two curricula, Wood Technology and Pulp and Paper Technology, to train men for careers in the wood industries.

WOOD TECHNOLOGY

Professor E. L. ELLWOOD, *In Charge*

Curriculum

The great wood industries which convert wood into thousands of commercial products offer many opportunities for wood technology majors.

The curriculum has been designed to give sound coverage in mathematics and the sciences and to permit sufficient flexibility to enable students to specialize along lines of major interest. At the end of the sophomore year, wood technology students attend a 10 week practicum which is prerequisite to junior standing. At the beginning of the junior year students select an option.

The option in wood products manufacturing trains men for supervisory and production positions in the manufacture of such products as lumber veneer, plywood, particle board, dimension stock, furniture, cabinets millwork, and flooring.

The wood products economics and management option stresses the field of business administration and economics and trains men for careers i merchandising and administration in the wood processing industries, th construction industry, or with material suppliers.

This curriculum leads to the degree of Bachelor of Science in woc technology. A minimum of 151 credits is required for graduation.

Opportunities

A career with wood industries offers a variety of opportunities for you men trained in wood properties, manufacturing operations and busin methods. The application of new processes and materials in the conv sion of timber into the thousands of wood products has created a dema for technically trained men. Companies manufacturing lumber, ven and plywood, hardwood dimension stock, furniture, millwork, floori pianos, caskets, wood turnings, adhesives, preservatives, finishing materi and composition boards are types of industries interested in employ graduates.

ood Technology Curriculum

r the freshman year see page 181.

Sophomore Year

ll Semester	Credits	Spring Semester	Credits
201, General Economics	3	CH 220, Organic Chemistry	4
CG 231, Basic Speaking Skills	3	FOR 203, Wood Structure and Properties II	3
R 202, Wood Structure and Properties I	3	*MA 212, Calculus	3
A 211, Calculus	3	ME 101, Engineering Graphics	2
Y 211, General Physics	4	*PY 212, General Physics	4
201, Military Science or		MS 202, Military Science or	
221, Air Science	1	AS 222, Air Science	1
201, Physical Education	1	PE 202, Physical Education	1
	18		18

Summer Practicum

rst Session Wood Products	Credits	Second Session Wood	Credits
acticum (Five Weeks)		Practicum (Five Weeks)	
OR 205-S, Wood Machining Practicum	1	FOR 210-S, Mensuration Practicum	2
OR 206-S, Wood Drying Practicum	1	FOR 211-S, Logging and Milling Practicum	2
OR 207-S, Gluing Practicum	1	FOR 212-S, Graphic Methods	1
OR 208-S, Wood Finishing Practicum	1		5
OR 209-S, Plant Inspections	1		
	5		

Junior Year

ll Semester	Credits	Spring Semester	Credits
M 341, Mechanics A (Statics)	2	FOR 219, Forest Economy and Its Operation	3
NG 321, Scientific Writing	3	FOR 302, Wood Processes II	4
OR 301, Wood Processes I	4	For 444, Intro. to Quality Control	3
361, Statistics for Engineers	3	Technical Electives	3
chnical Electives	4	Electives	5
	16		18

Senior Year

ll Semester	Credits	Spring Semester	Credits
OR 434, Wood Operations I	3	FOR 435, Wood Operations II	3
OR 521, Wood Chemistry	3	FOR 441, Design of Wood Structures	3
chnical Electives	3	FOR 591, Wood Technology Problems	3
ectives	9	Technical Electives	3
	18	Electives	6
			18

*Students who have completed MA 101, 102, should take MA 201, 202, and PY 201, 202.

Fields of Specialization

At the beginning of the junior year, students with exceptional academic records may, with the approval of the faculty, elect the Honors Program. Other students will elect one of the following options. When an option is chosen the student will select at least two courses from one area of emphasis and at least one course from each of the other two areas of emphasis. The remaining elective hours are to be courses selected by the student in consultation with his adviser to best fit his particular interests

Wood Products Manufacturing Option

		Credi
OPERATIONS ANALYSIS	EC 450, Economic Decision Processes	3
	EC 552, Econometrics	3
BUSINESS ADMINISTRATION	EC 310, Economics of the Firm	3
	EC 432, Industrial Relations	3
STATISTICS	ST 515, Experimental Statistics for Engineers	3
	ST 516, Experimental Statistics for Engineers	3

Wood Products Economics and Management Option

		Crea
ECONOMICS	EC 301, Production and Prices	3
	EC 302, National Income and Economic Welfare	3
	EC 448, International Trade	3
OPERATIONS ANALYSIS	EC 450, Economic Decision Processes	
	EC 552, Econometrics	
BUSINESS ADMINISTRATION	EC 310, Economics of the Firm	
	EC 312, Elements of Accounting	
	EC 425, Industrial Management	

PULP AND PAPER TECHNOLOGY

Professor R. G. HITCHINGS, *In Charge*

Curriculum

The curriculum in pulp and paper technology trains men for technical work in the rapidly growing pulp and paper industry. Graduates are prepared for careers as pulp technologists, paper mill chemists, quality control specialists, and mill superintendents. After a thorough background in basic sciences, the program offers special work in wood pulping processes, chemical and by-products recovery, pulp bleaching, and the various papermaking operations such as refining, sizing, filling, coloring, coating, and converting.

The pulp and paper industry ranks fifth among all American industries. In 1960 pulp and paper products were valued at 10.7 billions of dollars and the industry employed more than 562,000 skilled workers. This is primarily a Southern industry with 60 per cent of the nation's pulpwood produced in the South.

Financially supported by 55 major companies, this program was created to meet the critical need for trained men. It is a regional program

ıd has been approved by the Southern Regional Education Board as ıe undergraduate program to serve the Southeast in this field. A number ⁻ scholarships are available. The new Robertson Laboratory of Pulp and aper Technology provides this program with outstanding facilities.

All students majoring in this curriculum are required to spend at least ⁻ıe summer working in a pulp or paper mill where arrangements have ⁻een made by the College for such employment. Three hours of academic ⁻edit are granted the student after completion of 12 weeks of mill work ıd presentation of a satisfactory report covering this work experience. In ddition to this minimum summer work requirement, students are urged ı work in mills the two remaining summers between academic years be-ıuse of the great value of practical experience in this industry.

This curriculum leads to the degree of Bachelor of Science in pulp and aper technology. A minimum of 147 credits is required for graduation. A fth year leading to the degree of Bachelor of Science in chemical engi-⁻eering is available for interested students.

ulp and Paper Technology Curriculum

ɔr the freshman year see page 183

Sophomore Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
H 221, Organic Chemistry	4	CH 223, Organic Chemistry	4
IA 211, Calculus B	3	FOR 342, Fiber Analysis	3
Y 211, General Physics	4	•MA 212, Calculus C	3
S 201, Military Science		•PY 212, General Physics	4
or		MS 202, Military Science	
S 221, Air Science	1	or	
2 201, Physical Education	1	AS 222, Air Science	1
English Elective	3	PE 202, Physical Education	1
Electives	3		
	19		16

Summer

	Credits
FOR 491, Forestry Problems, Mill Experience	3

Students who have completed MA 101, 102 should take MA 201, 202 and PY 201, 202

Junior Year

Fall Semester	*Credits*
CHE 301, Elements of Chemical Engineering	3
CH 215, Quantitative Analysis	4
FOR 321, Pulp and Paper Technology	3
ME 304, Fundamentals of Heat Power	3
Social Science Elective	3
English Elective	3
	19

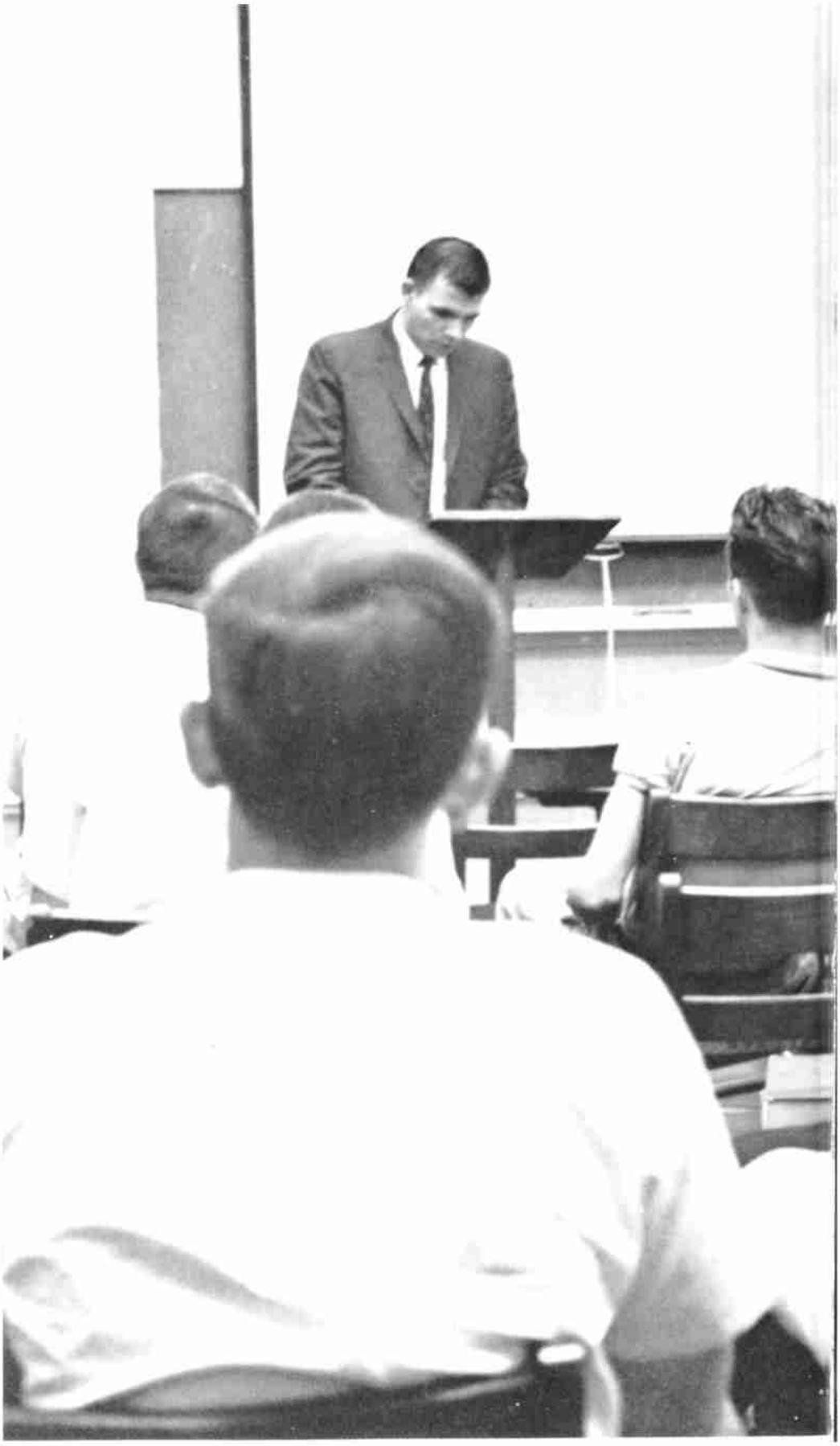
Spring Semester	*Credits*
CHE 302, Elements of Chemical Engineering	3
CH 231, Physical Chemistry	4
FOR 322, Pulp and Paper Technology	3
PSY 200, General Psychology	3
Social Science Elective	3
Elective	3
	19

Senior Year

Fall Semester	*Credits*
FOR 411, Pulp and Paper Unit Processes	3
FOR 413, Paper Properties and Additives	4
FOR 471, Pulping Process Analysis	4
FOR 491, Senior Research Problem	1
FOR 521, Wood Chemistry	3
Electives	3
	18

Spring Semester	*Credits*
FOR 403, Paper Process Analysis	3
FOR 412, Pulp and Paper Unit Processes	3
FOR 461, Paper Converting	1
FOR 463, Plant Inspections	1
FOR 482, Pulp and Paper Mill Management	2
FOR 522, Wood Chemistry	3
Electives	4
	17


FORESTRY



School of Liberal Arts

EED V. CAHILL, Dean

ne School of Liberal Arts has a two-fold mission: the training of students no wish to concentrate in the areas of the humanities and social sciences d to participate in the training of students whose primary interests are entific and technological. The first function has been undertaken to satis- a growing demand for a college education general in character, yet with fficient depth to provide the foundation for a degree of competence in a ven discipline. The second, represents the school's contribution to the ucation of all students on the campus and is discharged by offering either ective or required courses in the social sciences and humanities which e designed to fit the needs of students in the scientific and technological rricula.

In all instances, the School of Liberal Arts seeks to develop the student's mmunication skills and to acquaint him with our literary heritage; to crease his understanding of his economic, political, social and philo- ohical environment; to teach him to think critically and scientifically in e world of human affairs; and to assist him in developing physical strength d stamina as a basis for healthful living. In addition to the required and ective courses offered for all students, courses of study leading to the chelor of Arts and Bachelor of Science degrees have been established.

The School of Liberal Arts includes the departments of Economics, Eng h, History and Political Science, Modern Languages, Philosophy and Re- ion, Physical Education, Social Studies, and Sociology and Anthropology. r purposes of the Bachelor of Arts program, the Department of Psychol- y is associated with the faculty of the school.

URRICULA

The program of studies leading to the degree of Bachelor of Arts, with ajors in Economics, English, History, Political Science, Psychology, and ciology is as follows:

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111, Composition and Rhetoric	3	ENG 112, Composition and Reading	3
Modern Language	3	Modern Language	3
MA 111, Algebra and Trigonometry	4	MA 122, Analytic Geometry and Calculus A	4
Social Science	3	**Social Science	3

conomics 201, 202; Political Science 201, 202, 301 or 322; Psychology 200, 201; Sociology 202, ; Anthropology 252, 305)

At the intermediate level
Two of the required four courses must be in departmental sequence.

PE 101, Physical Education	1	PE 102, Physical Education	1
MS 101, Military Science I		MS 102, Military Science I	
or		or	
AS 121, Air Science I	1	AS 122, Air Science I	1
	15		15

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Literature	3	Literature	3
(English 261, 262; 265, 266. English 468 may be substituted for English 265; Modern Language 301, 302)			
**Social Science	3	**Social Science	3
Natural Science	3 or 4	Natural Science	3 or 4
(Biological Science 100 Botany 103; Zoology 103; Physics 211, 212; 221; Chemistry 101, 103 Geology, MIG 101, 120, 220, 222)			
PHI 205, Problems and types of Philosophy	3	Elective	3
Elective	3	Elective	3
PE 201, Physical Education	1	PE 202, Physical Education	1
MS 201, Military Science II		MS 202, Military Science II	
or		or	
AS 221, Air Science II	1	AS 222, Air Science II	1
	17 or 18		17 or 18

Junior and Senior Years

Aside from one semester of the History of Science or Philosophy of Science (Philosophy 405 or History 422), the work of the last two years is divided between the major of approximately 30 credits selected with assistance of departmental adviser and electives selected with the assistance of the adviser. The total graduation requirement is 128 credits.

The curriculum leading to the degree of Bachelor of Science follows a somewhat different plan. The student divides his time approximately equally between a concentration in Economics, English, History, Political Science, Sociology and scientific or technological courses. It will be to the advantage of the student entering this program to present at least four years of high school mathematics so that he may omit Mathematics III.

The curricular outline of the Bachelor of Science program follows:

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111, Composition and Rhetoric	3	ENG 112, Composition and Reading	3
*Modern Language	3	Modern Language	3
CH 101, General Chemistry I	4	CH 103, General Chemistry II	4
MA 111, Algebra and Trigonometry	4	MA 102, Analytic Geometry and Calculus I	4
PE 101, Physical Education	1	PHI 203, Introduction to Philosophy	3
MS 101, Military Science I		PE 102, Physical Education	1
or		MS 102, Military Science I	
AS 121, Air Science	1	or	
		AS 122, Air Science I	1
	16		16

* At the intermediate level
** Two of the required four courses must be in departmental sequence.

Sophomore Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
ENG 205, Reading for Discovery		ENG 205, Reading for Discovery	
or		or	
Elective	3	Elective	3
MA 201, Analytic Geometry and		MA 202, Analytic Geometry and	
and Calculus II	4	Calculus III	4
History		History	
or		or	
Social Science	3	Social Science	3
PY 205, General Physics	5	PY 208, General Physics	5
PE 201, Physical Education	1	PE 202, Physical Education	1
MS 201, Military Science II		MS 202, Military Science II	
or		or	
AS 221, Air Science II	1	AS 222, Air Science II	1
	17		17

In the junior and senior years, the student will complete a sequence of ght courses and seminars selected with assistance of the departmental dviser in the field of concentration and at the same time will complete at ast four courses in a prescribed sequence mathematics, basic science or technology. Electives, either limited or completely free, round out the ogram.

Department of Economics

ofessor ERNST W. SWANSON, *Head of the Department*

ofessors:

E. A. FAILS, B. M. OLSEN, T. W. WOOD

sociate Professors:

A. J. BARTLEY, L. A. DOW, CLEON HARRELL

sistant Professors:

GERALD GARB, W. R. HENDLEY, T. H. PARK, C. S. SHEN, O. G. THOMPSON

structors:

M. M. EL-KAMMASH, M. A. HUNT, W. J. STOBER

djunct Professor:

D. R. DIXON

he Department of Economics seeks to help students understand the onomic process, the nature and functioning of the economy and useful proaches to and methods of economic analysis. In pursuance of this end e department has a representative offering of courses in the major fields economic theory, applied economics and business operation at both undergraduate and graduate levels. Several courses have been designed primarily for students working toward advanced degrees in the technical hools. Members of the department are engaged in extension work and onomic research.

Department of English

Professor L. C. HARTLEY, *Head of the Department*
Professors:
A. M. FOUNTAIN, H. G. KINCHELOE, R. P. MARSHALL, JACK SUBERMAN, R. G. WALSER
Associate Professors:
P. H. DAVIS, H. G. ELDRIDGE, F. H. MOORE, GUY OWEN, E. H. PAGET, D. J. RULFS, A. B. R. SHELLEY L. H. SWAIN, L. R. WHICHARD, R. B. WYNNE
Assistant Professors:
LARRY CHAMPION, MAX HALPEREN, SADIE J. HARMON, A. S. KNOWLES, B. G. KOONCE, JACK PORTER, NORWOOD SMITH, PORTER WILLIAMS, JR.
Instructors:
D. P. ALLEN, P. E. BLANK, J. G. EASLEY, HAZEL GRIFFIN, HARRY HARGRAVE, EUGENE HOLLAHAN, W. W. MARTIN, NANCY G. MORGAN, HOWARD PEARCE, R. B. WHITE
Special Lecturer:
MARY C. WILLIAMS

The English Department offers both basic and advanced courses in three areas: composition, speech, and literature. The freshman course, which is common to all curricula and prerequisite to all advanced courses in English, is designed to give intensive training and practice in written communication, plus an introduction to literary types. Courses in business, scientific, and creative writing and in speech are offered both to meet course requirements in special curricula and to provide electives for interested students. Advanced courses are available for a major in literature in the Bachelor of Arts program, as well as for areas of concentration in literature and in communications in the Bachelor of Science program.

Department of History and Political Science

Professor P. W. EDSALL, *Head of the Department*
Professors:
M. L. BROWN, F. V. CAHILL, JR., J. T. CALDWELL, A. HOLTZMAN, STUART NOBLIN, L. V. SEEGERS
Associate Professors:
L. W. BARNHARDT, B. F. BEERS, W. J. BLOCK, J. L. HELGUERA
Assistant Professors:
M. S. DOWNS, C. F. KOLB, O. H. ORR, JR.
Instructors:
J. C. FARRELL, STANLEY SUVAL

An understanding of the historical background of our times and of political principles, political behavior and governmental systems is expected of the educated man. To enable students to acquire this understanding the Department of History and Political Science offers work in the principal fields of history and political science. Students may major or concentrate in either discipline. Minor programs are also available to graduate students. An important aspect of the department's work involves service courses in the curricula of the other schools. Students generally are invited to elect courses in either or both disciplines.

Department of Modern Languages

Professor G. W. POLAND, *Head of the Department*
Associate Professors:
F. J. ALLRED, S. T. BALLENGER
Assistant Professors:
RUTH B. HALL, H. L. TITUS
Instructors:
B. S. HOWARD, S. E. SIMONSEN

The Department of Modern Languages provides instruction in French, German, Spanish, Italian, and Russian as well as special instruction in English for foreign students. It also offers courses in the literature and culture of these language areas.

The department cooperates with graduate and research programs by offering special courses for graduate students in connection with language requirements for advanced degrees and by providing translation service. Graduate students enrolled in technical and scientific courses translate projects in their field of major interest. Upon satisfactory completion of these projects, they are accepted as evidence of reading ability in the particular language.

Department of Philosophy and Religion

Professor W. N. HICKS, *Head of the Department*
Associate Professors:
PAUL A. BREDENBERG, W. LAWRENCE HIGHFILL, J. LEONARD MIDDLETON
Assistant Professor:
*W. CURTIS FITZGERALD, JR.
Instructor:
WILLIAM KURYLO

The Department of Philosophy and Religion provides basic courses in philosophy and religion for students in the several schools of the College. The courses include offerings in the areas of logic, history of philosophy, philosophy of science, philosophy of art, philosophy of religion, ethics, the Bible and its background, religious movements in the United States, and world religions.

Effort is made to relate and make effective application of theoretical knowledge and understanding.

Department of Physical Education

Professor P. H. DERR, *Head of the Department*
Professor:
W. E. SMITH
Professor Emeritus:
JOHN F. MILLER

* On leave.

Associate Professors:
J. B. EDWARDS, HAROLD KEATING, J. F. KENFIELD, JR.
Assistant Professors:
J. L. CLEMENTS, N. E. COOPER, ARTHUR M. HOCH, W. R. LEONHARDT, J. H. LITTLE, F. J MURRAY, W. H. SONNER
Instructors:
H. O. FLOYD, JR., M. S. RHODES, W. M. SHEA

The Department of Physical Education contributes to the general welfare of the student by providing programs and conditions in which he may develop and maintain physical strength and stamina, relax tensions, acquire an appreciation for the importance of healthful living and develop knowledge and skills for recreation. The programs also provide situations in which the student may develop qualities of cooperation, leadership, and social poise.

In addition to instruction and supervision for the participant in physical education in regular classes; there are opportunities for all students to participate in beneficial forms of physical exercise through the program in intramural athletics.

Department of Psychology

(See Education)

Department of Social Studies

Professor G. A. GULLETTE, *Head of the Department*
Professors:
C. I. FOSTER, J. R. LAMBERT
Associate Professors:
R. N. ELLIOTT, R. S. METZGER
Assistant Professors:
W. F. EDWARDS, A. K. LOWENSTEIN
Instructors:
R. V. BRICKELL, R. M. CORNISH, R. J. CLACK

The Department of Social Studies draws its staff from the various fields of the humanities and the social sciences. It contributes to the training of men whose professional competence is devoted to the public interest by offering courses especially designed to emphasize the close interconnections that bind liberal studies to the world of science and technology.

Department of Sociology and Anthropology

Professor SANFORD WINSTON, *Head of the Department*
Associate Professors:
E. H. JOHNSON, H. D. RAWLS
Assistant Professors:
HERBERT COLLINS, J. G. HARDEE, J. W. TOMLIN

The Department of Sociology and Anthropology has three major functions in relation to the training and developing of students: (1) to make available

in undergraduate curriculum leading to a Bachelor of Arts degree; (2) to provide training in human group behavior for students majoring in other areas; and (3) in cooperation with the Rural Sociology Department providing a graduate program at both the master's and doctorate levels.

The general aim of the department is to provide a sound and highly developed undergraduate major which will lead to a rewarding and satisfying professional career; to provide other students with an opportunity to understand more fully the social world in which they live in relation to their own interests; and to provide an opportunity for exceptional students to pursue a graduate program in sociology.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Physical Sciences and Applied Mathematics

RTHUR CLAYTON MENIUS, JR., Dean
AREY G. MUMFORD, Assistant to the Dean

urrent events and the outlook for the future continue to emphasize the eed for an increasing supply of high caliber scientists, mathematicians, nd engineers. The School of Physical Sciences and Applied Mathematics dedicated to helping to supply this need. In addition to the Departaents of Chemistry, Experimental Statistics, Mathematics, and Physics, ne operations of Physical Sciences Research, the Computing Center, and ne Reactor Project were added to the school in 1961. The growth of the hool since its formation in 1960 has reaffirmed the fact that strong eduational and research opportunities in the basic sciences and mathematics re fundamentally necessary, and are important adjuncts to successful rograms in the applied fields.

The mission of the School of Physical Sciences and Applied Mathemaics at North Carolina State College is three-fold: the training of well ualified scientists and mathematicians; the technical support of curricula ı agriculture, design, education, engineering, forestry, and textiles; and esearch in science and mathematics.

acilities

The School of Physical Sciences and Applied Mathematics is fully quipped for instruction and research. Special equipment and laboratories ssociated with the departments of the school are a complete radio-chemisy laboratory; a low power homogeneous reactor and a heterogeneous eactor designed for 100 kw; a one million volt Van de Graaff accelerator; wo analog computers, GEDA and Donner; and an IBM 1410 digital comuter supplemented by access to the Univac 1105 at the University of lorth Carolina Computation Center at Chapel Hill. Other facilities on ne campus available for teaching and research include an RCA electron aicroscope, complete X-ray laboratories with diffraction and radiographic quipment, and precision instrument shops.

urricula

It is intended that the undergraduate degree for the school be Bachelor f Science with a major in chemistry, physics, applied mathematics or xperimental statistics. The curricula of the Departments of Chemistry, Mathematics, Physics, and Statistics are so arranged as to have essentially a ommon freshman year. Because of this, a student entering any one of hese curricula can, without penalty, change to another department in the

School of Physical Sciences and Applied Mathematics during his freshman year. This common year is outlined below.

Freshman Year in All Physical Sciences and Applied Mathematics Curricula

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101, General Inorganic Chemistry	4	CH 103, General and Qualitative Chemistry	4
or		or	
CH 105, General Inorganic Chemistry	4	CH 107, General and Qualitative Chemistry	4
and		and	
CH 106, General Inorganic Chemistry Laboratory	1	CH 108, General and Qualitative Chemistry Laboratory	1
ENG 111, English Composition	3	ENG 112, English Composition	3
MA 102, Analytic Geometry and Calculus I	4	MA 201, Analytic Geometry and Calculus II	4
PE 101, Physical Education	1	PE 102, Physical Education	1
MS 101, Military Science I		MS 102, Military Science I	
or		or	
AS 121, Air Science I	1	AS 122, Air Science I	1
Humanities	3	PY 205, General Physics I	4
or		or	
Natural Science	4	Natural Science	4
PSM 100, Orientation	0		
	16 or 17		17 or 18

The total number of hours required for graduation is to be a minimum of 135 hours which includes 8 hours of military science and physical education. Twenty-one semester hours are to be required in the humanities, exclusive of Freshman English. An additional requirement is one modern language.

Graduate Study

The Master of Science degree is offered by each department of this school with the doctorate available in mathematics, physics and statistics. The graduate programs are described in detail in the Graduate School Catalog.

Department of Chemistry

Professor RALPH CLAY SWANN, *Head of the Department*

Professors:

THOMAS GLENN BOWERY, GEORGE OSMORE DOAK, RICHARD HENRY LOEPPERT, WALTER JOHN PETERSON, WILLIS ALTON REID, COWIN COOK ROBINSON, PAUL PORTER SUTTON, SAMUEL TOVE, JOSEPH ARTHUR WEYBREW

Associate Professors:

DAVID MARSHALL CATES, ALONZO FREEMAN COOTS, LEON DAVID FREEDMAN, FORREST WILLIAM GETZEN, LOUIS ALLMAN JONES, RICHARD COLEMAN PINKERTON, RAYMOND CYRUS WHITE

Assistant Professors:

FRANK BRADLEY ARMSTRONG, THOMAS JACKS BLALOCK, LAWRENCE HOFFMAN BOWEN, WILLIAM PRENTISS INGRAM, JR., GEORGE GILBERT LONG, EDWARD CARROLL SISLER

Instructors:

WILLIAM RODGER JOHNSTON, ELIZABETH HINES MANNING, JOHN WESLEY MORGAN, GEORGE MOTLEY OLIVER, MRS. GRAYE JOHNSON SHAW, THOMAS MARSH WARD

The principal objective of the Department of Chemistry is to provide sound basic training in chemistry and the related sciences. Emphasis is placed on aiding and encouraging creative thinking.

urriculum

The curriculum for the Bachelor of Science degree in chemistry is de-gned to give the students fundamental training in mathematics and the .ological and physical sciences with maximum instruction in chemistry. raduates in chemistry are provided with a sound foundation for future raduate study.

The curriculum meets the requirements of the American Chemical So-ety for the training of professional chemists.

Chemistry Curriculum

or the freshman year see page 204.

Sophomore Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
H 221, Organic Chemistry I	4	CH 223, Organic Chemistry II	4
H 222, Organic Chemistry Lab.	1	CH 224, Organic Chemistry Lab.	1
A 202, Analytic Geometry and Calculus III	4	MA 301, Differential Equations	3
Y 206, General Physics	4	PY 207, General Physics	4
English	3	English	3
S 201, Military Science II or		MS 202, Military Science II or	
S 221, Air Science II	1	AS 222, Air Science II	1
E 201, Physical Education	1	PE 202, Physical Education	1
	18		17

Junior Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
H 431, Physical Chemistry I	3	CH 433, Physical Chemistry II	3
H 432, Physical Chemistry Lab.	1	CH 434, Physical Chemistry Lab.	1
L 103, Elementary German	3	CH 411, Analytical Chemistry I	4
Minor	3	ML 104, German Grammar and Prose Reading	3
Humanities	3	Minor	3
Free Electives	3	Humanities	3
	16		17

Senior Year

all Semester	*Credits*	*Spring Semester*	*Credits*
H 413, Analytical Chemistry II	4	CH 501, Inorganic Chemistry I	3
Major	3	Minor	3
Minor	3	Humanities	3
Humanities	3	Free Electives	7
Free Electives	3		16
	16		

[1] Chemistry majors are required to take CH 105, CH 106, CH 107, and CH 108. The Chemistry Department will recognize as a minor four semester courses in the biological sciences, engineering, mathematics, or physics. Any combination of four courses from two of these areas will constitute a "split" minor. The courses applied to a minor should exhibit the application of chemistry in the areas chosen. This sequence is to be chosen in consultation with the faculty adviser prior to the third year of study.

Department of Experimental Statistics

Professor J. A. RIGNEY, *Head of the Department*
Professors:
R. L. ANDERSON, *Graduate Administrator*, C. C. COCKERHAM, A. H. E. GRANDAGE, R. J. HADER, H. L. LUCAS, F. E. MCVAY, D. D. MASON, R. J. MONROE, D. R. SHREVE, R. W. STACY, R. G. D. STEEL
Visiting Professor:
D. W. HAYNE
Adjunct Professors:
W. S. CONNOR, A. L. FINKNER
Professor Emeritus:
GERTRUDE M. COX
Associate Professors:
W. J. HALL, R. G. PETERSON, C. H. PROCTOR, W. W. G. SMART, T. D. WALLACE
Visiting Associate Professors:
J. C. KOOP, H. R. VAN DER VAART
Adjunct Associate Professor:
S. ADDELMAN
Assistant Professors:
J. O. RAWLINGS, F. J. VERLINDEN
Assistant Statisticians:
M. A. CIPOLLONI, J H. MEADE, W. S. OVERTON, C. A. ROHDE, B. J. STINES, E. H. YEN

Statistics is a relatively new and rapidly expanding science. It is the body of scientific methodology which deals with efficient collection and presentation of data and with the general problem of drawing valid and reliable inferences from data. Early development of statistics occurred in the biological and social sciences. In recent years the use of statistical concepts and methodology has spread into virtually all areas of scientific endeavor, especially the physical sciences and engineering.

The Department of Experimental Statistics is part of the Institute of Statistics which also includes a Department of Biostatistics and a Department of Statistics at Chapel Hill. The Department of Experimental Statistics provides instruction, consultation and computational services on research projects, for other departments of all schools at North Carolina State College including the Agricultural Experiment Station. Governmental agencies and other institutions use the facilities of the department. The range and quality of the data handled furnish an excellent background for training students in the use of statistical procedures in such fields as the physical, biological and social sciences and in industrial development and engineering.

Opportunities

Most fields of research, development, production, and distribution are seeking persons trained in statistical methods and theory. Research groups are fast realizing the importance of statistics in planning experiments and in analyzing and computing results. Industry is placing increasing reliance on statistical methods to control the quality of goods in the process of manufacture and to determine the acceptability of goods already produced. Statistical procedures based on scientific sampling are becoming basic

ools for making weather forecasts, crop and livestock estimates, business end predictions, opinion polls and the like.

A graduate in statistics will find abundant opportunities in any of the eas listed above—both in industry and with federal and state agencies.

xperimental Statistics Curriculum

or the freshman year see page 204.

Assuming BO 103 and PY 205 were elected during the freshman year, a typical program for e succeeding three years might be as follows:

Sophomore Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
A 202, Calculus II	4	MA 301, Differential Equations	3
' 206, General Physics II	4	PY 207, General Physics III	4
201, Economics	3	EC 202, Economics	3
Foreign Language	3	ZO 103, General Zoology	4
S 201, Military Science	1	Foreign Language	3
201, Physical Education	1	MS 202, Military Science	1
		PE 202, Physical Education	1
	16		19

Junior Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
361, Introduction to Statistics	3	ST 362, Introduction to Statistics	3
Y 200, Introduction to Psychology	3	ST 302, IBM Laboratory	2
NG 321, Scientific Writing	3	Minor	3
Minor	3	Humanities	3
Humanities	3	Free Electives	6
	15		17

Senior Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
421, Basic Statistical Theory	3	ST 422, Basic Statistical Theory	3
515, Experimental Statistics for Engineers	3	ST 516, Experimental Statistics for Engineers	3
Minor	3	Minor	3
Humanities	3	Humanities	3
Free Electives	3	Free Electives	4
Major Electives	3		
	18		16

raduate Study

The Department of Experimental Statistics offers work leading to the Master of Science and Doctor of Philosophy degrees. Minor work may be aken in any of the wide variety of research programs on the campus. In ddition, a cooperative arrangement with the Departments of Biostatistics and Statistics at Chapel Hill provides for minor work in health affairs nd in statistical theory. Active participation in the graduate faculty by everal of the staff at the Research Triangle Institute provides further

strength of staff and a wider variety of research experience available to graduate students.

The department has at least one staff member who consults with researchers in each of the following fields and who conducts his own research on statistical problems which are encountered: the various agricultural sciences, quantitative genetics, industry and engineering, physical sciences and social sciences. In addition there is active research in the general fields of experimental design and sample surveys.

Department of Mathematics

Professor JOHN W. CELL, *Head of the Department*
Professors:
R. C. BULLOCK, J. M. CLARKSON, W. J. HARRINGTON, M. ITOH, JACK LEVINE, C. G. MUMFORD, H. M. NAHIKIAN, *Graduate Administrator*, H. V. PARK, *Administrative Assistant*, D. R. SHREVE, R. A. STRUBLE, J. H. WAHAB, H. P. WILLIAMS, L. S. WINTON
Associate Professors:
H. C. COOKE, A. R. NOLSTAD, D. M. PETERSON, H. A. PETREA, H. E. SPEECE, H. VAN DER VAART, G. C. WATSON
Adjunct Associate Professor:
ROBERT T. HERBST
Assistant Professors:
V. R. BRANTLEY, E. J. CANADAY, D. L. GEORGE, D. J. HANSEN, C. F. LEWIS, C. H. LITTLE, JR., MORTON LOWENGRUB, R. A. MACKERRACHER, ARMSTRONG MALTBIE, L. B. MARTIN, JR., PETER SHAHDAN, J. B. WILSON
Instructors:
C. N. ANDERSON, DOROTHY L. BRANT, JOYCE CARAWAY, MARTHA J. GARREN, RUTH B. HONEYCUTT, JULIE G. MCVAY, D. E. NIXON, CARLOTTA P. PATTON, J. L. SOX, G. S. SPEIDEL, JR.

There is great need in industry and in the field of teaching for people trained in applied mathematics. The increasing use of both digital and analog computers and the shift to automation in industry have given rise to requirements for mathematics analysts. The Department of Mathematics offers opportunities in the elementary and advanced courses for the student to learn important concepts in mathematics and to apply these to situations in mathematically oriented areas.

Curriculum

The curriculum for the Bachelor of Science degree in applied mathematics is designed to provide the student with a sound foundation in mathematics and at the same time to give him a reasonable acquaintance with some other area of science or engineering in which mathematics is applied. Required courses are relatively few in number so that the individual needs of the student are met more readily. The individual curriculum can be designed either to fit the needs of a student for a position in industry or to provide him with a strong foundation for future graduate work.

athematics Curriculum

- the freshman year see page 204.

Sophomore Year

l Semester	*Credits*	*Spring Semester*	*Credits*
. 202, Calculus and Analytic Geometry III	4	MA 301, Differential Equations	3
:206, General Physics II	4	PY 207, General Physics III	4
English Literature	3	••Humanity Elective	3
*Modern Language	3	*Modern Language	3
. 201, Military Science II or :221, Air Science II	1	MS 202, Military Science II or AS 222, Air Science II	1
. 201, Physical Education	1	PE 202, Physical Education	1
Humanity Elective	3	Free Elective	3
	19		18

Junior Year

l Semester	*Credits*	*Spring Semester*	*Credits*
. 403, Fundamental of Algebra	3	MA 405, Introduction to Determinants and Matrices	3
. 441, Advanced Calculus I	3	MA 512, Advanced Calculus II	3
Statistics	3	Statistics	3
••••Minor	3	••••Minor	3
••Humanity Elective	3	Humanity Elective	3
Free Elective	3	Free Elective	3
	18		18

Senior Year

l Semester	*Credits*	*Spring Semester*	*Credits*
*Major	6	•••Major	6
••••Minor	3	••••Minor	3
Humanity Elective	3	••Humanity Elective	3
e Elective	3	Free Elective	2
	15		14

aduate Study

The faculty of the Department of Mathematics feels that a student en- ring the Graduate School to work toward the degree of Master of Science applied mathematics should be well grounded in mathematics through o semesters of advanced calculus and two of modern algebra (or the uivalent). In addition, he should have a strong background in mechan- , physics, or in some other mathematically oriented area.

Minimum course requirements for the degree of Master of Science in plied mathematics are 30 hours of which six to nine hours must be ected from a minor field which is usually some branch of engineering,

* The particular language chosen (French, German, or Russian) is subject to the approval of the department head.
** These junior-senior humanities generally should be chosen from humanities offerings at the 300 level and above, or from modern language offerings beyond the required courses.
*** To be chosen from mathematics offerings at the 400-500 level.
**** The minor field is, as a minimum, a four-course sequence from one other area, and these courses normally should exhibit the application of mathematics in this area. They are not to include any course from this area that is otherwise applied in satisfying the requirements of this curriculum. This minor is to be chosen in consultation with the student's adviser prior to or during the junior year and this choice is subject to the approval of the department head.

physics, or statistics. In addition to the above requirements, the student must write a thesis and show a satisfactory reading knowledge of a foreign language.

For more detailed information and for requirements for the Doctor of Philosophy degree see the Graduate School Catalog.

Department of Physics

Burlington Professor RAYMOND L. MURRAY, *Head of the Department*
Burlington Professor:
WILLARD H. BENNETT
Professors:
W. O. DOGGETT, HARRY C. KELLY, FORREST W. LANCASTER, J. S. MEARES, A. C. MENIUS, JR., R. H. SNYDER, NEWTON UNDERWOOD, A. W. WALTNER
Associate Professors:
**J. T. LYNN, *Graduate Administrator*, R. F. STAINBACK, E. JACK STORY
Assistant Professors:
E. J. BROWN, WILLIAM P. BUCHER, GROVER C. COBB, JR., R. L. DOUGH, WILLIAM R. DAVIS RAOUL M. FREYRE, D. H. MARTIN, M. R. MOSS, J. Y. PARK
Instructors:
HUBERT L. OWEN, J. T. SPENCE

Physics is a fundamental science of observations, measurements and mathematical description of the particles and processes of nature. Included in the study of classical physics—mechanics, heat, sound, electricity, magnetism and optics—plus modern physics embracing atomic, ionic, and nuclear particles and phenomena. In addition to extending our basic knowledge of the universe, the science of physics provides an attack on problems of importance in modern technology. The variety of the contributions made by physicists is indicated by these typical activities—discovery and measurements on new particles of nature; the invention and use of new instruments to probe interplanetary space; the prediction of behavior of nuclear chain reactors; the study of processes fundamental to the release of thermonuclear energy; and research on missiles, satellites and spacecraft.

Programs

The Physics Department provides courses in fundamental physics and in several specializations relating to nuclear reactions, reactor analysis, radioactivity, radiological health and safety, electrical discharges in gases and space phenomena.

Opportunities

The demand for graduates with fundamental and specialized knowledge in physics has grown rapidly in recent years. The demands for scientists are currently greatest in the nuclear energy and missile and space fields in which large research and development programs are in progress. Positions are available to qualified individuals in government laboratories, industrial research facilities and in universities.

* On leave
** Acting head

ysics Curriculum

Typical curricula emphasizing fundamental physics and nuclear science e shown below.

: the freshman year see page 204.

Sophomore Year

l Semester	*Credits*	*Spring Semester*	*Credits*
.206, General Physics	4	PY 207, General Physics	4
202, Analytic Geometry and Calculus III	4	MA 301, Differential Equations	3
Foreign Language	3	English Elective	3
Humanities Elective	3	Foreign Language	3
:201, Physical Education	1	Humanities Elective	3
:201, Military Science II or .201, Air Science II	1	PE 202, Physical Education	1
		MS 201, Military Science II or AS 201, Air Science II	1
	16		18

Junior Year

! Semester	*Credits*	*Spring Semester*	*Credits*
401, Mechanics or 403, Electricity and Magnetism	4	PY 402, Heat and Sound or PY 404, Optics	4
407, Modern Physics	3	PY 410, Nuclear Physics I	4
441, Advanced Calculus I	3	Mathematics	3
301, Contemporary Civilization	3	SS 302, Contemporary Civilization	3
Minor	3	Minor	3
Free Elective	3		
	19		17

Senior Year

(Fundamental Physics Emphasis)

: Semester	*Credits*	*Spring Semester*	*Credits*
401, Mechanics or 403, Electricity and Magnetism	4	PY 402, Heat and Sound or PY 404, Optics	4
Mathematics	3	Mathematics	3
491, Contemporary Issues	3	PHI 405, Foundations of Science	3
Minor	3	Minor	3
Free Electives	6	Free Elective	3
	19		16

Senior Year

(Nuclear Science Emphasis)

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 510, Nuclear Physics II	4	PY 520, Physical Measurements in Radioactivity	3
PY 518, Radiation Hazards and Protection	3	PY 530, Introduction to Nuclear Reactor Theory	3
Mathematics	3	PY 531, Nuclear Reactor Laboratory	1
SS 491, Contemporary Issues	3	Mathematics	3
Free Electives	6	PHI 405, Foundations of Science	3
	19	Free Elective	3
			16

Graduate Study

The Department of Physics provides programs of advanced study applied physics leading to the master's and doctor's degrees. A research thesis is required for each degree. A comprehensive understanding classical and modern physics is stressed, with study in either nuclear s ence or fundamental physics, nuclear reactor theory, radiological heal and safety, plasma physics, space physics, and the theory of fields. Work the student's minor field will generally be taken in other departments the School of Physical Sciences and Applied Mathematics. Research fac ties available include a 10-kilowatt heterogeneous reactor, a 100-w water boiler reactor, a natural uranium sub-critical assembly, a one-M Van de Graaff accelerator, and high speed computing equipment. Plas laboratories with precision equipment are available. Experimental search is in progress on neutron diffusion by pulsed methods, high curr particle streams, and simulation of space conditions. Research and tea ing assistanships are available to qualified graduate students.

Computing Center

Professor D. R. SHREVE, *Director*

An IBM 1410 digital computer is located in the Computing Cente in Patterson Hall. The computer, a card type system with 40,000 chara rs of core storage, is used for faculty and student research, and for instruc on in scheduled credit courses and non-credit short courses.

Credit courses in computing are supplemented by instruction in m- puter programming included in courses offered by several departmen in the College, by a continuous offering of non-credit short courses, an by use of IBM 1620 computers, and a variety of analog computers in se ral other departments.

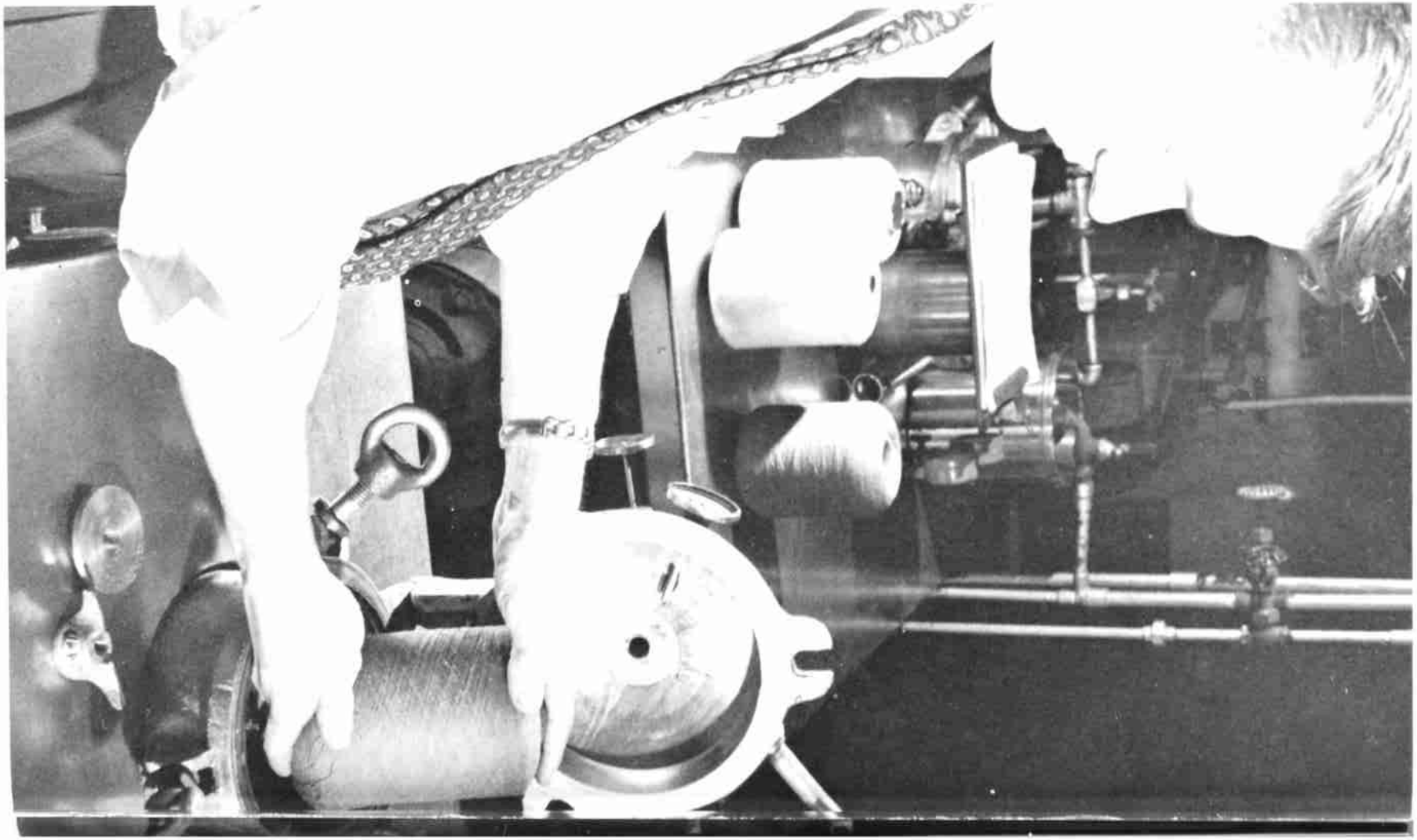
Physical Sciences Research

J. STORY, *Head*
search Engineer:
M. A. KOONTZ
search Associate:
B. E. LEONARD

ne Burlington Nuclear Laboratories building, which houses a 100 kilo itt heterogeneous research reactor, plus 32 rooms including research oratories, offices and shops, is the school's major facility for research nuclear physics, radiation, and nuclear sciences. The facilities also in- ude a 100 watt homogeneous reactor, a natural uranium subcritical sembly, and a considerable investment in research equipment, princi- lly nuclear electronics.

Other major facilities in the School of Physical Sciences and Applied athematics include plasma physics laboratories, a 1 Mev Van de Graaff celerator, chemistry and radioisotope laboratories, a spectroscopy labora- ry and analog computers.

In addition to contracted research for industrial firms, support is re- ived from federal agencies.



School Of Textiles

MALCOLM E. CAMPBELL, Dean
JAMES W. KLIBBE, Academic Coordinator

The manufacture of textiles has become one of the world's leading industries. North Carolina's textile industry now ranks first in the nation in terms of employment and value of manufactured products. Furthermore, the textile industry of the State and the area is broadly diversified, ranging from the production of man-made fibers to finished garments, from cotton spinning mills to finishing plants, from woven goods to all types of knitted materials, and from suppliers to machine manufacturers. Because of the tremendous expansion in the scope of textiles it has become necessary to utilize the talents of the chemist, the physicist, the engineer, the businessman, as well as the traditional spinner, weaver, and dyer.

The School of Textiles offers several programs at both the undergraduate and graduate levels in the applied sciences underlying the production and finishing of textile products. Textile research supplements and supports graduate study.

The purpose of the school is fourfold: to educate men and women for professional service in all phases of the textile industry; to develop their capacities for intelligent leadership; to aid in the economic development of the textile industry; and to cooperate with the textile industry in improving through scientific research, manufacturing efficiency and the quality and value of manufactured products.

In the educational program, for administration, the School of Textiles is organized into three departments: Textile Technology, Knitting Technology, and Textile Chemistry.

Curricula

The School of Textiles offers two basic four-year curricula, textile technology and textile chemistry. After the freshman year these two programs differ; however, there is sufficient similarity in the first year to permit the student to defer the final decision as to his major field of study until the end of the freshman year.

A program is offered by the school to permit the student with a B.S., A.B., or B.A. degree from an accredited college or university to complete the requirements for a Bachelor of Science degree in textile technology after the satisfactory completion of one year of study.

The over-all program of the textile technology curriculum includes course work in the basic sciences and humanities as well as in the profes

sional area of textiles. The arrangement of stems within the curriculu permits for specialization in various areas which lead in one direction a high concentration of work in the basic sciences and in the other dire tion to greater depth in the study of economics. The various avenues selection open to the students are as follows, with specialization as inc cated: fiber and yarn technology, fabric technology, general textiles, kn ting technology, and textile management.

The latter program provides substantial depth in the fundamentals economics as well as work in the basic sciences, humanities, and profe sional textile areas. It is believed that this program provides a firm found tion on which to develop business skills. As with the other programs textile technology, the student has further choice within the manageme program depending on his desire to follow micro, macro, or quantitati economics.

Textile chemistry is designed to give the student a fundamental edu tion in chemistry with special emphasis on the application of this scien to textiles. The textile chemistry curriculum places emphasis on chemi fundamentals so that those students who complete this program with high degree of excellence are adequately prepared for graduate stu either in pure or applied chemistry. Similarly, students who complete t program in any one of the stems in textile technology with a high degr of excellence would be acceptable for graduate study in many differe areas.

Inasmuch as the professional work in textiles is concentrated to a gr extent in the last two years in the student's program, it is quite possi for students from either junior colleges or other institutions of high learning to transfer to the School of Textiles with a minimum loss time.

Degrees

Upon completion of programs in textile technology, the degree Bachelor of Science in textile technology is conferred. Upon completion the program in textile chemistry, the degree of Bachelor of Science in t tile chemistry is conferred.

The degree of Master of Science in textile technology or of Master Science in textile chemistry is offered for the satisfactory completion c minimum of one year of graduate study in residence. Candidates for degree of Master of Science enter and are enrolled in the Graduate Sch of the College. A Master of Textile Technology degree is also offered. general requirements, consult the Graduate School Catalog.

Facilities

The Nelson Textile Building, erected in 1939 and greatly enlarged 1950, was designed to coordinate teaching and laboratory facilities. houses one of the most modern and best equipped textile institutions the world. The Department of Textile Chemistry is housed in remode Mangum Hall, one hundred yards south of the Nelson Textile Build

pportunities

Technological advances in textile fibers and manufacturing techniques ıve created a tremendous demand for men technically trained in textile ılleges. For the past several years, the School of Textiles has had a demand r graduates greater than it could supply. Its graduates have entered the xtile industry at salaries equal to or better than those offered in many her industries.

Graduates of the school are equipped to enter many fields related to xtiles, such as manufacturing, sales or research; and alumni of the school ɔld responsible positions in each of these fields. Many are now mill presi-ɛnts or general managers.

Some of the specific fields selected by State College textile graduates e production of yarns, production of woven and knitted fabrics, dyeing ıd finishing, industrial engineering, quality control, designing, styling, erchandising, converting, research, cost and production control, and les of equipment and materials to the textile industry.

To assist in the placement of students and alumni and to facilitate in-rviews by textile firms, the school maintains a full-time placement di-ɛctor.

espection Trips

For certain of the textile courses offered, it is desirable for the stu-ɛnt to see the manufacturing process under actual operating conditions. /hen possible, trips are arranged for student groups to visit outstand ıg manufacturing plants. Participation in the trips is required; transpor tion costs and other travel expenses, while held to a minimum insofar possible, must be paid by the student.

nort Courses

It is the policy of the school to offer course training for textile mill men ho have a limited amount of time to spend at the school. These courses e offered when a sufficient demand for them develops. The subject mat r is selected to meet the needs of the group.

istinguished Professorships

The School of Textiles has four sponsored professorships. These are ade possible by funds contributed to the North Carolina Textile Foun-ation, Inc., and especially designated to pay a part of the annual salary ɛ the professor selected to fill the position.

The four professorships, together with the year of establishment and the ame of the incumbent for each, are as follows:

Burlington Industries Professorship of Textiles 1946, Dame S. Hamby, rofessor of textiles, Department of Textile Technology.

Chester H. Roth Professorship of Knitting Technology 1948, William dward Shinn, professor of textiles and head of Department of Knitting echnology.

Abel C. Lineberger Professor of Yarn Manufacturing 1948, Elliot Bro Grover, professor of textiles and head of Department of Textile Techn ogy.

Edgar and Emily Hesslein Professorship of Fabric Development 19 (open)

Department of Knitting Technology

Professor WILLIAM E. SHINN, *Head of the Department and Director, Knitting Research*
Assistant Professor:
H. M. MIDDLETON, JR.
Instructor:
PETER LI

In recognition of the great importance of knitting and the other nee arts in the industrial life of this section, the Department of Knitt Technology makes available to this branch of the textile industry, pers nel trained in the fundamentals and practices underlying the productio knitted textiles.

Curriculum

Knitting technology students follow the textile technology curricu and elect Stem 4. For a list of the curriculum by years see pages 225 226.

Facilities

The laboratories of the Knitting Technology Department, organized equipped for instruction in many phases of the knit-goods industry, re grouped as follows:

Seamless Hosiery

Equipment for instruction in seamless hosiery production includes presentative types of machines arranged in two groups. The more eler tary types, including ribbers and plain hosiery machines with the ele tary attachments such as stripers, reverse plating and rubber top att ments, are arranged together for beginning students. The more adva types are grouped together for advanced students. This line includes vanced rib type machines, Komets, Banner Wrap Reverse, several typ float stitch machines, and machines for the manufacture of hosiery solid color patterns.

Nylon Hosiery

This section is equipped with full-fashioned hosiery knitting mac of modern types, in 45-gauge, 51-gauge, 54-gauge, and 66 gauge. The provided also three 400-needle women's nylon hosiery machines of the cular type. This equipment forms the basis for instruction in the ge course in hosiery manufacture and for the more advanced instruction in

fashioned hosiery production. Equipment for the looping and seaming of hosiery, for pre-boarding, dyeing and finishing of fine hosiery is provided in separate rooms.

Circular Knitwear

A wide assortment of large diameter fabric knitting machines is provided for demonstration and instruction in the production of cloth for both underwear and outerwear. This group includes latch needle and spring needle types for jersey, rib, interlock and Jacquard fabric.

Garment Cutting and Seaming

A laboratory for experimental garment design and manufacture has been set up with modern power cutting equipment and many types of industrial sewing machines for producing garments for both outerwear and underwear. This unit is supplemented by knit goods finishing equipment located in the hosiery and knitwear finishing laboratory.

Warp Knitting, Flat Knitting

The knitting department laboratories include eight warp knitting machines of the tricot and raschel types. These machines furnish the basis for instruction in the design analysis, and production of warp knitted fabrics. A collection of fabrics and several winding and warp preparation machines make it possible to process a variety of materials. Flat machines of the V-bed and links-and-links class are employed for instruction in the producton of heavier knitwear such as sweaters.

Knit Goods Finishing

Devoted entirely to experimental work in hosiery and knit goods finishing, this laboratory contains modern equipment for pre-boarding, dyeing and finishing machinery, a knit goods calendar for finishing knitted tubing, and a fabric brush.

Department of Textile Chemistry

Professor HENRY A. RUTHERFORD, *Head of the Department and Director, Chemical Research*
Professor:
K. S. CAMPBELL
Associate Professors:
A. C. HAYES, D. M. CATES, *Associate Director, Chemical Research*

The purpose of the Department of Textile Chemistry is to instruct students in the chemistry of natural and synthetic fibers, and in the theory and practice of scouring, bleaching, dyeing, finishing and printing of yarns and fabrics; to conduct laboratory experimental work demonstrating the principles set forth in lecture periods; to cooperate with the mills of the State in solving problems relating to the wet processing of textile materials.

Curriculum

Two recent changes in the curriculum in textile chemistry have resulted in a strengthening of the program. In the senior year, the student is given the option of electing a course of study which includes physical chemistry or may in its place elect a stem of courses in textile technology. In the latter, three areas are provided which furnish depth in quality control, fabric technology, or yarn technology. A student may elect also a three course sequence of a minimum of nine semester hours in psychology, industrial engineering, or from the School of General Studies.

Students who expect to pursue a course of graduate study are urged to take the chemistry option. The technology option is primarily for students who expect to go into production.

In either option, the curriculum places emphasis on the fundamentals of chemistry. Adequate background in social sciences and humanities is also provided.

Graduate Studies

A master's degree in textile chemistry is offered for the satisfactory completion of one year of graduate study in residence. The program in textile chemistry and its related area, polymer science, is intended to provide professional training at the graduate level. The student with a bachelor's degree in chemistry or chemical engineering will generally have the academic background to undertake it. The student with a major in physics may desire to enroll in one or two undergraduate courses in chemistry to erase certain deficiencies.

Five courses, that are described in the section on Description of Courses (TC 403, 404; TC 511, 512; TC 605; and TC 606), are the core of the education plan at the graduate level. The selection of courses beyond the ones mentioned depends on the student's interest and the nature of his thesis research. The objective is to stimulate basic research and to train scientists in the general field of fiber and polymer chemistry, with proper emphasis on the supporting sciences. Although fiber forming polymers are emphasized, the program is broad in scope, providing an opportunity for training and research in general principles in the polymer field, as well as advanced study in chemistry, physics, and mathematics.

Fellowships and assistantships are available for qualified students.

Facilities

Facilities available in textile chemistry follow:

Dyeing Laboratory

This is a complete laboratory with generous provision for bench space, equipment storage facilities, utilities and steam baths. It is used for laboratory work dealing with chemical properties of textiles, dye synthesis, color matching and all types of dyeing.

Dye House

In this room is assembled a collection of dyeing and finishing machinery r instructional and experimental purposes. Obtained over the last few ars, the equipment includes a singeing machine, a continuous dyeing nge of the pad-steam type, a Williams unit, a du Pont type continuous eaching unit, four package dyeing machines, a dye beck, dye jig, rotary siery dyeing machine, piece goods dyeing and finishing units utilizing y cans, enclosed tenter frame and a continuous loop drying and curing nit supplied with both steam and gas-fired heat sources and a laboratory lendar.

Research and Textile Chemical Analysis

Six laboratories equipped for chemical research on fibers and on textile emical specialties are available for use by advanced undergraduate stu-nts working on special problems and for research. Equipment includes reflectometer, a spectrophotometer with all supplementary apparatus, olorimeters and the common testing equiment used for evaluation and r determining color-fastness, wash-fastness, etc., of dyed fibers and fabrics.

extile Chemistry Curriculum

Freshman Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
NG 111, English	3	ENG 112, English	3
H 105, Chemistry	4	CH 107, Chemistry	4
A 101, Mathematics	5	MA 102, Mathematics	4
I 252, U. S. History	3	TX 221, Fundamentals of Textiles	3
MS 101, Military Science I		ME 101, Engineering Graphics	2
or		*MS 102, Military Science I	
AS 121, Air Science I	1	or	
PE 101, Physical Education	1	*AS 122, Air Science I	1
		*PE 102, Physical Education	1
	17		18

Sophomore Year

ll Semester	*Credits*	*Spring Semester*	*Credits*
A 211, Calculus	3	MA 212, Calculus	3
Y 211, Physics	4	PY 212, Physics	4
H 221, Organic Chemistry	4	**English Elective	3
X 281, Fiber Quality	3	CH 223, Organic Chemistry	4
MS 201, Military Science II		TX 261, Fabric Structure	3
or		*MS 202, Military Science II	
AS 221, Air Science II	1	or	
PE 201, Physical Education	1	*AS 222, Air Science II	1
		*PE 202, Physical Education	1
	16		19

* Students excused from military or air science and/or physical education will schedule equivalent credits in courses from the following departments: Economics, English, History and Political Science, Modern Languages, Philosophy and Religion, Psychology, Rural Sociology, Social Studies, or Sociology.
** If approved in advance, students who average C or above on composition, English 111, 112 may substitute 6 credits of modern languages.

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
*English Elective	3	PS 201, American Government	3
**Humanities, Economics or Social Science	6	Humanities or Economics	3
ST 361, Introduction to Statistics	3	TX 327, Textile Testing	4
TC 303, Textile Chemistry III	3	CH 215, Quantitative Analysis	4
Electives	3	TC 304, Textile Chemistry III	3
		Electives	3
	18		20

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
TC 403, Textile Chemical Technology	3	TC 404, Textile Chemical Technology	3
TC 405, Textile Chemical Tech. Lab.	2	TC 406, Textile Chemical Tech. Lab.	2
TC 511, Chemistry of Fibers	3	TC 501, Seminar in Textile Chemistry	2
TC 412, Textile Chemical Analysis	3	TX 581, Instrumentation	3
Electives	3	Electives	3
CH 431, Physical Chemistry (1)	3	CH 433, Physical Chemistry (1)	3
or		or	
Stem Hours (See below) (2)	3	Stem Hours (See below) (2)	4
	17		16 or 17

(1) Only for students electing chemistry option.
(2) Only for students electing technology option.

Credits Required—Freshman year, 35; sophomore year 35; junior year 38; senior year, Physical Chemistry Option 33; total 141. Senior year Technology Stem Option, 34; total 142.

Stem Requirements

Stem 1. Quality Control	*Credits*	*Stem 2. Fabric Technology*	*Credits*
TX 521, Textile Testing II	3	TX 365, Fabric Technology	4
TX 522, Textile Quality Control	3	TX 575, Fabric Analytics and Characteristics	3
Transfer to free electives	1		
	7		7

Stem 3. Yarn Technology	*Credits*
TX 303, Fiber and Yarn Technology	4
TX 430, Continuous Filament Yarns	
or	
TX 436, Staple Fiber Processing	3
	7

Stem 4. General

Students electing this stem must take a three-course sequence totaling a minimum of nine semester hours. The sequence will generally be selected from courses in psychology, industrial engineering, or from the School of General Studies. The sequence must be approved by the student's adviser.

* If approved in advance, students who average C or above on composition, English 111, 112 may substitute 6 credits of modern language.
** Students electing Stem 4 may use these credits in conjunction with the stem hours to take a third course sequence in psychology, industrial engineering, or economics.

Department of Textile Technology

rofessor ELLIOT B. GROVER, *Head of the Department and Textile Research*
rofessors:
J. F. BOGDAN, *Director, Processing Research*, D. S. HAMBY, J. A. PORTER
ssociate Professors:
W. E. MOSER, J. E. PARDUE, W. C. STUCKEY, JR.
ssistant Professors:
E. B. BERRY, J. W. KLIBBE, W. E. SMITH, R. L. WIGGINS
structors:
I. A. BIRKAN, JAMES A. KING, L. T. LASSITER, W. K. LYNCH, H. I. MAKHLOUF

The purpose of the Department of Textile Technology is to instruct stu ents in the theory and fundamental concepts, at both the basic and ad anced levels, of fiber properties and fiber processing through yarns and abrics. This is accomplished through the systematic study of the engi eering properties of both the materials being processed and of the equip ient involved in manufacturing. In addition, the department is engaged n research, with the support for the basic areas of work coming from ollege funds, and applied research through the sponsors of the work. Not nly faculty, but graduate and, when practical, undergraduate students are ncouraged to participate in the research programs.

urriculum

The curriculum in textile technology involves a basic education for ie first two years in the physical sciences, humanities, and social sciences. fter the student has completed this phase of his education, he is then ught the application of the fundamental sciences to the areas of textile chnology.

The textile technology curriculum represents a new approach to textile lucation. It is directed towards a common first year within the school with andardized basic requirements in physical sciences. The major portion of ourse work in textile technology is deferred to the junior and senior ars in order to provide the best possible background for students before ntering the major field.

The primary objective of the textile technology curriculum is to pro de as general an education as possible and at the same time to prepare e graduate for profitable employment in the textile industry. This is complished through an integration of physical sciences and the applica on of the sciences and economics to the field of textiles.

In addition to the wide selection of basic sciences, the student also has e opportunity for diversification within the School of Textiles. The rriculum offers depth in such selected areas as fiber and yarn technology, bric technology, knitting technology, general textiles, and textile manage ent.

The curriculum for the one year Bachelor of Science program in textile chnology for approved college graduates is found on page 230.

raduate Studies

The Department of Textile Technology offers a graduate program lead g to a degree of Master of Science in textile technology. This program

is designed for students interested in advanced study directed toward individual research and investigations, and is so developed that students may major in the field of textile technology and minor in approved areas such as statistics, industrial engineering, and textile quality control. A limited number of fellowships and scholarships are available to students who qualify. The Master of Textile Technology degree program is designed for the student primarily interested in manufacturing, sales, management, and other non-scientific or non-technical aspects of the textile industry. This degree does not require a thesis or a foreign language.

Facilities

The facilities of the Department of Textile Technology are subdivided into respective areas for processing cotton and other short staple fibers: woolen, worsted and long staple synthetic fibers: continuous filament yarns; warp preparation and slashing; cam, dobby, and jacquard weaving; physical testing; and applied research laboratories.

Cotton and Short Staple Synthetics

This area is complete in respect to the most modern of opening, picking, carding, combing, drawing, roving, spinning, winding, and twisting equipment. The laboratory facilities are kept up to-date which enables the school to maintain one of the most complete and modern facilities of this type in the world.

Woolen, Worsted, and Long-Staple Synthetic Fibers

A laboratory is set up for the processing of wool and long-staple synthetic fibers and blends. Included in the equipment is a Davis and Furber Wool Unit, complete from machinery to handle blending through spinning. Another set of machinery in this laboratory is designed to process the longer staple natural and synthetic fibers on the American worsted and new fiber systems. Tow-to-top machines, rectilinear combs, intersecting gills, wide ratch roving and spinning frames, and other supplemental equipment permit the processing of these fibers in many commercially oriented paths into spun yarns.

Continuous Filament Yarns

The continuous filament laboratory has the complete range of equipment necessary for the processing of thrown yarn and includes: soaking tub, extractor, dryer, twist-setting oven, spooler, upstroke twisters, double twister, quill winder, cone winders, and nylon sizing machine, plus supplementary equipment such as a texturizing machine.

Warp Preparation and Slashing

The equipment for preparing yarn for weaving includes a modern high speed warper, rayon-type slasher, and a small scale experimental slasher, as well as auxiliary equipment. There is also a silk-type combination warper and beamer used for making short warps for student instruction. There is a separate room for drawing in warps.

Cam, Dobby, and Jacquard Weaving

The weaving facilities are subdivided into three laboratories: cam, jacquard, and dobby weaving. On this equipment instruction is given in how to produce such fabrics as print cloths, denims, sateens, ginghams, fancy shirting, dobby weave dressing and drapery materials, pile, leno and jacquard fabrics, woven from natural and synthetic fibers. All weave rooms are completely humidified.

Physical Testing

There are three separate air-conditioned laboratories, two of which are used for teaching and undergraduate student work and another for industrial research and graduate student research.

The laboratories contain all equipment for the physical testing of fibers, yarns and fabrics. Included in the equipment are a complete range of fiber testing equipment, three Instron Testers, several torsion and other types of balances, several combination skein and fabric breaking machines, inclined plane testers, single strand pendulum testers, Uster dynamometer, bursting strength testers, drying ovens, abrasion machines, twist testers, hydrostatic pressure tester, automatic reels, permeability testers, eight evenness testers, three Uster spectrographs, and many other type of laboratory equipment, including both commercial and special instruments developed at the school. In addition, the laboratory contains microscopes, cross sectioning devices and equipment for photomicrography. A darkroom containing the necessary equipment for photographic work is also available.

Applied Research Laboratories

Four separate laboratories for applied research in fiber processing and weaving are located in this department. These laboratories are completely equipped and designed for research by students and faculty in the areas of fiber processing, warp preparation and weaving.

Textile Technology Curriculum

(Fiber and Yarn Technology, Fabric Technology, General Textiles, and Knitting Technology Stems)

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101, Chemistry	4	CH 103, Chemistry	4
*MA 101, Mathematics	5	*MA 102, Mathematics	4
ENG 111, English	3	ME 101, Engineering Graphics	2
HI 252, U. S. History	3	ENG 112, English	3
**MS 101, Military Science I		TX 221, Fundamentals of Textiles	3
or		**MS 102, Military Science I	
**AS 121, Air Science I	1	or	
**PE 101, Physical Education	1	**AS 122, Air Science I	1
		**PE 102, Physical Education	1
	17		18

* Students below a selected cut-off point in placement tests in mathematics will take Mathematics, MA 111, 112 and one more hour of free electives. In addition, they must take either Stem 3 or 4.

** Students excused from military or air science and/or physical education will schedule equivalent credits in courses from the following departments: Economics, English, History and Political Science, Modern Languages, Philosophy and Religion, Psychology, Rural Sociology, Social Studies, and Sociology.

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 201, Physics	5	PY 202, Physics	5
and		and	
MA 201, Calculus	4	MA 202, Calculus	4
or		or	
PY 211, Physics	4	PY 212, Physics	4
and		and	
*Electives from Schedule A	3	*Electives from Schedule A	4
**English	3	Humanities or Economics	3
PS 201, American Government	3	TX 281, Fiber Quality	3
TX 261, Fabric Structure	3	***MS 202, Military Science II	
***MS 201, Military Science II		or	
or		***AS 222, Air Science II	1
***AS 221, Air Science II	1	***PE 202, Physical Education	1
***PE 201, Physical Education	1		16 or 17
	18 or 20		

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
**English	3	TX 327, Textile Testing	4
ST 361, Statistics	3	Free Electives	3
TX 303, Fiber and Yarn Tech.	4	Stem Hours	8
TC 201, Textile Chemistry I	2	****Elective from Schedule A	3
TX 365, Fabric Technology	4		15 or 18
TX 342, Knitting Principles	2		
	18		

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Humanities	3	Social Sciences	3
TX 581, Instrumentation	3	TX 485, Mill Design and	
TC 307, Textile Chemistry	4	Organization	3
TX 442, Knitted Fabrics	3	Free Electives	6
Free Electives	3	Stem Hours	5
Stem Hours	3		17
	19		

Credits required—freshman year, 33; sophomore year, 36; junior year, 36; senior year, 36; total hours, 141.

* Students selecting this sequence of courses must re schedule hours in second semester of sophomore and junior year.

** If approved in advance, students who average C or above on Composition, English 111, 112, may substitute 6 credits of modern languages.

*** Students excused from military or air science and/or physical education will schedule equivalent credits in courses from the following departments: Economics, English, History and Political Science, Modern Languages, Philosophy and Religion, Psychology, Rural Sociology, Social Studies or Sociology.

**** Students electing PY 201, 202; MA 201, 202 sequence do not take this course.

Stem Requirements

(Fiber and Yarn Technology, Fabric Technology, General Textiles, and Knitting Technology Stems)

Stem 1 and 2 require the MA 201, 202 sequence.

Stem 1. Fiber and Yarn Technology	*Credits*
TX 304, Fiber & Yarn Tech.	4
TX 436, Staple Fiber Process.	3
TX 430, Cont. Filament Yarns	3
and either	
TX 366, Fabric Technology	4
and	
TX 483, Textile Cost Methods	2
or	
Selection from Schedule B	6, 7, or 8*
	16 (to 18)

Stem 2. Fabric Technology	*Credits*
TX 366, Fabric Technology	4
TX 575, Fabric Analytics and Characteristics	3
TX 478, Design and Weaving	3
and either	
TX 304, Fiber and Yarn Tech.	4
and	
TX 483, Textile Cost Methods	2
or	
Selection from Schedule B	6, 7, or 8*
	16 (to 18)

Stems 3 and 4 do not require MA 201, 202 sequence.

Stem 3. General Textiles	*Credits*
TX 304, Fiber & Yarn Tech.	4
TX 366, Fabric Technology	4
TX 483, Textile Cost Methods	2
Electives from Schedule C	6
	16

*Stem 4. **Knitting Technology*	*Credits*
TX 483, Textile Cost Methods	2
TX 430, Continuous Filament Yarns	3
TX 441, Flat Knitting	3
TX 444, Garment Manufacture	3
TX 447, 118, Advanced Knitting Lab	4
Transfer to Free Electives	1
	16

Schedule A

Schedule A is comprised of two or three course sequences totaling in each case a minimum of eight semester hours. The sequence elected by the student must meet with the approval of his adviser. Illustrative of the sequences would be studies in the areas of industrial engineering, industrial psychology, economics, or other approved fields of study. Any differences in hours between the minimum of eight which are required and the 10 allocated may be transferred to free electives.

Schedule B

Schedule B is comprised of two-course sequences totaling in each case a minimum of six credit hours. The sequence elected by the student must meet with the approval of his adviser. Illustrative of the sequences would be studies in the areas of mechanics and strength of materials, advanced statistics, advanced physics, industrial engineering, textile quality control, and other approved courses of the 300 level or above in the physical or applied science field.

Schedule C

Schedule C is comprised of two-course sequences in the field of textiles totaling in each case a minimum of six credit hours. Illustrative of the sequences available are the following:

Any hours above the six allocated may be taken from free electives.
Either Mathematics—Physics sequence is acceptable.

	Credits
TX 436, Staple Fiber Processing	3
and	
TX 430, Continuous Filament Yarns	3
TX 575, Fabric Analytics and Characteristics	3
and	
TX 478, Design and Weaving	3
TX 521, Textile Testing II	3
and	
TX 522, Textile Quality Control	3

Schedule D

Schedule D is comprised of a three course sequence from one of the following fields totaling in each case a minimum of nine credit hours: English, foreign languages, history, political science, sociology, psychology, natural science, and physical science.

Textile Technology Curriculum (Management Option)

Freshman Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101, Chemistry	4	CH 103, Chemistry	4
*MA 101, Mathematics	5	*MA 102, Mathematics	4
ENG 111, English	3	ME 101, Engineering Graphics	2
HI 252 U. S. History	3	ENG 112, English	3
**MS 101, Military Science I		TX 221, Fundamentals of Textiles	3
or		**MS 102, Military Science I	
**AS 121, Air Science I	1	or	
**PE 101, Physical Education	1	**AS 122, Air Science I	1
		**PE 102, Physical Education	1
	17		18

Sophomore Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 211, Physics	4	PY 212, Physics	4
MA 201, Mathematics	4	MA 202, Mathematics	4
or		or	
***MA 211, Mathematics	3	***MA 212, Mathematics	3
PS 201, American Government	3	TX 281, Fiber Quality	3
TX 261, Fabric Structure	3	EC 301, Economics	3
EC 201, Economics	3	**MS 202, Military Science II	
**MS 201, Military Science II		or	
or		**AS 222, Air Science II	1
**AS 221, Air Science II	1	**PE 202, Physical Education	1
**PE 201, Physical Education	1		
	18 or 19		15 or 16

* Students below a selected cut off point in placement tests in mathematics will take Mathematics MA 111, 112 and one more hour of free electives

** Students excused from military or air science and or physical education will schedule equivalent credits in courses from the following departments: Economics, English, History and Political Science, Modern Languages, Philosophy and Religion, Psychology, Rural Sociology, Social Studies, or Sociology

*** Students selecting this option transfer 2 hours to free electives

Junior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ST 361, Statistics	3	*English	3
TX 303, Fiber and Yarn Technology	4	TX 365, Fabric Technology	4
TC 201, Textile Chemistry I	2	TX 327, Textile Testing	4
EC 302, Economics	3	Free Electives	3
Stem Hours	6	Stem Hours	3
	18		17

Senior Year

Fall Semester	*Credits*	*Spring Semester*	*Credits*
*English	3	TX 485, Mill Design and Organization	3
TC 307, Textile Chemistry II	4	EC 490, Senior Seminar in Economics	3
TX 342, Knitting Principles	2	Free Electives	6
Free Electives	3	Stem Hours	6
Stem Hours	6		18
	18		

Credits required—freshman year, 33; sophomore year, 37; junior year, 35; senior year, 36; total 141.

Additional Stem Requirements

Stem 5. Micro Economics	*Credits*
EC 312, Accounting for Engineers	3
EC 410, Industry Studies or EC 413, Competition, Monopoly and Public Policy	3
Two courses from the following in economics: EC 310, EC 410, or EC 413, EC 440, EC 446, and EC 448	6
Selection from Schedule D	9
	21

Stem 6. Macro-Economics	*Credits*
EC 312, Accounting for Engineers	3
EC 440, Economics of Growth	3
EC 444, Economic Systems	3
EC 448, International Economics	3
Selections from Schedule D	9
	21

Stem 7. Applied Economics	*Credits*
EC 312, Accounting for Engineers	3
EC 410, Industry Studies or EC 450, Economic Decision Processes	3
EC 552, Econometrics	3
**MA 405, Introduction to Determinants & Matrices	3
Selections from Schedule D	9
	21

* If approved in advance, students who overage C or above on Composition, English 111, 112, may substitute 6 credits of modern language.

** MA 202 is a prerequisite for MA 405. Therefore, students taking Stem #7 must take MA 201, 202 rather than MA 211, 212.

One Year Bachelor of Science Curriculum

Fall Semester	*Credits*	*Spring Semester*	*Credits*
TX 221, Fundamentals of Textiles	3	TX 304, Fiber and Yarn Technology	4
TX 261, Fabric Structure	3	TX 327, Textile Testing	4
TX 281, Fiber Quality	3	TX 365, Fabric Technology	4
TX 303, Fiber and Yarn Technology	4	TX 430, Continuous Filament	3
TX 342, Knitting Principles	2	TX 485, Mill Design and Organization	3
*ST 361, Introduction to Statistics	3		
	18		18

Summer Semester

First Session	*Credits*	*Second Session*	*Credits*
TC 307, Textile Chemistry	4	TX 366, Fabric Technology	4
TX 436, Staple Fiber Processing	3		
	7		

Students completing this program may continue to the graduate level if scholastic average is suitable.

* If appropriate background has been received in statistics a substitution may be made for this course.

Textile Research

The School of Textiles is actively engaged in a program of basic and applied research both State-supported and sponsored, carried on primarily in the educational departments concerned. In textile chemistry, the overall direction is under Professor Henry A. Rutherford, head of the department. Dr. David Cates is the assistant director of chemical research, handling primarily basic areas, and W. R. Martin, Jr., heads the sponsored and applied areas. In the Department of Textile Technology, which encompasses all the areas outside those involved in chemistry and knitting, the overall direction is under Professor E. B. Grover, head of the department, with Professor John F. Bogdan in direct charge of all sponsored programs. Research in knitting technology is under the direction of Professor W. E. Shinn, head of the Department of Knitting Technology.

Textile Machine Development

C. M. ASBILL, JR., *Head*

The Department of Textile Machine Development was established to assist the textile industry and the students of the School of Textiles in matters relating to textile processing machinery and testing apparatus.

Specifically the objective of the department is to make available to the textile industry and to the faculty and students of the School of Textiles the facilities of a qualified textile engineering department with means for the design, construction and testing of new or improved equipment.

The department attempts to keep informed as to modern machinery and practices by maintaining close contact with textile mills and machine man-

ufacturers as well as by a digest of technical articles and patents, and by participation in technical and scientific conferences.

The physical facilities of the department include a completely equipped machine shop and electronics section, together with thoroughly trained operating personnel.

Textile Placement Bureau

Professor GEORGE H. DUNLAP, *Director*

The Placement Bureau is a clearing house for students in the graduating class and for textile alumni. It is a coordinating agency for the employer and the graduates of the School of Textiles. The Placement Bureau tries to keep an accurate file of all textile alumni and the progress they have made. Therefore, all alumni are requested to notify the director when they receive a promotion or transfer from one organization to another.

Textile Library

ADRIANA P. ORR, *Librarian*

As a result of a substantial gift by the Burlington Mills Corporation, the Textile Library was relocated in the Textile Building in 1951. The new, enlarged quarters were designed to incorporate the latest functional improvements.

The library was organized in 1944 incorporating the entire textile collection from the D. H. Hill Library. There are now about 9,000 volumes of which 3,000 are bound periodicals. The library subscribes to 150 current periodicals, both American and foreign, which are thoroughly indexed in Industrial Arts Index, Chemical Abstracts, Natural and Synthetic Fibers, Textile Technology Digest, and Textile Institute Journal Abstracts.

In addition to books and periodicals, the librarian and student assistants maintain files of pamphlets, reprints, trade catalogs, and patents. Special card indexes have been prepared for these collections.

The holdings of the Textile Library are available on loan not only to students and faculty of the College but also to research workers and industry employees throughout North Carolina.

THE GRADUATE SCHOOL

DONALD B. ANDERSON, Vice President, Graduate Studies and Research, Chapel Hill
WALTER J. PETERSON, Dean, Raleigh

The Graduate School of the Consolidated University of North Carolina is composed of three divisions, one at each of the three institutions of the University. Each unit is administered by a graduate dean and an administrative board representing the various degree-granting areas in each institution. The vice president for Graduate Studies and Research is the administrative officer of the Consolidated University who has responsibility for the development of policy in all graduate programs and for the coordination of the activities of the graduate schools at each of the three units of the University system.

Master's Degrees

At State College graduate instruction is offered in the following fields: agriculture, education, engineering, forestry, physical sciences and applied mathematics, and textiles. The Master of Science degree is offered in each of these areas. The Professional Master's degree, also offered in some of these fields, is intended for students who are interested in the more advanced applications of fundamental principles to specialized fields rather than in the acquisition of the broader background in advanced scientific studies which would fit them for careers in research.

Doctor of Philosophy Degree

The Doctor of Philosophy degree is offered in the following fields: agricultural economics, agricultural engineering, animal science, applied mathematics, applied physics, bacteriology, botany (in the fields of physiology and ecology), ceramic engineering, chemical engineering, civil engineering, crop science, electrical engineering, entomology, experimental statistics, food science, forestry, genetics, mechanical engineering, nuclear engineering, plant pathology, rural sociology, soil science, and zoology (in the fields of ecology and wildlife biology).

Students interested in graduate study should consult the Graduate School Catalog which is sent to them upon request. Inquiries should be addressed to: *Dean of the Graduate School, North Carolina State College, Raleigh, North Carolina.*

COLLEGE EXTENSION DIVISION

WARD W. RUGGLES, Director

ne College Extension Division's services, which cover a multitude of lds, are designed for persons who cannot attend classes on the campus d for designated groups and communities.

There must be a sufficient number of persons registered for a course for to be held. In setting up courses, such matters as distance from the llege, nature of the subject, and availability of instructors must be taken to consideration.

orrespondence Courses

Correspondence courses for college credit are offered in agriculture, chitecture, economics, education, engineering, English, entomology, ology, history, political science, mathematics, modern languages, psy- ology, rural sociology, sociology, and statistics. In these fields there are ore than 75 courses offered.

The Correspondence Bureau also has a program of four high school urses—English review, review of elementary algebra, solid geometry, d plane geometry. These non-credit courses give high school graduates opportunity to fullfill the college entrance requirements and also assist rsons who make low scores on their entrance examinations.

Other correspondence courses may be taken for professional credit rather an college credit.

vening College

The Evening College is another Extension Division service. Each fall d spring semester, a series of college credit courses is presented on the ate College campus for residents of the Raleigh area. In addition, there e offerings of hobby and vocational classes. Similar courses are offered communities where the demand is sufficiently great and other courses e conducted at military bases in North Carolina.

The Evening College offers resident credit for extension night class work and its program allows persons to work towards a degree.

The Extension Division conducts a series of night classes in sub-freshman mathematics on the State College campus.

Short Courses and Conferences

A wide variety of short courses and conferences are planned each year by the Extension Division in cooperation with several State College schools.

Among these specialized courses are those designed for electrical meter engineers, veterinarians, sawmill operators, pest control operators, clay plant operators, gas plant operators, dry kiln operators, nurserymen, and artificial breeders.

Included among the other short courses offered annually are the cattlemen's conference, dairymen's conference, swine conference, pesticide school, and the State garden schools plus courses in statistical quality control, furniture finishing, grain marketing, farm and small business income tax, sport fishing, job evaluation, quality control, cotton classing, warm air heating and air conditioning and a short course for commercial flower growers.

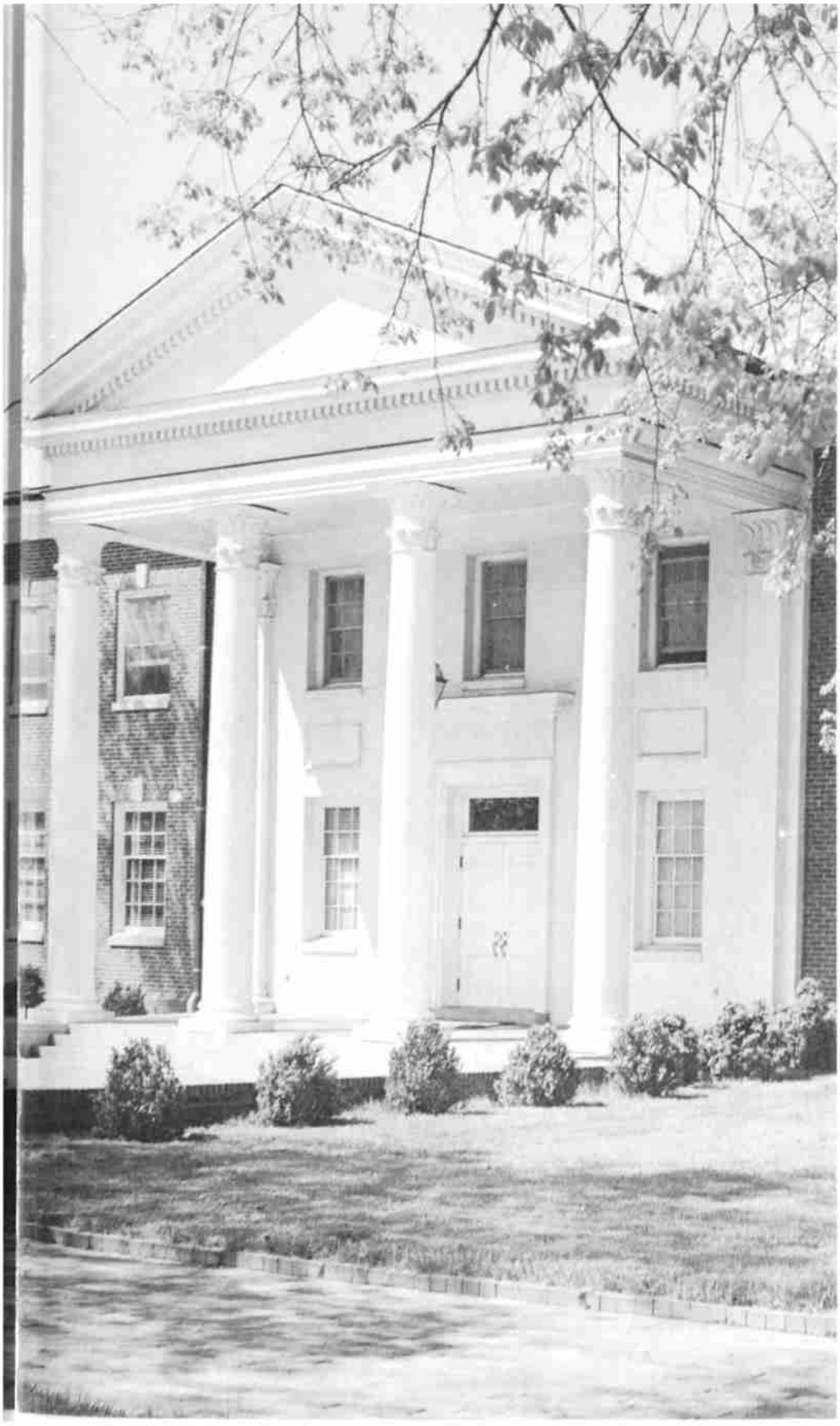
Other programs available are dairy herd testing, nutrition school, oil burner schools, textile conferences, quality concrete conference, North Carolina press mechanical conference, short courses in modern farming, industry research conference, safety school, nuclear engineering courses, and scores of other programs which benefit trade and professional groups.

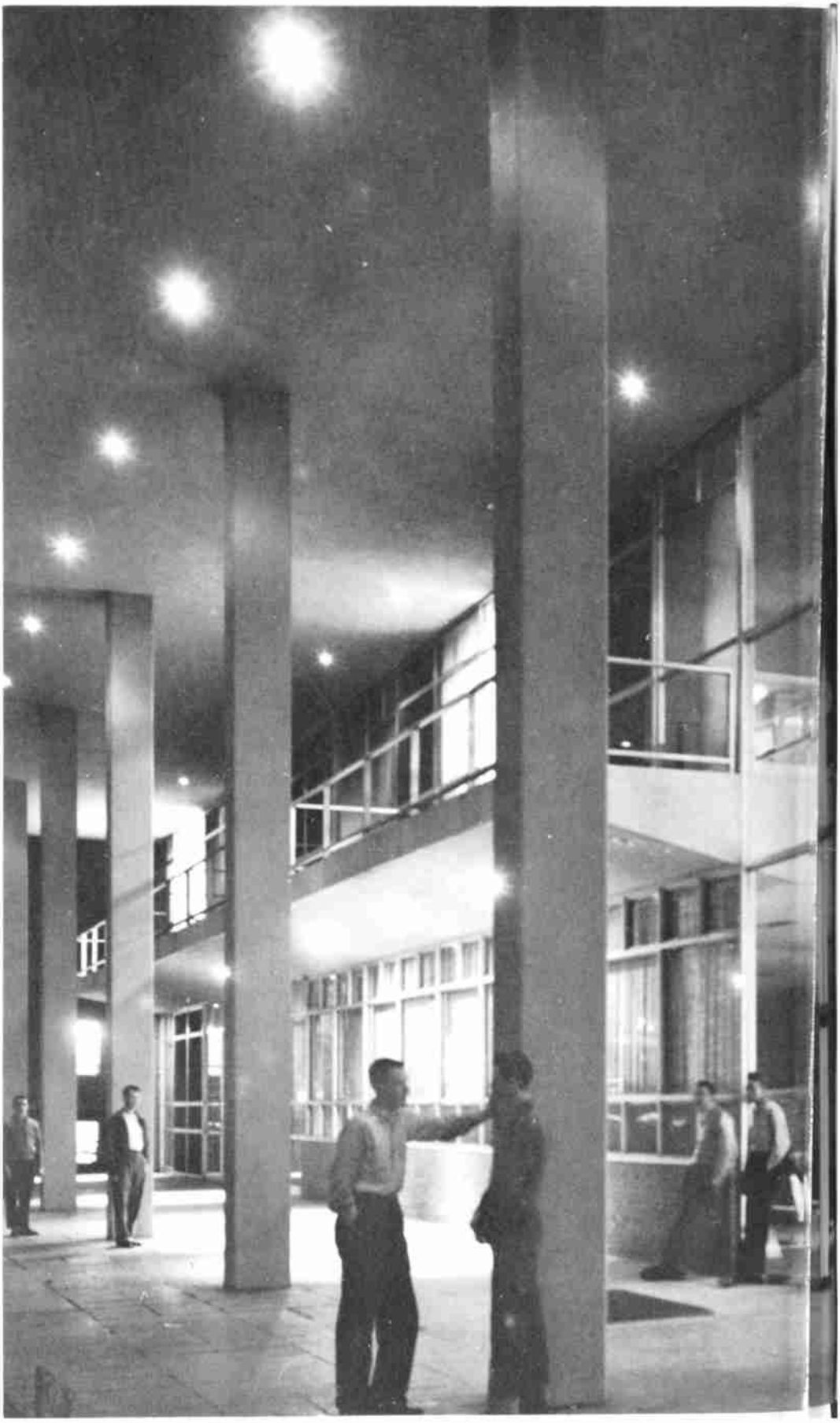
Other courses offered are or pertain to improving managerial capacity egg industry, pest control operators, soft frozen dairy products, industrial engineering seminar, surveying, state highway conference, public works conference, roofing and sheet metal forum, southeastern park and recreation training institute, industrial ventilation conference, electrical supervisors, plumbing inspectors, maintenance of commercial vehicles, stopwatch time study, fire alarm superintendents and professional driver training.

The Gaston Technical Institute is conducted by the Extension Division as a division of the College's School of Engineering. Gaston Tech, located in Gastonia, offers four two-year technical training courses in electrical, civil, electronics, and mechanical production technology. A separate catalog on the Institute and its curriculs is available upon request.

The North Carolina Truck Driver Training School conducts 12 four-week training courses for professional truck drivers each year. These schools are sponsored by the N. C. Motor Carriers Association. A bulletin giving complete details and application forms is available.

For additional information, persons interested in extension classes, correspondence courses, or any of the other programs sponsored by the Extension Division should write: *Mr. Edward W. Ruggles, Division of College Extension, North Carolina State College, Raleigh, North Carolina.*





DESCRIPTIONS OF COURSES

a typical course description, the semester hours of credit, the number of actual lecture and boratory hours of meeting per week, and the term or terms in which the course is offered e shown in this manner: 2 (1-2)f s.

The two indicates the number of semester hours credit given for satisfactory completion the course. The (1-2) indicates that the course meets for one hour (number on the left) lecture and for two hours (number on the right) of laboratory work each week. The f s esignation (fall semester and spring semester respectively) indicates that the course may be ken either during the fall or spring semester.

Agricultural Economics

Courses for Undergraduates

AGC 212 Economics of Agriculture **3 (3-0) f s**
Prerequisite: EC 201
n introduction to the economic principles underlying agricultural production and market-ng; organization for production in agriculture; consumers and their influence upon the demand for agricultural products; relationships between agriculture and other segments of he economy; dynamic factors in the economy which affect agriculture. Staff

AGC 303 Organization and Business Management of Farms **3 (2-2) f s**
Prerequisite: AGC 212
An application of basic economic principles and techniques to the problems facing a farm business; use of budgeting, programming, systems analysis and other modern techniques to determine what, how, and how much to produce when faced with numerous alternatives; analysis of problems associated with firm size and the acquisition of adequate resources; use and analysis of farm records as an aid to better management. Two all day Saturday field trips are required of all students. Messrs. Ihnen, Hoover

AGC 311 Organization and Business Management of Marketing Firms **3 (2-2) f s**
Prerequisite: AGC 212
A study of the agricultural marketing system and the current economic forces affecting its structure and efficiency; decision-making by agricultural business firms, with some discussion of integration and inter-firm relationships. Effects of monoply in marketing relative to government policies of control. Classroom discussion is supplemented by visits to marketing firms and by practical problems illustrating firm decisions. A laboratory period will be included in alternate weeks beginning with the second full week of classes. Students are expected to individually examine the marketing problems associated with the commodity of their choice. Messrs. Peeler, Simmons

AGC 322 Organization and Management of Cooperatives **2 (2-0) s**
Prerequisite: AGC 212
A study of the principles of cooperation applied to farmers' purchasing, marketing, and service cooperatives; the role of cooperatives in our society, and problems associated with organization, operation, and management.
(Offered in Spring 1963 and alternate years) Mr. King

Courses for Advanced Undergraduates

AGC 413 Farm Appraisal and Finance **3 (2-3) s**
Prerequisite: AGC 303
Examination of the source of productivity and value of farm inputs; a critical analysis of, and practice in the use of, farm appraisal procedures currently used for land and buildings; a review of the sources of, and repayment practices used in, short and intermediate credit in agriculture; consideration of the forces operating in the whole economy with an examination of the implications of these changes for both the lender and borrower in agriculture.
Mr. Hoover

AGC 431 Agricultural Price Analysis **3 (3-0) f**
Prerequisite: AGC 212
Principles of price formation; the role of prices in the determination of economic activity; the interaction of cash and futures prices for agricultural commodities; methods of price analysis, construction of index numbers, analysis of time series data including the estimation of trend and seasonal variations in prices.
Staff

Courses for Graduates and Advanced Undergraduates

AGC 512 Economic Analysis of Agricultural Factor Markets **3 (3-0) s**
Prerequisite: AGC 212
This course is oriented to the relative significance of land, labor and capital as factors of production in a modern agricultural economy, including major changes in the respective roles of these factors of production in recent years. An examination is made of the changes in characteristics of the supply and demand for these factors. The structure and efficiency of markets for these factors, including relevance of the institutional and attitudinal setting in each type of market, and nature of the demand-supply equilibration will be investigated. Public policies as they affect efficiency of the factor markets and other goals relating to the use of the basic factors of production in agriculture also will be considered.
Mr. Tolley

AGC 521 Procurement, Processing and Distribution of Agricultural Products **3 (3-0) s**
Prerequisite: AGC 311 or equivalent
A study of marketing firms as producers of marketing services and their role in the pricing process; the influence of government policies on their behavior of marketing firms; methods for increasing the efficiency of marketing agricultural products.
Mr. King

AGC 523 Planning Farm and Area Adjustments **3 (2-2) f**
Prerequisite: AGC 303 or equivalent
The application of economic principles in the solution of production problems on typical farms in the state; methods and techniques of economic analysis of the farm business; application of research findings to production decisions; development of area agricultural programs.
Mr. Coutu

AGC 533 Agricultural Policy **3 (3-0) s**
Prerequisite: AGC 212
A review of the agricultural policy and action programs of the Federal Government in their economic and political setting; analysis of objectives, principal means, and observable results under short-term and long-term viewpoints, and under the criteria of resource use and income distribution within agriculture, and between agriculture and the rest of the economy; appraisal of alternative policy proposals; the effects of commodity support programs on domestic and foreign consumption, and some of the international aspects of United States agricultural policy; the attempts at world market regulations, and the role of international organizations, agreements, and programs.
Staff

AGC 551 Agricultural Production Economics **3 (3-0) f**
Prerequisite: AGC 212
An economic analysis of agricultural production, including: production functions, cost functions, programming and decision-making principles; and the applications of these principles to farm and regional resource allocation, and to the distribution of income to and within agriculture.
Mr. Toussaint

GC 552 Consumption, Distribution, and Prices in Agriculture **3 (3-0) s**
erequisite: AGC 212 or equivalent
sis for family decisions concerning consumption of goods and services and supply of oductive factors; forces determining prices and incomes; interrelationships between economic cisions of the household and the firm. Mr. Henry

GC 561 Seminar in Contemporary Economic Problems in Agriculture **Maximum 6**
erequisite: Senior or graduate standing and consent of the instructor
alysis of economic problems of current interest in agriculture. Credit for this course will volve a scientific appraisal of a selected problem and alternative solutions. Staff

ourses for Graduate Students Only

GC 602 Monetary and Fiscal Policies in Relation to Agriculture **3 (3-0) s**
erequisite or corequisite: EC 501 or equivalent
ne essentials of monetary theory necessary in interpreting and evaluating monetary and cal operations and policies as to their effect upon income, employment, and price level; e monetary and fiscal structure, and the mechanics of monetary and fiscal operations in e United States; and the relation of monetary and fiscal policies to agricultural income and ices. Mr. Tolley

GC 612 International Trade in Relation to Agriculture **3 (3-0) s**
erequisites or corequisites: AGC 602 and 641
he principles of international and interregional trade; structures of trade relationships be- een countries engaged in the import or export of agricultural products; attempts at stabiliz- g trade and financial transactions. Staff

GC 621 Research in Agricultural Economics **Credits by arrangement**
erequisite: Graduate standing in Agricultural Economics and consent of Graduate Advisory ommittee
consideration of research methods and procedures employed in the field of agricultural onomics, including qualitative and quantitative analysis, inductive and deductive methods research procedure, selection of projects, planning and execution of the research project. Staff

GC 631 Economic and Social Foundations of Agricultural Policy **3 (3-0) f**
erequisite: AGC 501 or equivalent
he study of logical and empirical problems of inquiry into public policies and programs iat affect agriculture; analysis of policy-making processes, interdependencies among eco- omic, political and social objectives and action; the study of forces which shape economic stitutions and goals and of the logic, beliefs and values on which policies and programs iat affect agriculture are founded. Staff

GC 632 Welfare Effects of Agricultural Policies and Programs **3 (3-0) s**
rerequisite: AGC 642
escription of the conditions defining optimal resource allocation; application of the condi- ons for maximum welfare in appraisal of economic policies and programs affecting resource locations, income distribution, and economic development of agriculture. Mr. Bishop

GC 641 Economics of Production, Supply and Market Interdependency **3 (3-0) s**
rerequisite or corequisite: EC 501 or equivalent
n advanced study in the logic of, and empirical inquiry into, producer behavior and choice mong combinations of factors and kinds and quantities of output; aggregative consequences f individuals' and firms' decisions in terms of product supply and factor demand; factor iarkets and income distribution; general interdependency among economic variables. Mr. Seagraves

GC 642 Economics of Consumption, Demand and Market Interdependency **3 (3-0) f**
rerequisites: AGC 641 and ST 513 or equivalent
n advanced study in the theory of, and research related to, household behavior; aggregative onsequences of household decisions concerning factor supply and product demand; pricing nd income distribution; economic equilibrium. Mr. King

AGC 651 (ST 651) Econometric Methods I **3 (3-0) f**
Prerequisites: ST 421, ST 502, and AGC 642
The role and uses of statistical inference in agricultural economic research; measurement problems and their solutions arising from the statistical model and the nature of the data; limitations and interpretation of results of economic measurement from statistical techniques. Topics include the problems of specification, aggregation, identification, multicolinearity and autocorrelation. Attention also is given to expectations models and simultaneous stochastic equations. Mr. Wallace

AGC 652 (ST 652) Econometric Methods II **3 (3-0) s**
Prerequisites: ST 522 and AGC 551
Techniques for problem analysis in agricultural economics; attention to analysis of time series data; non parametric inference; experimental design in economic research; estimation of parameters in production functions and in simultaneous models; selected special topics.
Mr. Anderson

AGC 671 Analysis of Economic Development in Agriculture **3 (3-0) f**
Prerequisite: AGC 641
A theoretical and empirical study of the processes of economic growth; the problems of underdeveloped countries; the role of agriculture in a developing economy; an examination of policies and programs needed for effective economic development. Mr. Maddox

Agricultural Education

(See Education)

Agricultural Engineering

Courses for Undergraduates

AGE 151, 152 Farm Mechanics **2 (1-3) f s**
Prerequisite: Enrollment in ASE or ATE curriculum
These courses are designed to acquaint Agricultural Engineering students with materials and tool processes related to the various fields of endeavor in Agricultural Engineering; also to develop the student's ability to plan in terms of the manual and managerial skills related to the utilization of such materials and processes. Mr. Blum

AGE 201 Agricultural Construction and Maintenance I **2 (1-3) f s**
This course is designed to acquaint the student with planning procedures, construction materials and woodworking tools, building layout and design, and preventative maintenance. Limited laboratory practice in the manual and managerial skills involved in the utilization of such information is included. Messrs. Howell, Blum

AGE 202 Agricultural Construction and Maintenance II **2 (1-3) f s**
This course is designed to acquaint the student with the manual and managerial skills involved in the construction, repair, and maintenance of farm machinery and utilities. The use of materials, tools, and facilities needed will be stressed. Considerable emphasis will be placed on arc and oxyacetylene welding. Messrs. Howell, Blum

AGE 211 Farm Power and Machinery I **3 (2-2) f s**
Corequisite: PY 201 or PY 211 for ASE or ATE students
A study of modern farm machinery, power units and equipment with emphasis on selection, operation, maintenance, care and adjustments from the operator's viewpoint. Staff

Courses for Advanced Undergraduates

AGE 303 Energy Conversion for Agricultural Production **2 (2-0) s**
Prerequisites: BO 103 or ZO 103, MA 112 or MA 201, PY 211 or PY 201
Energy transformations and exchanges of plants and animals are studied on the basis of physical theories and principles. Specific examples in thermal radiation, convection, conduction, phase changes, muscle work, photosynthesis, respiration, and concentration of solutions will be discussed. Mr. Suggs

AGE 321 Irrigation, Drainage and Terracing **3 (2-3) s**
Prerequisite: Junior standing
Needs for irrigation in the Southeast and methods of accomplishment; methods of draining excess water from agricultural areas; the use of basic surveying equipment; and the need for and methods of accomplishing erosion control by mechanical measures to supplement vegetative programs. Staff

AGE 331 (FS 331) Food Engineering **3 (2-2) s**
Prerequisite: PY 211
Fundamentals of power application in the processing and preservation of perishable food products. Mr. Jones

AGE 332 Farm Buildings and Crop Processing **3 (2-3) s**
Prerequisite: Junior standing
Construction materials, structural features and design loads. Functional planning of farm buildings for housing domestic animals and for storing and handling farm crops. Curing and drying of farm crops. Messrs. Blum, Weaver

AGE 341 Farm Electrification and Utilities **3 (2-2) f**
Prerequisite: Junior standing
Problems and general study in the proper selection and use of applicable farm electric equipment and allied utilities. Mr. Weaver

AGE 371 Soil and Water Conservation Engineering **4 (3-3) s**
Prerequisites: CE 201, SSC 200
General aspects of agricultural hydrology, including precipitation, classification of climate, rainfall disposition, methods of estimating runoff, fundamental soil and water relationships and hydraulics of flow in open channels and closed conduits, will be given. Included also are factors affecting erosion, methods of controlling erosion, land use classification, drainage, land clearing, irrigation methods, design requirements for portable irrigation systems and economic aspects of irrigation in the Southeast. Mr. Wiser

AGE 401 Problems in Farm Mechanics **3 (2-2) f**
Prerequisites:. AGE 201, 202, Enrollment in Agricultural Education
A study of the mechanical activities engaged in by the vocational agriculture teacher; with emphasis on the role of the teacher in the area of agricultural engineering technology. Included is a study of facilities, equipment, and shop management. Mr. Howell

AGE 411 Farm Power and Machinery IIB **3(2-3) f s**
Prerequisite: AGE 211
This course is designed to provide students in Agricultural Engineering Technology with a knowledge of the operations of manufacturing and distribution organizations of farm machinery and their places in these organizations. Included is a practical course in farm tractors and engines with emphasis on familiarizing the student with component parts their application, operation, and maintenance, as well as with the selection of these units from the standpoint of power, performance, and ratings. Messrs. Tore, Greene

AGE 451 Conditioning Principles for Plant and Animal Systems **2 (2-0) f**
Prerequisite: ME 301
Principles of heat transfer and diffusion are presented using the mathematical equations to point out analogous systems. The use of electric analogs to describe thermal and diffusion systems is demonstrated. Psychrometric and heat transfer principles are used to indicate methods of conditioning the environment in agricultural structures. Thin layer drying theory and dimensional analysis are used to describe bulk drying systems of agricultural crops.
Mr. Jordan

AGE 452 Senior Seminar **1 (1-0**
Students will prepare talks in their particular field of interest, presenting them to the gro
Also, two or three field trips to selected points of educational opportunities will be m
during the semester. Maximum of two credits allowed. Mr. Has

AGE 462 Farm Power and Machinery IIA **4 (3-3**
Prerequisites: AGE 211, EM 301
A study of engineering analysis as it applies to problems in the power and machinery f
of Agricultural Engineering. The course is intended to strengthen the students ability
approach agricultural engineering problems in a systematic manner. Mr. Bo

AGE 481 Agricultural Structures as Production Units **4 (3-3**
Prerequisites: AGE 451, EM 301
Application of conditioning principles to provide the required environment for optimum
cultural production is stressed. Environmental requirements of animals and of harvested c
are discussed. Analysis for labor reduction and the replacement of human decisions
electric controls are indicated. Environmental requirements, proper arrangement, equipm
equipment selection and control, and estimation of external loads are presented to indi
the design procedures for a sound, functional building. Mr. Jo

AGE 491 Rural Electrification **4 (3-3**
Prerequisite: EE 320
Wiring and circuitry for both single and three phase applications of electricity to farm
rural community processes and operations. A very brief study of the local and regional or
zation as developed by the electric industries for the dependable generation, transmission,
distribution of power. Electric motor characteristics and selection are studied in the labor
along with those of water systems, feed grinders and mixers; lighting systems, cooling, v
lating, heating, and the application of switches and controls. Mr. W

Courses for Graduates and Advanced Undergraduates

AGE 551 Special Problems **Credits by arrange**
Prerequisite: Senior or graduate standing in Agricultural Engineering
Each student will select a subject on which he will do research and write a technical r
on his results. He may choose a subject pertaining to his particular interest in any ar
study in Agricultural Engineering. Mr. Hassler,

AGE 552 Instrumentation for Agricultural Research and Processing **1 (0**
Prerequisites: EE 320, MA 301
Elaboration of the theory and principles of various primary sensing elements. Relate
output signal of electrical transducers to wheatstone bridge and potentiometer measurin
cuits for calibration of the signal with the variable under study. Introduces the princip
circuits and mechanisms used for indicating, recording, and/or controlling process vari
Representative equipment will be employed whenever feasible. Mr. Sp

Courses for Graduates Only

AGE 651 Research in Agricultural Engineering **Credits by arrange**
Prerequisite: Graduate standing in Agricultural Engineering
A maximum of six credits is allowed toward a master's degree; no limitation on credi
doctorate program.
Performance of a particular investigation of concern to Agricultural Engineering. The
will begin with the selection of a problem and culminate with the presentation of a the
Graduate

AGE 652 Seminar **1 (1-0**
Prerequisite: Graduate standing
A maximum of two credits is allowed.
Elaboration of the subject areas, techniques and methods peculiar to professional it
through presentations of personal and published works; opportunity for students to p
and defend, critically, ideas, concepts and inferences. Discussions to point up analytical
tions and analogies between problems in Agricultural Engineering and other technologie
to present the relationship of Agricultural Engineering to the socioeconomic enterprise
Mr. F

: 654 Agricultural Process Engineering **3 (3-0) f s**
equisite: MA 511
eralized classical thermodynamics is extended by Onsager's relations to provide a theore- basis for analyzing the energetics of systems that include life processes.
Mr. Johnson

661 Analysis of Function and Design of Farm Machinery **3 (2-3) f or s**
equisite: PY 401
ods and tools used in determining the functional requirements of machine components; ng of machine specifications in terms of fundamental parameters; introduction of the ciples of discriminate and indiscriminate mechanical selection of agricultural products emphasis on the theory of servo-systems.
Mr. Bowen

671 Theory of Drainage Irrigation and Erosion Control **4 (3-3) f or s**
equisite: MA 512
hasis is placed on the physical and mathematical aspects of problems in conservation neering and an attempt is made to rationalize procedures which have often come about ugh experience rather than through analytical considerations. Examples are presented of where such an analytical approach has already improved, or shows promise of improving, n criteria and procedures.
Mr. van Schilfgaarde

: 681 Analysis of Function and Design of Farm Buildings **4 (4-0) f or s**
equisite: AGE 481
udy of the functional requirements of farm structures with respect to man, animals and s and development of the means for providing structures which fulfill the functional irements. Application of the science and art of engineering in the solution of environ tal problems. Advanced planning in the integration of structural and environmental n.
Mr. Jordan

Agriculture

103 Introduction to Agriculture **1 (0-2) f**
udy of Agriculture as a profession and as it relates to the entire economy of the United s.

311 Agricultural Communications Methods and Media **3 (3-0) s**
equisites: ENG 111 and 112
gned to give an insight into the communications process; written, oral and visual tech ues of communications; a survey of the channels of communications available; and tech ues for using these channels individually or combined into a publicity or public relations rmation program.
Mr. Carpenter

401 Principles and Methods of Extension Education **3 (3-0) s**
equisite: Senior standing (Graduate credit in special cases with permission of committee) udy of the background, development and operation of the Agricultural Extension Service sideration is given to major events leading to the establishment of Agricultural Extension, objectives, organization and philosophy. Major emphasis is placed upon the principles un ying extension education together with methods of program building and teaching.
Mr. Sloan

Air Science

Basic Course

121 Air Science I **1 (0-1) f**
ring the fall semester, each student will be required to participate in the Leadership Lab tory program for one hour per week. Classroom requirements will be met by the satis ory completion of at least three academic hours of an approved course in the field of thematics, modern languages or humanities.

AS 122 Air Science I 1 (2-1)
An introductory examination of the factors of aerospace power, major ideological conflicts requirements for military forces in being, responsibilities of citizenship, development and tradi tions of the military profession, role and attributes of the professional officer in America democracy, organization of the armed forces as factors in the preservation of national security and the United States Air Force as a major factor in the security of the free world.

AS 221 Air Science II 1 (2-1)
An introductory survey of aerospace missiles and craft, and their propulsion and guidance systems; target intelligence and electronic warfare; nuclear, chemical and biological warhead agents; defensive, strategic and tactical operations; problems, mechanics and military impli cations of space operations; and a survey of contemporary military thought.

AS 222 Air Science II 1 (0-1)
Leadership laboratory will continue; however, the classroom requirements will be met b satisfactory completion of at least three academic hours of an approved course in the fiel of physical or natural sciences or in the intermediate levels of mathematics, modern languag humanities or social sciences.

The Advanced Course

The leadership laboratory program continues for one hour per week throughout the advanc course with students assuming command and control of progressively larger units and greate responsibilities.

AS 321 Air Science III 1 (2-1-
Prerequisites: Basic Air Science Courses
Instruction deals with staff organization and functions, and the skills required for effecti staff work, including oral and written communications and problem solving; basic psycholo cal and sociological principles of leadership and their application to leadership practice problems. Classroom requirements will be partially met by the satisfactory completion of eit SOC-301, SOC-501, or EC-426.

AS 322 Air Science III 2 (3-1-
Study continues in principles of leadership, and instruction includes communicating and c structing in the Air Force and an introduction to military justice.

AS 421 Air Science IV 2 (3-1
Prerequisite: Air Science III
Instruction deals with weather and navigation, a flying instruction program, and an inten study of global relations of special concern to the Air Force officer with emphasis on in national relations and geography.

AS 422 Air Science IV 1 (2-1
The study of the military aspects of world political geography continues; course include briefing for commissioned service and the leadership laboratory. Classroom requirements be partially met by the satisfactory completion of one of these courses: PS-302, HI-415, SS- SS-302, SS-491, SS-492.

Summer Training Unit

An integral part of the Advanced Course is the Summer Training Unit, a four-week encam ment at an active Air Force Base. During the summer encampment a cadet is trained in use of weapons, in close-order drill; he will participate in physical training, competi sports, orientation flying and will become familiar with aerospace vehicles and emerg equipment; he will observe at first hand various organizations on the base in the perform of their everyday operations. Normally a student enrolled in the advanced course will at a Summer Training Unit between his junior and senior years; under unusual circumsta attendance can be postponed until the summer following completion of degree requirem

Animal Science

rses for Undergraduates

201 Elements of Dairy Science **4 (3-3) f s**
amental principles of milk production; breeds, selection, feeding and management of cattle; composition, quality and food value of milk products; principles of processing manufacturing dairy products. Mr. Everett

202 Fundamentals of Animal Husbandry **4 (3-3) f s**
iples of feeding, managing and marketing meat animals. Year to year and seasonal price s and relationships. Relation of slaughter grades to carcass cut out values.
Mr. Goode

302 Selecting Dairy and Meat Animals **2 (0-6) f**
idy of dairy and meat animals including desired characteristics in breeding and market als and relating to productive performance. Market classes and grades of beef cattle, and swine and relation of live animal grade to carcass grade will be studied. Herd study, pedigree evaluation and breed history and organization will be included.
Messrs. Murley and Gregory

303 (FS 303) Meat and Meat Products **3 (2-3) s**
quisite: CH 451
of live animal and carcass relationship, dressing percentages and cut out values. htering, cutting, curing, freezing and handling of meat and meat products for commercial home use. Messrs. Blumer, Craig

308 Advanced Selecting Dairy and Meat Animals **1 (0-3) s**
quisite: ANS 302
isive practice on developing proficiency in selecting techniques for dairy and meat ani with emphasis on oral reasons. Visits will be made to leading farms to study different ls. Messrs. Murley, Gregory

309 (FS 309) Meat Selection **1 (0-6) f**
iled consideration of factors involved in selection of carcasses and wholesale cuts of beef, and lamb. Practice in identification of wholesale and retail cuts. Mr. Blumer

312 Principles of Livestock Nutrition **3 (3-0) s**
quisites: CH 431, ZO 301
damentals of modern animal nutrition, including classification of nutrients, their general bolism and roles in productive functions. Mr. Ramsey

404 Dairy Farm Problems **3 (2-3) s**
equisite: ANS 201
nced study of practical dairy farm management including farm records, farm buildings, ation, roughage utilization and herd culling. Mr. Murley

406 Animal Science Seminar **1 (1-0) s**
ew and discussion of special topics and the current literature pertaining to all phases of al science. Mr. Porterfield

407 Advanced Livestock Production **4 (3-3) s**
equisites: GN 411 and ANS 312
udy of the economic, nutritional, genetic, physiological and managerial factors affecting operation of commercial and purebred livestock enterprises. Mr. Barrick

408 Reproduction and Lactation **3 (2-3) s**
equisite: ZO 301
tomy of the reproductive organs and mammary glands with detailed coverage of the siological processes involved and of factors controlling and influencing them. A special arch problem selected by the student is required. Messrs. Mochrie, Myers, Ulberg

Courses for Graduates and Advanced Undergraduates

ANS 503 (GN 503) Genetic Improvement of Livestock 3 (3-0) f
Prerequisite: GN 411
Traits of economic importance in livestock production, and their mode of inheritance. Genotypic and genetic relationships between traits. The place of selection, inbreeding and crossbreeding in a program of animal improvement. Mr. Bishop

ANS 505 Diseases of Farm Animals 3 (3-0) f
Prerequisites: CH 101, CH 203; BO 421 desired
The pathology of bacterial, virus, parasitic, nutritional and thermal diseases, and metabolic disease processes. M. Barnes

ANS 507 Topical Problems in Animal Science Maximum 6 f, s
Special problems may be selected or assigned in various phases of Animal Science. A maximum of six credits is allowed. Staff

ANS 513 Needs and Utilization of Nutrients by Livestock 3 (3-0) s
Prerequisite: ANS 312 or equivalent
Measurement of nutrient needs of livestock and the nutrient values of feeds. Nutritive requirements for productive functions. Mr. Wise

Courses for Graduates Only

ANS 600 Research in Animal Science Credits by arrangement f, s
A maximum of six hours is allowed toward the master's degree; no limitation on credits for doctorate programs.

ANS 601 Seminar in Animal Nutrition 1 (1-0) f, s
Prerequisite: Permission of seminar leaders
Orientation in philosophy of research; preparation for research in agriculture, animal research methodology. Nutrition Staff

ANS 602 (GN 602) Population Genetics in Animal Improvement 3 (Arranged
Prerequisites: ST 512 and GN 512
A study of the forces influencing gene frequencies, inbreeding and its effects, and alternative breeding plans. Mr. Legates

ANS 603 Animal Nutrition: Mineral Metabolism (3-0) f
Prerequisite: CH 551
Principles of mineral metabolism with emphasis on metabolic functions, reaction mechanisms and interrelationships. Mr. Matrone

ANS 604 (ZO 604) Experimental Animal Physiology (2-4) f
Prerequisite: ZO 513 or equivalent
A study of the theories and techniques involved in the use of animals in physiologic investigation. Messrs. Ultrig, Wise

ANS 614 (BO 614) Bacterial Metabolism (2-3) s
Prerequisites: BO 514 or equivalent and CH 551
The energy metabolism of bacteria; synthesis of carbohydrates, lipids, proteins purines, pyrimidines, and nucleic acids; bacterial photosynthesis; enzyme formation and metabolic control mechanisms; active transport systems. M. McNeil

ANS 621 (CH 621) Enzymes and Intermediary Metabolism (3-4) f
Prerequisites: CH 511 and permission of instructor
A study of the properties of enzymes and enzyme action; intermediary metabolism of carbohydrates, lipids, fatty acids, vitamins, purines and phorphrins; metabolic energy relationships. Mr. Tove

IS 622 (CH 622, ST 622) Principles of Biological Assays **3 (2-2) s**
erequisites: CH 551 and ST 512
chniques and designs of biological assays for vitamins. The interrelationship of logical prin-
les, design and analysis is emphasized. Messrs. Smart, Tove

Anthropology

(Also see Sociology)

ourses for Undergraduates

IT 251 Physical Anthropology **3 (3-0) f**
ie study of the development of man as a species; analysis of the formation and spread of
es; introduction to archaeology as a study of the material remains of ancient man and his
ivities.

IT 252 Cultural Anthropology **3 (3-0) s**
ie analysis of various living societies and their cultures in terms of social adjustment to
urrent needs.

IT 305 Peoples of the World **3 (3-0) f s**
is course seeks to develop insights of wide applicability concerning human relationships and
adjustment of man to his geographical, social, and cultural environments. The course is
signed to demonstrate interrelationships among diverse factors affecting human behavior
all societies.

IT 410 Theories of Culture **3 (3-0) f**
erequisites: SOC 202, SOC 301 or equivalent
ie study of major anthropological theories of culture with intensive analysis of their appli-
ion.

Architecture

ourses for Undergraduates

IC 201, 202 Architectural Design I, II **4 (3-6) f s**
erequisite: DN 102
quired of second year students in Architecture and Landscape Architecture
troductory exercises in architectural design. The design of small buildings of specific
nction and simple construction which can be related to the student's experience; emphasis
the influence of environment, climate, etc.
Messrs. Boaz, Buisson, Clarke, Waugh, Wurman

RC 300 Historic Architecture Research **2 credits s**
erequisite: ARC 202
equired of all students in Architecture and Landscape Architecture
esearch and the recording of sites, monuments, buildings, or artifacts of historical interest.
Mr. Shogren

RC 301, 302 Architectural Design III, IV **6 (3-12) f s**
rerequisites: ARC 202, EM 200, PY 211
equired of third year students in Architecture
ontinuing exercises in architectural design, based on larger buildings with more complex
terior and exterior relationships. Emphasis on the problems of functional planning, research
building requirements, and recognized methods of constructions.
Messrs. Harris, Shawcroft, Shogren

ARC 312 Materials and Specifications **3 (3-0)**
Prerequisite: ARC 202
Required of third year students in Architecture
Functional and physical characteristics of building materials; the preparation of architectur specifications. Mr. Wau

ARC 377, 378 Environmental Factors **3 (3-**
An investigation of environmental factors affecting architectural design. Heating and cooli systems; and controls and principles of plumbing including venting, drainage, demand a load calculations, water distribution, pipe sizing, storm drainage and sprinkler systems first semester. Lighting and acoustical design and electrical equipment and design in sec semester. Mr. Ka

ARC 401, 402 Architectural Design V, VI **6 (3-12)**
Prerequisites: ARC 302, CE 339, EM 301
Required of fourth year students in Architecture
The design of large buildings or building complexes and economic and sociological influen on them, stressing the use of technology and industrialization. Emphasis on the log coordination of the many factors of building design. Mr. Ha

ARC 421, 422 Structural Design I, II **3 (3-3)**
Prerequisite: CE 339
Required of fourth year students in Architecture
Principles and applications of steel and timber design; principles and application of reinfor concrete design; and elements of foundations. Mr. K

ARC 501, 502 Architectural Design VII, VIII **7,9 (3-12)!**
Prerequisites: ARC 402, ARC 300
Required of fifth year students in Architecture
A continuation of ARC 401, 402 with special emphasis on the development of arch-typ designs and the use of subjective selection by the designer. An architectural thesis is requ in the spring semester. Mr. Glowczer

ARC 511 Professional Practice **2 (2-**
Prerequisite: ARC 312
Required for graduation in Architecture
A study of the ethics, organization, and procedures of professional architectural prac building codes, and legal obligations. Mr.

ARC 531, 532 Structural Design III, IV **2 (2-2**
Prerequisite: ARC 422
Required of fifth year students in Architecture
Comparative study of structures and structural elements; their possibilities and limitat review and discussion of structural principles. Engineering consultation. Mr. I

Biology

BS 301 Fundamentals of Biology **3 (3**
A survey of the major principles of the biological sciences. A course designed for students have not had a college course in the biological sciences.

Botany and Bacteriology

Courses for Undergraduates

BO 103 General Botany **4 (3-**
An introduction to the field of Botany. Emphasis is placed on the structure, physiolog sexual reproduction of green and non-green plants and on the principles of heredit ecology as they apply to these groups. The course may serve as a terminal course or introduction prior to further study in Botany. Mr. C

2201 Aquatic Vascular Plants **2 (1-2) f**
requisite: BO 103
omprehensive survey of marsh and aquatic vascular plants with emphasis on identification habitat relationships. (Offered in alternate years. Given in 1962 63.) Mr. Beal

2214 Dendrology **4 (2-4) s**
requisite: BO 103
ystematic survey of the evergreen (gymnosperm) and hardwood (angiosperm) genera and ies of North American trees. Emphasis is upon terminology, structure, relationships, and ntification of woody plants. Mr. Hardin

3301 General Morphology **3 (2-3) f**
requisite: BO 103 or equivalent
urvey of the principal groups of plants from the standpoint of their structure, develop- nt and reproduction. Emphasis is placed on evolutionary relationships as revealed by com- isons in body organization and life histories of living and extinct forms. Some time is nt on general identification of the plants in their native habitats. Mr. Hardin

3403 Systematic Botany **3 (0-6) s**
requisite: BO 103
ystematic survey of vascular plants emphasizing field identification, terminology, and gen- evolutionary relationships. Mr. Beal

4412 General Bacteriology **4 (2-4) f**
requisites: CH 103 or 107 (CH 221, 215 or 411 recommended but not required)
advanced biology course dealing with bacteria and other microorganisms, their structure, elopment, and function. Emphasis is placed on the fundamental concepts and techniques microbiology such as isolation, cultivation, observation, morphology, and the physiology nutrition of bacteria. The applications of microbiology, the role of microbes in nature, their role in infection and immunity are considered. Mr. Elkan

4421 Plant Physiology **4 (2-4) f s**
requisites: BO 103, 2 courses in chemistry
introductory treatment of the chemical and physical processes occurring in higher green nts with emphasis upon the mechanisms, factors affecting, correlations between processes, biological significance. Messrs. Scofield and Troyer

4441 Plant Ecology **3 (2-3) f**
requisite: BO 103
introduction to the study of plants in relation to their environment. Major topics con- red are: factors of the environment; the structure, analysis, and dynamics of plant com nities; past and present distribution of vegetation types. Mr. Cooper

urses for Graduates and Advanced Undergraduates

5505 (FS 505) Food Microbiology

5511 Advanced Bacteriology **3 (1-4) s**
requisites: BO 412, CH 220, 221 or 223
s course will present the principles and techniques of isolation and characterization of teria from a wide range of habitats. Particular stress will be given to the principles of ichment techniques, differential and selective media, and pertinent diagnostic tests that are licable to particular groups of bacteria. Messrs. Evans and Elkan

5512 Morphology of Vascular Plants **3 (1-6) f**
requisite: BO 103
study of comparative morphology, ontogeny and evolution of the vascular plants. Em sis is placed upon the phylogeny of sexual reproduction and of the vascular systems. Mr. Ball

BO 513 Plant Anatomy 3 (1-6)
Prerequisite: BO 103
A study of the anatomy of the Angiosperms and Gymnosperms. The development of tissues is traced from their origin by meristems to their mature states. Mr. Bal

BO 514 Introductory Bacterial Physiology 3 (3-0)
Prerequisites: BO 412, CH 220, 221 or 223; CH 351 or 551 (May be taken concurrently.)
Emphasis will be placed on general principles and function with respect to the living cel Included will be a study of cell structure, growth, death, reproduction, nutrition, and metabolism. An attempt will be made to illustrate the application of basic principles to applied areas of bacteriology and to other areas of basic science. Mr. Evan

BO 521 Systematic Botany of Monocot Families 3 (0-6)
Prerequisites: BO 103, 403
A comprehensive survey of the systematics and evolution of monocot families. Special emphasis is given to terminology, morphology, identification and relationships. (Offered alternate years. Not given in 1962 63.) Mr. Bel

BO 523 Systematic Botany of Dicot Families 3 (2-3)
Prerequisites: BO 103, 403
A comprehensive survey of the systematics and evolution of dicot families. Special emphasis is given to terminology, morphology, identification and relationships. Offered alternate years. Given in 1962-63.) Mr. Harc

BO 531 (SOI 532) Soil Microbiology

BO 534 Physiology of Plant Cells 3 (3-0
Prerequisite: BO 421 or equivalent. Advanced preparation in chemistry or physics may substituted with the permission of the instructor.
An advanced treatment of basic plant processes at the cellular level with emphasis on theoretical principles. Mr. Tro

BO 535 Water, Solute, and Gas Relations of Plants 2 (2-0
Prerequisite: BO 534
An advanced treatment of processes of higher plants involving exchange of materials betwe the plant and its surroundings and movement of materials within the plant. Theoretical principles are emphasized. (Offered alternate years. Given in 1962-63.) Mr. Tro

BO 536 Growth and Development of Plants 2 (2-0
Prerequisite: BO 534
An advanced treatment of the physiology of growth and development of higher plants, emphasis on theoretical principles. (Offered alternate years. Not given in 1962-63.)
Mr. Tr

BO 544 Plant Geography 3 (3-0
Prerequisites: BO 403, 441, GN 441, or equivalents
A course in descriptive and interpretive plant geography, synthesizing data from the f of ecology, genetics, geography, paleobotany, and taxonomy. The course will include a su of the present distribution of major vegetation types throughout the world, a discussion the history and development of this present pattern of vegetation, and a discussion of principles and theories of plant geography. (Offered alternate years. Given in 1962-63.)
Mr. Co

BO 545 Advanced Plant Ecology 3 (2-
Prerequisites: BO 421, 441 or equivalents
An advanced consideration, through class discussions and individual projects, of the princi theories and methods of plant ecology. Mr. Co

BO 570 (CE 570) Sanitary Microbiology 3 (2-
Prerequisites: AGE 211, EM 321
Fundamental aspects of microbiology and biochemistry are presented and related to lems of stream pollution, refuse disposal and biological treatment. Laboratory exercises sent basic microbiological techniques and illustrate from a chemical viewpoint some o basic microbial aspects of waste disposal. Mr. I

574 Phycology **3 (1-4) s**
requisite: BO 103 or equivalent
ystematic study of the structure and classification of the algae, both fresh water and marine. e life history and ecology of important local species will be emphasized.
Mr. Whitford

urses for Graduates Only

614 (ANS 614) Bacterial Metabolism

620 Advanced Taxonomy **3 (2-2) s**
requisites: BO 521, 523 or permission of instructor
course in the principles of plant taxonomy including the history of taxonomy, systems of sification, rules of nomenclature, taxonomic literature, taxonomic and biosystematic meth , and monographic techniques. Mr. Hardin

632 (SSC 632) Advanced Soil Microbiology

635 The Mineral Nutrition of Plants **3 (2-3) s**
requisites: BO 421 and a course in Biochemistry
cussion of diffusion, molecular specificity and energetics of active transport. The physical mistry of the essential elements and its significance to their biochemical functions.
Mr. Kahn

636 Discussions in Plant Physiology **1 (1-0) s**
requisite: BO 534
oup discussions at an advanced level of selected topics of current interest in plant physiol .
Mr. Troyer

640 Special Problems in Bacteriology **Credits by arrangement f s**
ected research in some specialized phase of bacteriology other than a thesis problem but igned to provide experience and training in research. Graduate Staff

641 Research in Bacteriology **Credits by arrangement f s**
ginal research preparatory to writing a master's thesis or a Ph.D. dissertation.
Graduate Staff

650 Special Problems in Botany **Credits by arrangement f s**
ected research in some specialized phase of botany other than a thesis problem but designed provide experience and training in research. Graduate Staff

651 Research in Botany **Credits by arrangement f s**
ginal research preparatory to writing a master's thesis or a Ph.D. dissertation.
Graduate Staff

660 Bacteriology Seminar **1 (1-0) f s**
cific articles, progress reports in research, and special problems of interest to bacteriologists reviewed and discussed. Graduate student credit allowed if one paper per semester is sented at seminar. Graduate Staff

661 Botany Seminar **1 (1-0) f s**
ntific articles, progress reports in research, and special problems of interest to botanists reviewed and discussed. Graduate student credit allowed if one paper per semester is pre ted at seminar. Graduate Staff

Ceramic Engineering

Courses for Undergraduates

MIC 210 Ceramic Materials and Processes 3 (2-3) f s
Designed for students not majoring in Ceramic Engineering. Includes raw materials, forming processes, effect of thermal treatment, properties and uses of ceramic products. Lecture and Laboratory.

MIC 301 Ceramic Operations I 4 (3-3) f
Prerequisite: MIM 201
Unit operations pertaining to ceramic product manufacture. Crushing, grinding, particle size classification and packing. Colloidal and rheological properties of slips, slurries, and plastic masses. Lecture and Laboratory.

MIC 302 Ceramic Operations II 3 (2-3) s
Prerequisites: MIC 301, PY 201
A continuation of MIC 301. Dewatering of slips and slurries. Properties of air and air-vapor mixtures, heat transmission, fluid flow, drying, drier calculations, furnaces, kilns and kiln calculations. Lecture and Laboratory.

MIC 312 Ceramic Process Principles I 4 (3-3) f
Corequisite: MIC 302
Effect of heat on non-metallic minerals. Thermodynamic calculations. Industrial fuels and combustion, review of heterogeneous equilibria. Crystal structures. Pyrochemical and pyro-physical changes in ceramic bodies. Lecture and Laboratory.

MIC 413 Ceramic Process Principles II 4 (3-3) s
Prerequisites: MIC 312, CH 532
A continuation of MIC 312. A study of the glassy state to include structure of glass, properties and types of glasses. Glazes, enamels, opacity, color and devitrification. Nature of glass phases in kiln fired ceramic bodies. Lecture and Laboratory.

MIC 414 Senior Thesis 3 (1-6) f
One semester required of seniors in Ceramic Engineering. A second semester may be elected. An introduction to research. Literature search, laboratory investigation and written report in the form of a thesis. Conference and laboratory.

MIC 415, 416 Ceramic Engineering Design 2 (0-6) f
The methods of design of ceramic equipment, structures and plant designing.

MIC 420 Industrial Ceramics 3 (3-0)
A study of the various ceramic industries, including manufacturing techniques, labor and professional relationships, and the present and future status of the respective industries. Lectures and discussion.

MIC 425 Seminar 1 (1-0)
One semester required of seniors in Ceramic Engineering. A second semester may be elected. Literature survey of selected topics in Ceramic Engineering. Oral and written reports, discussions.

Courses for Graduates and Advanced Undergraduates

MIC 503 Ceramic Microscopy 3 (2-3)
Prerequisite: MIC 531
Petrographic techniques for the systematic study of ceramic materials and products. Interpretation and representation of results.

:C 505 Research and Control Methods **3 (2-3) s**
:requisite: MIC 413
:erpretation of results, instrumental methods applied to research and product development. .tistical quality control.

:C 507, 508 Advanced Ceramic Experiments **3 (1-6) f s**
:requisite: MIC 414 or equivalent
vanced studies in ceramic laboratory experimentation.

:C 511 Advanced Studies in Firing **3 (2-3) f s**
:requisite: MIC 413
vanced studies of ceramic firing procedures with emphasis on the design, calculation and nomic evaluation of kilns and furnaces.

:C 522 Structural Clay Products **3 (3 0) s**
:requisite: MIC 413
e technology of the structural clay products industries with emphasis on the latest de- opments in the field.

:C 527 Refractories in Service **3 or 3**
:requisite: CH 342
study of the physical and chemical properties of the more important refractories in re- :ct to their environment in industrial and laboratory furnaces.

:C 540 Glass Technology **3 or 3**
:requisite: MIC 413
ndamentals of glass manufacture including compositions, properties and application of principle types of commercial glass.

:C 548 Technology of Cements **3 (3-0) s**
:requisite: MIC 413
e technology of the Portland cement industry including manufacture, control and uses.

)urses for Graduates Only

C 601 Ceramic Phase Relationships **3 or 3**
:requisite: Consent of Instructor
terogeneous equilibrium, phase transformations, dissociation, fusion, lattice energy, defect .ctures, thermodynamic properties of ionic phases and silicate melts.

C 605, 606 Crystal Structures **2 (2-0) f s**
:requisite: CH 342
:ic laws of crystal structure. Relation of crystal structure to chemical and physical properties.

C 613 Ceramic Thermal Mineralogy **3 (3-0) s**
:requisite: MIC 605
plications of the principles of thermo-chemical mineralogy to ceramic problems.

C 615, 616 High Temperature Technology **3 (2-3)**
:requisite: MIC 613
advanced consideration of the generation of high temperatures, furnace designs, and at- sphere controls. Theory of sintering hot pressing and thermo-chemical properties of high- :perature materials.

C 650 Ceramic Research **1 to 9 credits per semester**
original and independent investigation in ceramic engineering. A report of such an in- tigation is required as a graduate thesis.

C 660 Ceramic Engineering Seminar **1 (1-0) f s**
ports and discussion of special topics in ceramic engineering and allied fields.

C 661 Special Studies in Ceramic Engineering **1 to 3 credits per semester**
:cial studies of advanced topics in ceramic engineering. Credit will vary with the topic.

Chemical Engineering

Courses for Undergraduates

CHE 205 Chemical Process Principles **4 (3-2) f**
Prerequisites: MA 102, CH 103
Required of sophomores in Chemical Engineering.
The calculation of material and energy balances, stoichiometry, gas laws, vapor pressure, humidity, saturation, themophysics and thermochemistry. Three lectures and one problem period.

CHE 301, 302 Elements of Chemical Engineering **3 (3-0) f s**
An introduction to principles of chemical engineering including calculations involved in industrial processes and equipment. The course is designed for students not majoring in chemical engineering.

CHE 311 Introductory Chemical Engineering **4 (3-3) s**
Prerequisite: CHE 205
Required of sophomores in Chemical Engineering
A continuation of CHE 205. One laboratory period is devoted to typical chemical engineering measurements.

CHE 411 Unit Operations I **3 (3-0) f**
Prerequisites: MA 202, PY 202
Required of juniors in Chemical Engineering
Principles of fluid flow, heat transfer, evaporation, etc., with emphasis on design calculations

CHE 412 Unit Operations II **3 (3-0)**
Prerequisite: CHE 411
Required of seniors in Chemical Engineering
A continuation of CHE 411 with emphasis on the diffusional operations such as absorption distillation, extraction, drying, etc.

CHE 415 Chemical Engineering Thermodynamics **4 (3-2)**
Prerequisite: CHE 311
Required of juniors in Chemical Engineering
A study of the laws of thermodynamics and their application to chemical engineering problems. Emphasis on the theory, data and approximation methods as applied to physical and chemical systems.

CHE 421, 422 Reactor Energy Transfer **3 (3-0) f**
Prerequisites: MA 202, PY 202
Required courses in Nuclear Engineering curriculum
Thermodynamics, heat tranfer and fluid flow with emphasis on problems and methods used in the design and analysis of nuclear reactors.

CHE 431, 432 Unit Operations Laboratory I and II **3 (1-6)**
Prerequisite: CHE 411
Required of seniors in Chemical Engineering
Laboratory work on typical apparatus involving the unit operations. Experiments are designed to augment the theory and data of the lecture courses and to develop proficiency in writing of technical reports.

CHE 453 Chemical Processing of Radioactive Materials **3 (3**
Consideration of the unique procedures required for the bulk manipulation of radioactive chemicals. Particular attention is given to remote operational procedures of precipitation, centrifugation, conveying, solvent extraction and ion exchange. Design of apparatus involving low maintenance and ease of replacement and cleaning by safe methods is considered. Other topics include decontamination procedures and disposal of wastes.

HE 460 Seminar **1 (1-0) f s**
ne semester required of seniors in Chemical Engineering.
terature survey of selected topics in chemical engineering. Emphasis on written and oral esentation.

HE 470 Chemical Engineering Projects **2 Arrange f s**
ective for seniors in Chemical Engineering
troduction to research through experimental, theoretical and literature studies of chemical gineering problems. Oral and written presentation of reports.

ourses for Graduates and Advanced Undergraduates

HE 525 Process Measurement and Control **3 Arrange f s**
erequisite: CHE 411
heory and application of methods for measuring, transmitting, recording and controlling ch process variables as temperature, pressure, flow rate, liquid level, concentration, humidity, c. Commercial instruments are utilized for study of a wide variety of industrial control oblems. Recorder-controllers are available to simulating industrial control problems of rying difficulty.

HE 527 Chemical Process Engineering **3 (3-0) s**
erequisite: CHE 412
study of selected chemical processes with emphasis on the engineering, chemical and econom factors involved.

HE 540 Electrochemical Engineering **3 (3-0) s**
rerequisite: Physical Chemistry
he application of electrochemical principles to such topics as electrolysis, electroanalysis, ectroplating, metal refining, etc.

HE 541 Cellulose Industries **3 (3-0) f**
rerequisite: Organic Chemistry
fethods of manufacture and application of cellulose chemical conversion products. Emphasis laced on recent development in the fields of synthetic fibers, films, lacquers and other cellu se compounds.

HE 542 Technology of Pulp and Paper **3 Arrange f**
rerequisite: Organic Chemistry
undamentals of pulp and paper manufacture with emphasis on recent advances in the field. ne laboratory period per week is devoted to topics such as digestion and treatment of pulp, andsheet preparation and testing, fiber analysis and chemical and physical tests.

HE 543 Technology of Plastics **3 (3-0) s**
rerequisite: Organic Chemistry
he properties, methods of manufacture and application of synthetic resins. Recent develop ents in the field are stressed.

HE 545 Petroleum Refinery Engineering **3 (3-0) s**
rerequisite: CHE 412
n introduction to the petroleum industry including (1) nature of petroleum and its fractions, ctane numbers, viscosity relationships, etc., (2) operations of thermal and catalytic cracking, tabilization, alkylation isomerization, crude fractionation, etc., (3) problem work covering high ressure phase relationships and related material.

HE 546 Chemical Reaction Rates **3 (3-0) f**
rerequisite: CHE 415
A basic study of the rates of homogeneous reactions, heterogeneous reactions and catalysis.

CHE 551 Thermal Problems in Nuclear Engineering **3 (3-0)**
Prerequisite: ME 302 or 303 or CHE 411 or equivalent
The design and operation of nuclear reactors and the utilization of the power from them involves major problems in nearly every phase of heat transfer, and many important problems in fluid flow. Possible solutions to these problems are several affected by the influences of radiation on heat transfer media, hazards of handling radioactive substances, etc. The course considers the thermal problems of nuclear reactor design and the principles of fluid flow and heat transfer necessary to their solutions.
The course is intended for engineers and science students with backgrounds in physics and mathematics and elementary thermodynamics.

CHE 553 Separation Processes in Nuclear Engineering **3 (3-0)**
Prerequisite: CHE 412 or equivalent
A study of the principles and techniques of separation and purification of chemical components, based upon mass transfer by diffusion. Specific techniques covered are distillation, extraction, absorption and ion exchange, particularly in regard to continuous, counter-current operations. Special topics include a survey of fuel processing, technology of uranium processing, complexing actions of solvents and halide distillation.
The course is primarily intended for engineers and science students with backgrounds in mathematics, physics and elementary chemistry but who have had no previous course in separation processes.

CHE 570 Chemical Engineering Projects **3 Arrange**
Prerequisite or corequisite: CHE 412
A laboratory study of some phase of chemical engineering or allied field.

Courses for Graduates Only

CHE 610 Heat Transfer I **3 (3-0)**
Prerequisite: CHE 411
An advanced course dealing primarily with heat transfer between liquids and solids, optimum operating conditions and design of equipment, conduction, heating and cooling of solid radiant heat transmission.

CHE 611 Heat Transfer II **2 (2-0)**
Prerequisite: CHE 610
An intensive study of recent advances in heat tranfer and allied fields.

CHE 612 Diffusional Operations **3 (3-0)**
Prerequisite: CHE 412
An advanced treatment of mass transfer particularly as applied to absorption, extraction, drying, humidification and dehumidification.

CHE 613 Distillation **3 (3-**
Prerequisite: CHE 412
Vapor-liquid equilibria of non-ideal solutions, continuous distillation of binary and multicomponent systems, batch distillation, azeotropic and extraction distillation.

CHE 614 Drying of Solids **2 (2-**
Prerequisite: CHE 412
An advanced course on the mechanism of drying operations with application to design of equipment, such as cabinet, tunnel, rotary, drum and spray driers.

CHE 615 Thermodynamics I **3 (3-0**
Prerequisite: CHE 415
Advanced topics in Chemical Engineering thermodynamics including equilibria of physical and chemical systems, high pressure systems, generalized properties of hydrocarbons, etc.

CHE 616 Thermodynamics II **2 (2-0**
Prerequisite: CHE 615
An intensive study of recent advances in thermodynamics.

ΞE 617 Catalysis of Industrial Reactions **3 (3-0)**
erequisite: CHE 546
study of the mechanism of catalysis with emphasis on practical application to operation d design of industrial process.

ΞE 631, 632 Chemical Process Design **3 (3-0) f s**
erequisite: CHE 412
sign and selection of process equipment, through solution of comprehensive problems in- ıving unit operations, kinetics, thermodynamics, strength of materials and chemistry.

ΞE 641, 642 Advanced Chemical Engineering Laboratory **2 Arrange f s**
erequisite: CHE 412
.vanced laboratory work in a selected field with emphasis on theory, techniques and per- mance of equipment.

ΞE 650 Advanced Topics in Chemical Engineering **1 to 3 credits per semester f s**
study of recent developments in chemical engineering theory and practice, such as ion change, crystallization, mixing molecular distillation, hydrogenation, fluorination, etc. The ɔic will vary from term to term.

ΞE 660 Chemical Engineering Seminar **1 credit per semester f s**
erature investigations and reports of special topics in chemical engineering and allied fields.

E 680 Chemical Engineering Research **1 to 9 credits per semester f s**
lependent investigation of an advanced chemical engineering problem. A report of such an 'estigation is required as a graduate thesis.

Chemistry

ɔurses for Undergraduates

101 General Chemistry I **4 (3-2) f s**
e language of chemistry, fundamental chemical laws and theories, limited study of selected :mical elements, compounds, reactions, and processes.
Messrs. White, Blalock and staff

103 General Chemistry II **4 (3-2) f s**
erequisite: CH 101
mogeneous and heterogeneous equilibrium, oxidation and reduction, metallurgy, funda- ntal properties of metals, non-metals and their compounds, introductions to organic and clear chemistry, industrial applications of some metals, non-metals and their compounds. e laboratory work is mostly semimicro qualitative analysis.
Messrs. White, Blalock, and staff

105 General Inorganic Chemistry **4 (3-3) f s**
e language of chemistry, fundamental laws and theories, limited study of selected chemi- elements, compounds and reactions. Emphasis upon atomic structure. Designed for students o plan to take advanced courses in chemistry. Messrs. Freedman and Jones

106 General Inorganic Chemistry Laboratory **1 (0-3) f**
requisite: CH 105
boratory work to supplement the laboratory of CH 105. Staff

107 General Chemistry and Qualitative Analysis **4 (3-3) f s**
erequisite: CH 105
mogeneous and heterogeneous equilibria and their applications to qualitative analysis; ited study of selected chemical elements, compounds, and reactions; introduction to nuclear emistry. Emphasis upon ionic equilibria. The laboratory work is mainly semimicro quali- ive analysis. Designed for students who plan to take advanced courses in chemistry.
Staff

CH 108 General Chemistry and Qualitative Analysis Laboratory **1 (0-3) f s**
Corequisite: CH 107
Laboratory work to supplement CH 107. Staff

CH 215 Quantitative Analysis **4 (3-3) f s**
Prerequisite: CH 103
One semester course in volumetric and gravimetric analysis. Includes techniques, stoichiometry and principles of neutralization, oxidation and precipitation methods and the chemistry of representative laboratory determinations. Mr. Oliver

CH 220 Introductory Organic Chemistry **4 (3-3) f s**
Prerequisite: CH 103
An introduction to the fundamental principles of organic chemistry included in the study of the hydrocarbons, alcohols, ethers, aldehydes, ketones, acids and derivatives, esters, phenols, fats, carbohydrates, amino acids, proteins, and a selected group of natural and synthetic products. Mr. Robinson

CH 221 Organic Chemistry I **4 (3-3) f**
Prerequisite: CH 107 or CH 103
Fundamentals of organic chemistry covering both aliphatic and aromatic compounds.
Messrs. Loeppert and Rei

CH 222 Organic Chemistry Laboratory **1 (0-3) f**
Corequisite: CH 221
Laboratory work to supplement CH 221 Staff

CH 223 Organic Chemistry II **4 (3-3) s**
Prerequisite: CH 221
A continuation of CH 221 Messrs. Loeppert and Reid

CH 224 Organic Chemistry Laboratory **1 (0-3) s**
Corequisite: CH 223
Laboratory work to supplement CH 223 Staff

CH 231 Introductory Physical Chemistry **4 (3-3)**
Prerequisites: CH 103 and MA 112
Designed for students whose background in mathematics and physics is not sufficient to meet the requirements of the CH 431-433 physical chemistry course, but who desire instruction on chemical principles in addition to that provided at the freshmen level.
Staff

CH 351 Introductory Biochemistry **3 (2-3)**
Prerequisite: CH 220
The fundamental chemistry of living matter. Mr. Ingu

Courses for Advanced Undergraduates

CH 411 Analytical Chemistry I **4 (2-6)**
Prerequisites: CH 431, 432; Corequisites: CH 433, 434
An introduction to analytical chemistry, including both classical and modern techniques involving the distribution of a component between phases; for example, gravimetric methods, gas chromatography and adsorption. Messrs. Long and Pinkus

CH 413 Analytical Chemistry II **4 (2-6)**
Prerequisite: CH 411
A continuation of Analytical Chemistry I with emphasis upon modern approaches to acid-base chemistry, oxidation-reduction, potentiometric methods, and spectrophotometry.
Messrs. Long and Pinkus

H 420 Organic Preparations **3 (1-6) f s**
Prerequisites: Three years of chemistry including CH 223
Experiments selected to acquaint the student with advanced methods and techniques in the preparation of organic substances. Mr. Doak

H 431-433 Physical Chemistry I and II **3 (3-0) f s**
Prerequisites: CH 107, MA 202 and PY 202
An intensive study of the states of matter, solutions, colloids, homogeneous and heterogeneous equilibrium, reaction kinetics, electrolysis, conductance, oxidation reactions, and ionic equilibrium. Messrs. Getzen, Bowen, and Sutton

H 432-434 Physical Chemistry Laboratories **1 (0-3) f s**
Prerequisites: CH 431 and CH 433
Laboratory courses to accompany lecture work in Physical Chemistry I and II respectively.
Staff

H 435 Physical Chemistry III **3 (3-0) f**
Prerequisite: CH 433
An intensive study of the structure of atoms and molecules, an introduction to statistics, and selected topics in modern physical chemistry. Staff

H 441 Colloid Chemistry **3 (2-3) s**
Prerequisites: CH 220 and CH 215
Adsorption, preparation, properties, constitution, stability, and application of sols, gels, emulsions, foams, and aerosols; dialysis, Donnan membrane equilibrium. Mr. Getzen

H 491 Reading in Honors Chemistry **Credits by arrangement f s**
A reading course for exceptionally able students at the senior level. The students will do extensive reading in areas of advanced chemistry and will present written reports of their readings. Staff

Courses for Graduates and Advanced Undergraduates

H 501 Inorganic Chemistry I **3 (3-0) f**
Prerequisite: CH 433
A course in modern inorganic chemistry from the point of view of the chemical bond. Topics covered are: chemical periodicity and its origins in atomic structure; the ionic bond and electronegativity; crystal structure and bonding in ionic solids; the metallic state, conduction and semiconductors; the preparation and properties of illustrative compounds.
Mr. Pinkerton

H 503 Inorganic Chemistry II **3 (3-0) s**
Prerequisite: CH 501
A continuation of CH 501. Topics covered are: the hydrogen molecule-ion and the theory of the covalent bond; molecular orbitals and hybridization; dipole moments and magnetic properties; the theory of acids and bases; non-aqueous solvents; coordination compounds, carbonyls and quasi-aromatic compounds; and the chemistry of the transition metals, lanthanides and actinides. Mr. Long

H 511 Chemical Spectroscopy **4 (2-6) f**
Prerequisite: CH 433
Theory, analytical applications and interpretation of spectra as applied to chemical problems. Major emphasis will be placed upon ultraviolet, visible and infrared spectra.
Mr. Long

H 512 (TC 512) Chemistry of High Polymers

CH 513 Electroanalytical Chemistry **4 (3-3)**
Prerequisite: CH 413
A course in electroanalytical chemistry including the foundations of theoretical electrochemistry. Topics covered are: Potentiometric measurements and electrical resistance; diffusion, transport; theory of dilute solutions; polarography and amperometric measurements surface effects and electrode kinetics; electrochemistry in non-aqueous systems.
Mr. Pinkerton

CH 521 Advanced Organic Chemistry I **3 (3-0)**
Resonance, reaction mechanisms; hydrocarbons, organic halides, alcohols, amines, and carbonyl compounds. Mr. Doa

CH 523 Advanced Organic Chemistry II **3 (3-0)**
Stereochemistry, steroids and other natural products, organometallics, and heterocycles.
Mr. Doa

CH 525 Physical Organic Chemistry **3 (3-0)**
Prerequisites: CH 223 and CH 433
Theoretical and physical aspects of organic chemistry; structure and mechanism in organic chemistry. Mr. Loeppe

CH 527 Chemistry of Metal-Organic Compounds **3 (3-0)**
Prerequisites: Three years of chemistry including CH 223
A study of the preparation, properties and reactions of compounds containing the carbon-metal bond, with a brief description of their uses. Mr. Do

CH 528 Qualitative Organic Analysis **3 (1-6-**
Prerequisites: Three years of chemistry including CH 223
A study of class reactions, functional groups, separation, identification and preparation of derivatives. St

CH 529 Quantitative Organic Analysis **3 (1-6-**
Prerequisites: CH 223 and CH 413
Quantitative determination of carbon, hydrogen, nitrogen, the halogens, sulfur and various functional groups in organic materials, with emphasis on semimicro methods.
S

CH 531 Chemical Thermodynamics **3 (3-0**
Prerequisites: CH 433 and MA 301
An extension of elementary principles to the treatment of ideal and real gases, ideal solutions, electrolytic solutions, galvanic cells, surface systems, and irreversible processes. An introduction to statistical thermodynamics and the estimation of thermodynamic functions from spectroscopic data. Mr. Su

CH 533 Chemical Kinetics **3 (3-0**
Prerequisites: CH 433 and MA 301
An intensive survey of the basic principles of chemical kinetics with emphasis on experimental and mathematical techniques, elements of the kinetic theory, and theory of the transition state. Applications to gas reactions, reactions in solution, and mechanism studies. Mr. Bo

CH 535 Surface Phenomena **3 (3-0**
Prerequisites: CH 433 and MA 301
An intensive survey of the topics of current interest in surface phenomena. This course is designed to cover the foundations of the present understanding of surface behavior. Formulation of basic theories are presented together with illustrations of their current applications. Mr. G

CH 537 Quantum Chemistry **3 (3-0**
Prerequisites: CH 435, PY 401 and PY 407
The elements of wave mechanics applied to stationary energy states and time dependent phenomena. Applications of quantum theory to chemistry, particularly chemical bonds.
Mr.

I 543 Radioisotope Principles **3 (3-0) f**
erequisites: CH 433, PY 202 and MA 2 2
presentation of the basic knowledge of radioactivity, nuclear rea ti ns, i nizing radiatic ns, d radiochemistry essential to competence in the use of radioisotopes. Mr Coots

I 544 Radioisotope Techniques **1 (0-3) f**
›requisite: CH 543
laboratory course in the physical and chemical techniques essential to competence in the e of radioisotopes. Mr. Coots

I 545 Radiochemistry **3 (3-0) s**
erequisites: CH 543, or PY 467 and PY 410
1 advanced presentation of the applicati ns of radioactivity to chemistry and of the applica ti ns of chemistry to the radioactive elements, particularly the heavy elements and sion products. Mr. Coots

I 546 Radiochemistry Laboratory **1 (0-3) s**
›requisite: CH 545
he laboratory work associated with CH 545 Radiochemistry. Mr. Coots

I 551 General Biological Chemistry **5 (3 6) f**
rerequisites: 3 years of chemistry including CH 223
he chemical constitution of living matter Biochemical processes as well as compounds are udied. Mr. Peterson

H 553 Chemistry of Proteins and Nucleic Acids **3 (3-0) s**
rerequisite: CH 551
omposition, distribution, structure, properties and metabolism of amino acids, proteins and ucleic acids. Mr. Armstrong

H 555 Plant Chemistry **3 (2-3) s**
rerequisite: CH 551
omposition of plants, properties, nature, and classification of plant constituents, changes oc- ›ring during growth, ripening and storage of plant products. Mr. Sisler

Courses for Graduates Only

H 621 (ANS 621) Enzymes and Intermediary Metabolism **4 (3-0) s**
rerequisite: CH 551
› study of the properties of enzymes and enzyme action, intermediary metabolism of car ohydrates, amino acids, fatty acids, vitamins, purines and porphyrins, metabolic energy elationships. Mr. Love

CH 622 (ANS 622) Principles of Biological Assays **3 (2-2) s**
'rerequisites: CH 551 or ANS 312 and ST 512
Techniques and designs of biological assays for vitamins; interrelationships of logical prin iples, design, and analysis is emphasized. Staff

CH 631 Chemical Research **Credits by arrangements f s**
'rerequisites: Forty semester credits in chemistry. Open to all graduates.
special problems that will furnish material for a thesis. A maximum of 6 semester credits is llowed toward a master's degree, no limitation on credits in doctorate programs. Staff

CH 641 Seminar **Credits by arrangement f s**
Prerequisite: Graduate standing in chemistry.
Required of graduate students specializing in chemistry.
Scientific articles, progress reports in research, and special problems of interest to chemists are reviewed and discussed.
A maximum of two semester credits is allowed toward the master's degree, but any number toward the doctorate. Staff

CH 651 Special Topics in Chemistry **Maximum 3 credits f**
Prerequisite: Graduate standing in chemistry
Critical study of some special problems in one of the branches of chemistry involving original investigation together with a survey of pertinent literature. Staf

CH 671 Advanced Physical Chemistry **3 (3-0)**
Prerequisite: CH 533
Involves a thorough review of the fundamental principles of physical chemistry with extensio and application of these to the study of solid state. Mr. Sutto

CH 672 Advanced Physical Chemistry **3 (3-0)**
Prerequisite: CH 671
There will be laid down the elements of statistical mechanics and kinetic theory, in term of which certain topics from CH 671 will be more exhaustively developed. Mr. Sutto

Civil Engineering

Courses for Undergraduates

CE 201 Surveying I **3 (2-3) f**
Prerequisite: MA 101
Required of sophomores in Civil Engineering, Civil Engineering Construction Option, Forest and juniors in Geological Engineering
Elements of plane surveying: taping, transit, level, stadia, plane table, topograpic surveyi and mapping, care and adjustment of instruments; public land surveys.

CE 202 Surveying II **3 (2-3**
Prerequisite: CE 201
Required of sophomores in Civil Engineering and Civil Engineering Construction Option
Construction surveys; earthwork computations, route surveys, simple, compound, parabc and special curves; elementary astronomical surveying.

CE 305, 306 Transportation Engineering I, II **3 (2-2)**
Prerequisite: CE 202
Transportation systems; elements of railroad, highway, traffic and airport engineering; phys and mechanical properties of soil that govern their use as engineering materials.

CE 321 Materials Testing Laboratory I **2 (1-3) s**
Prerequisite: EM 200
Physical properties of aggregates. Manufacture and chemical properties of cementing age - Physical properties of wet and hardened concretes; design and proportioning of conc e mixes; tensile, compressive, and flexural properties of plain and reinforced concrete.

CE 322 Materials Testing Laboratory II **2 (1-3) s**
Corequisite: EM 301
Properties of clay and cement masonary units. Growth, structure and mechanical prope es of various species of wood. Production and mechanical properties of structural metals; el ic and plastic tensile properties of steel. Test of riveted and welded joints.

CE 324 Structural Analysis I **3 (2- s**
Prerequisite: EM 200; Corequisite: EM 301
Required of juniors in Civil Engineering and Civil Engineering Construction Option
Stress analysis of statically determinate beams and framed structures under fixed and mc ng loads; influence line treatment for moving loads; analysis and design of a simple truss

: 338 Structures I **3 (3-0) f**
erequisite: EM 200
quired of juniors in Architecture
alysis of simple structures, reactions, shear and moment diagrams; stresses in numbers of med structures; graphic statics.

: 339 Structures II **3 (3-0) s**
erequisites: CE 338 and EM 301
quired of juniors in Architecture
alysis of indeterminate structures; slopes and deflections; analysis of indeterminate frames moment distribution.

: 361 Estimates and Costs I **3 (2-3) f**
erequisite: Junior standing
quired of juniors in Civil Engineering Construction Option
terpretation of working drawings; analysis of construction plans and specifications; approximate and detailed estimates of costs.

: 362 Estimates and Costs II **3 (2-3) s**
erequisite: CE 361
quired of juniors in Civil Engineering Construction Option
eparation of complete costs estimates of construction projects; bidding procedures and eparation of bids.

E 382 Hydraulics **3 (3-0) f s**
erequisite: EM 200
equired of juniors in Civil Engineering
roperties of fluids and mechanics of fluid flow in pipes and open channels; theory of design id characteristics of pumps and hydraulic motors; measurement of fluid flow.

ourses for Advanced Undergraduates

E 425 Structural Analysis II **3 (2-3) f**
rerequisites: CE 324 and EM 301
equired of seniors in Civil Engineering
eflection of beams and trusses; indeterminate stress analysis by moment area, slope deflection nd moment distribution.

E 427 Structural Design I **4 (3-3) f**
rerequisites: EM 301 and CE 324
equired of seniors in Civil Engineering and Civil Engineering Construction Option
nalysis and design of reinforced concrete building elements; design of tension, compression nd simple flexural members of steel and of timber.

E 428 Structural Design II **3 (1-6) s**
Prerequisites: CE 427 and CE 425
Required of seniors in Civil Engineering
Design specifications; connection details; independent and complete design of engineering structures.

E 429 Structural Design III **3 (2-3) s**
Prerequisite: CE 427
Required of seniors in Civil Engineering Construction Option
Design of tension, compression and flexural elements of steel and timber; solution of problems in erection, forms, shoring and falsework.

CE 442 Soil Mechanics **3 (2-3) f**
Prerequisite: CE 305
Required of seniors in Civil Engineering
Fundamental stress relations, Mohr's rupture hypothesis, shearing strength, earth pressure theories, bearing capacity, stability of slopes, hydrostatics, and hydrodynamics of ground water.

CE 443 Foundations **3 (3-0) s**
Prerequisite: CE 427
Required of seniors in Civil Engineering Construction Option
Identification and classification of soils; geological aspects of foundation engineering; methods of investigating subsoil conditions; control of water; type of foundations and conditions favoring their use; legal concepts of foundation engineering.

CE 461 Project Planning and Control I **3 (2-3) f**
Prerequisite: CE 362
Required of seniors in Civil Engineering Construction Option
Analysis of construction plant layout requirements and performance characteristics of equipment.

CE 462 Project Planning and Control II **3 (2-3) s**
Prerequisite: CE 461
Required of seniors in Civil Engineering Construction Option
Scheduling, analysis and control of construction projects.

CE 464 Legal Aspects of Contracting **3 (3-0) s**
Prerequisite: Senior standing
Required of seniors in Civil Engineering Construction Option, elective
Legal aspects of construction contract documents and specifications; owner-engineering-contractor relationships and responsibilities; bids and contract performance; labor laws.

CE 481 Hydrology and Drainage **2 (2-0) f**
Prerequisite: CE 382
Required of seniors in Civil Engineering
Occurrence and distribution of rainfall; runoff, surface and ground waters; design of drainage and control structures.

CE 482 Water and Sewage Works **3 (3-0)**
Prerequisite: Senior standing
Required of seniors in Civil Engineering
Water supply analysis and design, including population estimates, consumption, source selection aqueducts, distribution systems and pumping stations; elements of water treatment; collection and disposal of sewage; elements of sewage treatment.

CE 485 Elements of Hydraulics and Hydrology **3 (3-0)**
Prerequisite: EM 200
Required of seniors in Civil Engineering and Construction Option
Elements of fluid mechanics, hydraulics and hydrology, with application to problems in construction engineering.

CE 492, 493 Professional Practice I, II **1 (1-0) f s**
Prerequisite: Senior standing
Required of seniors in Civil Engineering and Civil Engineering Construction Option
Professional engineering societies and their functions; professional standards; topics of current interest to the civil engineer.

Courses for Graduates and Advanced Undergraduates

CE 507 Airphoto Analysis I **3 (2-3) f**
Prerequisite: Junior standing
Engineering evaluation of aerial photographs, including analysis of soils and surface drainage characteristics.

CE 508 Airphoto Analysis II **3 (2-3)**
Prerequisite: CE 507
Engineering evaluation of aerial photographs for highway and airport projects.

:E 509 Photogrammetry **3 (2-3) f s**
rerequisite: CE 201
lements of photogrammetry as applied to surveying and mapping. Aerial and terrestrial hotogrammetry. Flight planning and ground controls. Stereoscopy and stereoscopic plotting nstruments. Measurements on photographs.

:E 510 Advanced Surveying **3 (2-3) f s**
rerequisite: CE 202
.ate coordinate systems and map projections. Elements of geodetic and astronomical surveying. djustment of observations by the method of least squares.

E 514 Municipal Engineering Projects **3 (2-3) s**
rerequisite: Senior standing
pecial problems relating to public works, public utilities, urban planning and city engineering.

E 515 Transportation Operations **3 (3-0) f**
rerequisite: CE 306
.he analysis of traffic and transportation engineering operations.

E 516 Transportation Design **3 (2-3) f**
rerequisite: CE 306
.he geometric elements of traffic and transportation engineering design.

E 524 Analysis and Design of Masonary Structures **3 (3-0) f**
orequisite: CE 425
nalysis and design of arches, culverts, dams, foundations and retaining walls.

E 525, 526 Advanced Structural Analysis I, II **3 (3-0) f s**
rerequisite: CE 425
nalysis of rigid frames and continuous structures; treatment of redundant members and econdary stresses.

E 527 Numerical Methods in Structural Analysis **3 (3-0) s**
rerequisite: CE 425
Newmark's numerical integration procedure and its applications; matrix operations, relaxation nd iteration, finite difference method. Force and displacement methods, string polygon ethod. High-speed computation.

:E 531 Experimental Stress Analysis **3 (2-3) f**
rerequisite: CE 425
rinciples and methods of experimental analysis; dimensional analysis; applications to full-cale structures.

:E 532 Structural Laboratory **3 (1-6) s**
rerequisite: CE 425
Test procedures and limitations and interpretations of experimental results.

:E 534 Plastic Analysis and Design **3 (3-0) s**
rerequisite: CE 427
Analysis of steel structure behavior beyond the elastic limit; concept of design for ultimate oad and the use of load factors. Analysis and design of component parts of frames. Methods f predicting strength and deformation behavior of structures loaded in the plastic range. Bracing and connection requirements for frames.

:E 535 Ultimate Strength Theory and Design **3 (3-0) f**
rerequisite: CE 427
Ultimate strength theories of axially loaded column flexure, combined flexure and axial oad, shear. Critical review of important research and their relationship with the development f modern design codes for reinforced concrete.

CE 536 Theory and Design of Prestressed Concrete **3 (3-0) s**
Prerequisite: CE 427
The principles of prestressed concrete. Materials. Methods of prestressing. Loss of prestress. Design of beams for bending, shear and bond. Ultimate strength. Deflection. Composite beams. Continuous beams. Special topics. Design projects.

CE 544 Foundation Engineering **3 (3-0) f s**
Prerequisite: CE 442
Subsoil investigations; excavations; design of sheeting and bracing systems; control of water; footing, grillage and pile foundations caisson and cofferdam methods of construction; legal aspects of foundation engineering.

CE 547 Fundamentals of Soil Mechanics **3 (3-0) f s**
Prerequisite: EM 301
Physical and mechanical properties of soils governing their use for engineering purposes; stress relations and applications to a variety of fundamental problems.

CE 548 Engineering Properties of Soils I **3 (2-3) f**
Corequisite: CE 442
The study of soil properties that are significant in earthwork engineering, including properties of soil solids, basic clay mineral concepts, classification, identification, plasticity, permeability, capillarity and stabilization. Laboratory work includes classification, permeability and compaction tests.

CE 549 Engineering Properties of Soils II **3 (2-3)**
Prerequisite: CE 548
Continuation of CE 548, including the study of compressibility, stress-strain relations and shear strength theories for soil. Laboratory work includes consolidation and shear strength tests.

CE 570 Sanitary Microbiology **3 (2-3) f**
(See BO 570)

CE 571 Theory of Water and Sewage Treatment **3 (3-0)**
Prerequisite: Senior Standing
Study of the physical and chemical principles underlying water and sewage treatment processes; diffusion of gases, solubility, equilibrium and ionization, anaerobic and aerobic stabilization processes, sludge conditioning and disposal.

CE 572 Unit Operations and Processes in Sanitary Engineering **3 (1-6)**
Prerequisite: CE 571
Processes and operations in sanitary engineering; sedimentation, aeration, filtration, adsorption, coagulation, softening, sludge digestion, aerobic treatment of sewage.

CE 573 Analysis of Water and Sewage **3 (1-6)**
Corequisite: CE 571
Chemical and Physical analysis of water and sewage and interpretation of results.

CE 574 Radioactive Waste Disposal **3 (2-3) f**
Prerequisite: PY 410
Unit operations and processes employed in treatment and disposal of radioactive wastes.

CE 580 Flow in Open Channels **3 (3-0) f**
Prerequisite: CE 481
The theory and applications of flow in open channels, including dimensional analysis, momentum-energy principle, gradually varied flow, high-velocity flow, energy dissipators, spillways, waves, channel transition and model studies.

CE 591, 592 Civil Engineering Seminar **1 (1-0) f s**
Discussion and reports of subjects in civil engineering and allied fields.

E 598 Civil Engineering Projects **1 to 6 (arrange) f s**
Special projects in some phases of civil engineering.

Courses for Graduates Only

E 601 Transportation Planning **3 (2-3) s**
Prerequisite: CE 515
The planning, administration, economics and financing of various transportation engineering facilities.

E 602 Advanced Transportation Design **3 (2-3) s**
Prerequisite: CE 516
Design of major traffic and transportation engineering projects.

E 603 Airport Planning and Design **3 (2-3) f**
Prerequisites: CE 515 and 516
The analysis, planning and design of air transportation facilities.

E 604 Urban Transportation Planning **3 (2-3) s**
Prerequisite: CE 515
Thoroughfare planning as related to land usage and urban master-planning.

E 623 Theory and Design of Arches **3 (3-0) f**
Prerequisites: CE 428 and CE 526
General theory of elastic arches. Boundary conditions and their effect on the behavior of the arch. Single span, multiple span arches on elastic piers, influence lines of various functions under moving loads, economical layout of arches, design criteria for steel and concrete arches.

E 624 Analysis and Design of Structural Shells and Folded Plates **3 (3-0) s**
Prerequisites: CE 623 and EM 511
Roof structures consisting of surfaces of revolution, both single and compound curved. Membrane stresses, bending stresses at boundaries. Domes and cylindrical shells. Approximate and exact analyses. Design of criteria. Folded plane structures of concrete plates and steel frames.

CE 625, 626 Advanced Structural Design I, II **3 (2-3) f s**
Prerequisite: CE 428; Corequisites: CE 525 and 526
Complete structural designs of a variety of projects; principles of limit and prestress design.

CE 627 Design of Blast Resistant Structures **3 (3-0) f**
Prerequisites: CE 526, CE 535 and EM 554
Sources, intensities, and methods of transmission of dynamic loads. Behavior of structural elements under dynamic loadings. Behavior of structural systems subjected to pulse and impact loads. Design criteria and factor of safety. Design of surface and underground structures for nuclear blasts.

CE 641, 642 Advanced Soil Mechanics **3 (3-0) f s**
Prerequisite: CE 422 or corequisite: CE 547
Theories of soil mechanics; failure conditions; mechanical interaction between solids and water, and problems in elasticity pertaining to earthwork engineering; soil dynamics.

CE 643 Hydraulics of Ground Water **3 (3-0) f s**
Prerequisite: CE 442 or 547
Principles of ground water hydraulics; theory of flow through idealized porous media; the flow net solution; seepage and well problems.

CE 671 Advanced Water Supply and Sewerage **4 (3-3) f**
Prerequisite: CE 482
Problems relating to the design of water supply and sewerage works.

CE 672 Advanced Water and Sewage Treatment **4 (3-3) s**
Prerequisite: CE 482
Problems relating to the treatment of water and sewage.

CE 673 Industrial Water Supply and Waste Disposal **3 (3-0) f s**
Corequisite: CE 571
Water requirements of industry and the disposal of industrial wastes.

CE 674 Stream Sanitation **3 (3-0) f s**
Corequisite: CE 571
Biological, chemical and hydrological factors that affect stream sanitation and stream use.

CE 698 Civil Engineering Research **1-6 (arrange) f s**
Independent investigation of an advanced civil engineering problem; a report of such an investigation is required as a graduate thesis.

Crop Science

Courses for Undergraduates

CS 211 Field Crops I **3 (2-2) f s**
Prerequisite: BO 103
Discussion of fundamental principles underlying crop production. The application of these principles to the major and minor field crops. The elements of plant identification, crop grading and judging. Mr. Lewis

CS 311 Field Crops II **3 (2-2) f**
Prerequisites: CS 211, SSC 200
Specific problems in field crop production other than forage crops. Discussion of those crops in farm rotations brings together all the major aspects of crop production for different climatic areas. Mr. Lewis

CS 312 Pastures and Forage Crops **3 (3-0) s**
Prerequisites: CS 211, SSC 200 recommended
A study of the production and preservation of the principal forage crops. Special attention is given to the development and maintenance of pastures. Mr. Chamble

CS 412 Advanced Pastures and Forage Crops **2 (2-0)**
Prerequisite: CS 312
Pasture species and management (cultural treatment) from an international viewpoint, and the inter-relationship of grazing animals on pasture development and management will be emphasized. Natural grassland and the place of special plant species will be considered. Mr. Gro

CS 413 Plant Breeding **3 (3-0)**
Prerequisite: GN 411
The application of genetic principles to the improvement of economic plants, including discussions of the methods employed in the development and the perpetuation of desirable clones, varieties and hybrids. Mr. Harve

CS 414 Weeds and Their Control **3 (2-2)**
Prerequisites: CS 211, CH 203 or equivalent
Principles involved in cultural and chemical weed control. Discussions on chemistry herbicides and the effects of the chemicals on the plant. Identification of common weeds and their seeds is given. Mr. Klingma

Courses for Advanced Undergraduates and Graduates

S 511 Tobacco Technology **2 (2-0) s**
Prerequisites: CS 311, BO 421 or equivalent
A study of special problems concerned with the tobacco crop. The latest research problems and findings dealing with this important cash crop will be discussed.
Mr. Jones

S 521 Special Problems **Credits by arrangement**
Prerequisite: Students admitted only with consent of instructor
Special problems in various phases in Crop Science. Problems may be selected or will be assigned. Emphasis will be placed on review of recent and current research.
Graduate Staff

S 541 (GN 541 or HS 541) Plant Breeding Methods **3 (3-0) f**
Prerequisites: GN 512, ST 511 recommended
An advanced study of methods of plant breeding as related to principles and concepts of inheritance. Messrs. Haynes, Timothy

S 542 (GN 542 or HS 542) Plant Breeding Field Procedures **2 (0-4) (In Summer Sessions)**
Prerequisite: CS 541 or GN 541 or HS 541
A laboratory and field study of the application of the various plant breeding techniques and methods used in the improvement of economic plants. Mr. Harvey

Courses for Graduates Only

Students are to consult the instructor before registration.

S 611 Forage Crop Ecology **2 (2-0) s**
Prerequisites: CS 412, BO 441
A study of the effect of environmental factors on the growth of forage crops. Attention will be given to methods of research in forage ecology. Mr. Chamblee

S 612 Special Topics in Weed Control **2 (2-0) s**
Prerequisites or corequisites: BO 403, BO 532 or 533, CS 414
Detailed examination of current concepts and literature of weed control. The chemistry, physiology, ecology, taxonomy, microbiology, equipment, and techniques used in weed control research will be discussed. Graduate Staff

S 631 Seminar **1 (1-0) f s**
Prerequisite: Graduate standing
Scientific articles, progress reports in research, and special problems of interest to agronomists reviewed and discussed. A maximum of two credits is allowed toward the master's degree, however, additional credits toward the doctorate are allowed. Graduate Staff

S 641 Research **Credits by arrangement**
Prerequisite: Graduate standing
A maximum of six credits is allowed toward the master's degree, but any number toward the doctorate. Graduate Staff

Design

Courses for Undergraduates

DN 101, 102 Design I, II **3 (3-6) f s**
Required of first year students in the School of Design
Introduction to the elements and expression of two and three dimensional design involving a variety of tools, materials, and techniques. Orientation of historical and contemporary concepts of art and architecture.
Messrs. Baron, Bireline, Macomber, Hertzman, Sappenfield, Stuart, Taylor

DN 111, 112 Descriptive Drawing I, II **2 (0-4) f s**
Required of first year students in the School of Design
Problems in visual analysis with emphasis on the systems man has devised to describe his visual experience. Messrs. Bireline, Cox, Hertzman, Sappenfield, Taylor

DN 121, 122 Technical Drawing I, II **3 (2-4) f s**
Required of first year students in the School of Design
Descriptive geometry and allied technical drawing. Lectures and simple exercises in analytical programming of architectural elements.
Messrs. Boaz, Buisson, Glowczewski, Sappenfield, Shawcroft, Shogren, Thurlow

DN 211, 212 Descriptive Drawing III, IV **2 (0-4) f**
Prerequisite: DN 112
Required of second year students in the School of Design
Problems continuing the studies begun in freshman year with the addition of the study of color and its effects. Messrs. Cox, Hertzman, Macomber, Sappenfield

DN 311, 312 Advanced Descriptive Drawing I, II **2 (0-6) f s**
Prerequisite: DN 212
Required of third year students in the School of Design
Advanced problems in the fields of painting, sculpture, drawing, and graphics.
Messrs. Bireline, Cox, Stua

DN 321, 322 History of Architecture I, II **3 (3-0) f s**
Prerequisite: HI 245
Required of all students in Architecture and Landscape Architecture
A critical study of architecture from prehistoric times to the present including references landscape architecture, painting, sculpture, and artifacts. Mr. Buisso

DN 411, 412 Advanced Descriptive Drawing III, IV **2 (0-6) f s**
Prerequisite: DN 312
Required of fourth year students in the School of Design
Advanced problems in the fields of painting, sculpture, drawing, and graphics.
Messrs. Bireline, Cox, Stua

DN 421, 422 History of Design, I, II **3 (3-0) f s**
Prerequisite: HI 246
Required of all students in Architecture and Landscape Architecture
Specialized historical studies in design fields.
Messrs. Clarke, Har

DN 511, 512 Advanced Descriptive Drawing V, VI **2 (0-6) f s**
Prerequisite: DN 412
Required of fifth year students in Landscape Architecture and Product Design
Advanced problems in the fields of painting, sculpture, drawing, and graphics.
Messrs. Bireline, Cox, Joslin, Stua

DN 541 Seminar on Ideas in Design **2 (2-0) f**
Corequisites: ARC 501, LA 501 or PD 501
Required of fifth year students in the School of Design
An introduction to aesthetics and the relationships of philosophic thought to design.
Mr. Kamphoef

Economics

Courses for Undergraduates

EC 201, 202 Economics **3 (3-0) f s**
Fundamental principles applying to the organization and functioning of our economy.

EC 205 The Economic Process **3 (3-0) f s**
An analysis of the process and principles by which an economy allocates resources, distributes goods and income and determines rate of growth.

EC 301 Production and Prices **3 (3-0) f or s**
Prerequisite: EC 201 or EC 205
An intensive study of the functioning of the market economy. An examination of the role of prices in determining the allocation of resources, the functioning of the firm in the economy, and forces governing the production of economic goods.

EC 302 National Income and Economic Welfare **3 (3-0) f or s**
Prerequisite: EC 201 or EC 205
An intensive examination of factors determining the national income. The economic and social effects of the level, composition, and distribution of national income will be studied with reference to theories of economic welfare and to public policy.

EC 310 Economics of the Firm **3 (3-0) s**
Prerequisite: EC 201 or EC 205
An examination of the economic setting within which the business firm makes decisions, and an application of economic analysis to these decisions. Economics from the focal point of managerial decision-making.

EC 312 Accounting for Engineers **3 (3-0) f s**
A study of accounting principles from the management point of view; the analysis, recording and interpretation of business data; preparation of financial statesments, their use and interpretation.

EC 315 Salesmanship **2 (2-0) f s**
An introduction to the principles and techniques of selling from the standpoint of the individual salesman. A course designed for the technical student anticipating entering the field of distribution.

EC 401, 402 Principles of Accounting **3 (2-2) f s**
Fundamental principles of accounting theory and practice; the analysis and recording of business transactions; explanation and interpretation of the structure, forms and use of financial statements.

EC 407 Business Law I **3 (3-0) f s**
Prerequisite: EC 201 or EC 205
A course dealing with elementary legal concepts, contracts, agency, negotiable instruments, sales of personal property, chattel mortgages, partnerships, corporations, suretyship and bailments, insurance.

EC 408 Business Law II **3 (3-0) f s**
Prerequisite: EC 407
Deals with real property, mortgages on urban and farm lands, landlord and tenant, requirements for valid deed, insurance law, wills, suretyship, and conditional sales.

EC 409 Introduction to Production Costs **3 (3-0) f s**
Prerequisite: EC 312
An introduction to accounting for manufacturing, fabrication and construction-type enterprises. The determination and allocation of costs of materials, labor, and overhead. Special emphasis is placed on managerial analysis, interpretation, and control of cost data.

EC 410 Industry Studies **3 (3-0) f**
Prerequisite: EC 201 or EC 205
An analysis of organization, market structure, and competitive behavior in specific industries, using the tools of the economist as a guide to pertinent factors and their significance. The course will be organized along the lines of intensive but broadly relevant case-studies.

EC 411 Marketing Methods **3 (3-0) f s**
Prerequisite: EC 201 or EC 205
Marketing institutions and their functions and agencies; retailing; market analysis; problems in marketing.

EC 413 Competition, Monopoly, and Public Policy **3 (3-0) s**
Prerequisite: EC 201 or EC 205. EC 301 recommended but not required
An analysis of the effect of modern industrial structure on competitive behavior and performance, in the light of contemporary price theory and the theory of workable competition. A critical evaluation of the legislative content, judicial interpretation, and economic effects of the anti trust laws.

EC 414 Tax Accounting **3 (2-2) f s**
Prerequisite: EC 312 or EC 401
An analysis of the Federal tax laws relating to the individual and business. Determining and reporting income. Payroll taxes and methods of reporting them. Actual practice in the preparation of income tax returns.

EC 420 Corporation Finance **3 (3-0) f s**
Prerequisite: EC 201 or EC 205
Financial instruments and capital structure; procuring funds; managing working capital; managing corporate capitalization; financial institutions and their work.

EC 425 Industrial Management **3 (3-0) f**
Prerequisite: Junior standing
Principles and techniques of modern scientific management; relation of finance, marketing, industrial relations, accounting, and statistics to production planning and control; analysis of economic, political and social influences on production.

EC 426 Personnel Management **3 (3-0) s**
Prerequisite: Junior standing
The scientific management of manpower, from the viewpoint of the supervisor and the personnel specialists. A study of personnel policy and a review of the scientific techniques regarding the specific problems of employment, training, promotion, transfer, health and safety, employee service, and joint relations.

EC 431 Labor Problems **3 (3-0) f s**
Prerequisite: Junior standing
An economic approach to labor problems including wages, hours, working conditions, insecurity, substandard workers, minority groups, social security, and public policy relative to these problems.

EC 432 Industrial Relations **3 (3-0) f s**
Prerequisite: Junior standing
Collective bargaining. Analysis of basic labor law and its interpretation by the courts and governmental agencies. An examination of specific terms of labor contracts and their implications for labor and management. An examination of labor objectives and tactics and management objectives and tactics. Problems of operating under the labor contract.

EC 440 Economics of Growth **3 (3-0)**
Prerequisite: EC 201 or EC 205
An examination of the institutional background required for national economic development. The conditions apparent for past growth of nations are compared with conditions obtained in presently retarded nations. Conclusions are drawn from this comparison to provide an introduction to the theoretical models of growth.

EC 442 Evolution of Economic Ideas **3 (3-0) f or s**
Prerequisite: EC 201 or EC 205
An analysis of the development of economic thought and method during the past two centuries. Economics considered as a cumulative body of knowledge in a context of emerging technology, changing institutions, pressing new problems, and the growth of science.

:C 446 Economic Forecasting **3 (3-0) f or s**
rerequisite: EC 201 or EC 205. EC 302 recommended but not required
n examination of the basic principles and techniques of economic forecasting with strong nphasis upon the economic models upon which forecasting is based.

: 448 International Economics **3 (3-0) f**
erequisite: EC 201 or EC 205
study of international economics, including trade, investment, monetary relations, and rtain aspects of economic development. Emphasis upon analytical and policy approaches, though some institutional material is included.

: 450 Economics Decision Processes **3 (3-0) s**
erequisites: EC 201 or EC 205, MA 202 or MA 212
n analysis of processes for decision making by individuals and groups. Linear programming, obability, and game theory in the light of a general theory of decision.

: 490 Senior Seminar in Economics **3 (3-0) f s**
erequisite: Consent of instructor
he terminal course in undergraduate study of economics. The student is assisted in summarizing his training, and in improving his capacity to recognize problems and to select gically consistent means of solving the problems. This is done on a small group and individ-l basis.

ourses for Graduates and Advanced Undergraduates

: 501 (AGC 501) Intermediate Economic Theory **3 (3-0) f**
erequisite: EC 301 or AGC 212 or equivalent
n intensive analysis of the determination of prices and of market behavior including demand, sts and production, pricing under competitive conditions, and pricing under monopoly d other imperfectly competitive conditions.

: 502 Money, Income, and Employment **3 (3-0) s**
erequisite: EC 302 or EC 501 or equivalent
study of the methods and concepts of national income analysis with particular reference the role of monetary policy in maintaining full employment without inflation.

: 510 (PS 510) Public Finance **3 (3-0) f s**
erequisite: EC 201 or EC 205
survey of the theories and practices of governmental taxing, spending, and borrowing, inuding intergovernmental relationships and administrative practices and problems.

: 525 Management Policy and Decision Making **3 (3-0) f**
erequisites: Nine hours in economics and related courses and consent of the instructor
review and consideration of modern management processes used in making top level policies d decisions. An evaluation of economic, social and institutional pressures, and of the economic and non-economic motivations, which impinge upon the individual and the organization. ie problem of coordinating the objectives and the mechanics of management is examined.

: 531 Management of Industrial Relations **3 (3-0) s**
erequisites: Senior standing and consent of instructor
seminar course designed to round out the technical student's program. Includes a survey the labor movement organization and structure of unions, labor law and public policy, e union contract and bargaining process, and current trends and tendencies in the field collective bargaining.

: 541 Origins of the United States' Economy **3 (3-0) f**
erequisites: Senior or Graduate standing; EC 205, HI 261, or HI 333, or equivalents
seminar on growth and development of American economic institutions. Emphasis is aced on the relationship between the growth of the economy of the United States and cories of economic development.

EC 550 Mathematical Models in Economics **3 (3-0) f or s**
Prerequisites: EC 201 or EC 205, MA 202 or MA 212, EC 450 recommended but not required
An introductory study of economic models emphasizing their formal properties. The theory of individual economic units is presented as a special case in the theory of inductive behavior. Mathematical discussions of the theory of the consumer, the theory of the firm, and welfare economics will show the relevance of such topics as constrained maxima and minima, set theory, partially and simply ordered systems, probability theory, and game theory to economics.

EC 552 Econometrics **3 (3-0) f or s**
Prerequisites: EC 201 or EC 205, MA 202 or MA 212, ST 361
An analysis of methods for economic inference. Multi-equation economic models: their specification, identification, and estimation.

EC 555 Linear Programming **3 (3-0) f s**
Prerequisites: EC 201 or EC 205, MA 202 or MA 212, MA 405
Recent developments in the theory of production, allocation, and organization. Optimal combination of integrated productive processes within the firm. Applications in the economics of industry and of agriculture.

EC 590, 591 Seminar in Special Economic Topics **3 (3-0) f s**
Prerequisite: Consent of instructor
Topics presented by a visiting professor or special lecturer. This course will be offered from time to time as distinguished visiting scholars are available.

Courses for Graduates Only

EC 601 Advanced Economic Theory **3 (3-0) f**
Prerequisite: EC 501 or equivalent
A rigorous examination of contemporary microeconomic theory.

EC 602 (AGC 602) Monetary and Employment Theory **3 (3-0) f**
Prerequisite: EC 502 or equivalent
The course consists of an analysis of the forces determining the level of income and employment; a review of some of the theories of economic fluctuations; and a critical examination of a selected macroeconomic system.

EC 603 History of Economic Thought **3 (3-0)**
Prerequisites: EC 442 or EC 501, EC 502 or equivalent
A systematic analysis of the development and cumulation of economic thought, designed in part to provide a sharper focus and more adequate perspective for the understanding of contemporary economics.

EC 605 Research in Economics **Credits by arrangement**
Prerequisite: Graduate standing
Individual research in economics, under staff supervision and direction.

EC 640 Theory of Economic Growth **3 (3-0)**
Prerequisite: EC 440 or EC 502 or equivalent
Several theoretical models of economic growth are compared and analyzed. Contemporary developments in the theory of national economic growth are studied and evaluated for consistency with older theories.

EC 648 Theory of International Trade **3 (3-0)**
Prerequisite: EC 448 or EC 501 or equivalent
A consideration, on a seminar basis, of the specialized body of economic theory dealing with the international movement of goods, services, capital, and payments. Also, a theoretical, oriented consideration of policy.

C 650 Economic Decision Theory **3 (3-0) f or s**
rerequisites: EC 501 or equivalent, EC 550 or EC 555
tudy of general theories of choice. Structure of decision problems; the role of information; ormulation of objectives. Current research problems.

C 655 Topics in Mathematical Economics **3 (3-0) f s**
rerequisites: EC 501 or equivalent, EC 550 or EC 555
seminar and research course devoted to recent literature and developments in mathematical conomics.

C 665 Economic Behavior of the Organization **3 (3-0) s**
rerequisites: EC 501 or equivalent, consent of instructor
his seminar will apply methods and findings derived from the behavioral sciences to the conomic behavior of the organization, particularly the business firm. Among the approaches hich may be utilized are organization theory, information theory, reference group theory, id decision theory.

*Education (General Courses)

ourses for Undergraduates

) 308 Visual Aids **2 (1-2) s**
ethods and techniques of visual instruction; lettering; statistical illustration; chart, graph id poster making; photography; projector operation, care and use. Staff

) 344 Secondary Education **2 (1-2) f s**
n overview of secondary education, including development, problems, services, trends, teach- g profession, role of school in the community, purposes and objectives. The development and atus of secondary education in North Carolina is taken up. Mr. Shannon

) 410 Driver Education **3 (2-2) s**
Summer session only
ne principles of teaching basic driving skills, including the new concept of defensive driving, servance and interpretation of motor vehicle laws, adverse driving conditions, handling of cident situations and care of the car. Mr. Crawford

ourses for Graduates and Advanced Undergraduates

) 501 Education of Exceptional Children **3 (2-2) f**
scussion of principles and techniques of teaching the exceptional child with major interest the mentally handicapped and slow learner.
actice will be given in curriculum instruction for groups of children, individual techniques r dealing with retarded children in the average classroom. Opportunity for individual work th an exceptional child will be provided. Mr. Corter

) 502 Analysis of Reading Abilities **3 (3-0) f**
erequisite: Six hours in Education or Psychology
study of tests and techniques in determining specific abilities; a study of reading retardation d factors underlying reading difficulties. Mr. Rust

) 503 Improvement of Reading Abilities **3 (3-0) s**
erequisite: Six hours in Education or Psychology
study of methods used in developing specific reading skills or in overcoming certain reading ficulties; a study of methods used in developing pupil vocabularies and word analysis lls; a study of how to control vocabulary burden of reading material. Mr. Rust

*The departmental course descriptions in the School of Education follow the general courses.

ED 563 Effective Teaching **3 (3-0) f**
Prerequisite: Twelve hours in Education
Analysis of the teaching learning process; assumptions that underlie course approaches; identi fying problems of importance; problem solution for effective learning; evaluation of teachin and learning; making specific plans for effective teaching.
Mr. Scarborougl

Courses for Graduates Only

ED 614 Modern Principles and Practices in Secondary Education **2 (2-0) f**
Prerequisite: Twelve hours in Education
Foundations of modern programs of secondary education; purposes, curriculum, organizatio administration, and the place and importance of the high school in the community in rel tion to contemporary social force.
Graduate Sta

ED 615 Introduction to Educational Research **3 (3-0)**
Prerequisite: Twelve hours in Education
An introductory course for students preparing for an advanced degree. The purposes are assist the student in understanding the meaning and purpose of educational research an the research approach to problems; to develop students' ability to identify education problems, and to plan and carry out research to solve these problems; to aid in the prepar tion of the research report. Special attention is given to tools and methods of researc Consideration is also given to the educator as a consumer of research.
Mr. Chans

ED 665 Supervising Student Teaching **3 (3-0) f**
Prerequisite: Twelve hours in Education
A study of the program of student teaching in teacher education. Special consideration w be given the role of the supervising teacher including the following areas: planning for effe tive student teaching, observation and orientation, school community study, analysis of situ tion, evaluating student teachers, and coordination with State College.
Graduate St

Agricultural Education

Courses for Undergraduates

ED 102 Objectives in Agricultural Education **1 (1-0**
Designed to help the student understand the purpose of Agricultural Education at St College. Also provides an opportunity for students to develop an understanding of purpc of vocational agriculture in the school community.
S

ED 201 Farming Programs and FFA **2 (2-0**
Provides an opportunity for students to get an understanding of the place of farming p grams and FFA in vocational agriculture, as well as the role of the teacher in these p grams.
S

ED 313 Teaching Rural People **2 (2-0**
The purpose of the course is to give the student an understanding of the basic princi involved in the teaching-learning process. The course will be built around problem experie of farm people with principles of teaching and learning related to these experiences.
S

ED 411 Student Teaching in Agriculture **6 (3-1**
The first part of the semester (usually six weeks) will be on campus. The remainder of semester will be spent in a high school department of vocational agriculture doing full-t student teaching. The student will get experience in all phases of the vocational agricul program, including community study, adult education, home supervision. The student tea will be supervised by the local teacher of agriculture and a member of the staff in A cultural Education.

ED 412 Teaching Adults **2 (1-2) f**
Principles of effective teaching applied to adult and young farmers. Experience in organizing and conducting groups for discussion of local problems. Staff

ED 413 Teaching Materials **2 (1-2) f**
Developing and using teaching materials for more effective instruction. Experience in this area with adult and high school classes. Staff

ED 430 Senior Seminar **1 (1-0) f s**
An analysis on the job of the teacher of vocational agriculture with particular emphasis upon current problems.

Courses for Graduates and Advanced Undergraduates

ED 554 Planning Programs in Agricultural Education **3 (3-0) f s**
Prerequisite: ED 411
Consideration of the community as a unit for planning programs in agricultural education; objectives and evaluation of community programs; use of advisory groups; school and community relationships; organization of the department and use of facilities.
Messrs. Beam, Scarborough

ED 558 Special Problems in Teaching **Maximum 6 credits**
Prerequisite: ED 411
Current problems in agricultural education. Opportunities for students to study particular problems under the guidance of the staff. Graduate Staff

ED 568 Adult Education in Agriculture **3 (3-0) f s**
Prerequisite: ED 411
This course is designed to meet the needs of teachers as leaders in adult education. More emphasis is being given to working with adults as part of the community program of vocational agriculture. This course will give the teacher an opportunity to study some of the basic problems and values in working with adult groups. Particular attention will be given to the problem of fitting the educational program for adults into the high school program of vocational agriculture, as well as to methods of teaching adults.
Messrs. Beam, Scarborough

Courses for Graduates Only

ED 616 Advanced Problems in Teaching **3 (3-0) f s**
Prerequisite: ED 558
Group study in current and advanced problems in the teaching and administration of agricultural education; evaluation of procedures and consideration for improving.
Graduate Staff

ED 617 Philosophy of Agricultural Education **3 (3-0) f s**
Prerequisite: ED 554
An examination of current educational philosophies and their relation to agricultural education. Principles and practices involved in the leadership of a teacher of agriculture and in making his work effective in a rural community. Study of leaders in the field.
Mr. Scarborough

ED 618 Seminar in Agricultural Education **Maximum 2 credits**
A critical review of current problems, articles, and books of interest to students of agricultural education. Graduate Staff

ED 621 Research in Agricultural Education **Maximum 6 credits**
Individual direction in research on a specific problem of concern to the student. Generally, the student is preparing his thesis or research problem. Graduate Staff

ED 664 Supervision in Agricultural Education **3 (3-0) f s**
Prerequisite: ED 563
Organization, administration, evaluation and possible improvement of present supervisory practice; theory, principles and techniques of effective supervision in agricultural education at different levels.

Industrial Arts

Courses for Undergraduates

IA 100 Introduction to Industrial Arts **1 (1-0) f**
A basic course designed to orient the student to college life and to introduce him to the philosophy, objectives, and scope of industrial arts as related to teacher education and industrial employment. A study of the problems and opportunities in the profession.
Staff

IA 103 Drafting I **3 (1-4) f**
Graphical communication encompassing sketching and instrument drawing. Theory and practice taught through the medium of freehand sketching involving oblique, isometric, perspective, exploded, assembly, sections, and orthographic projection type drawings. The last portion of the course is devoted to instrument drawing. Mr. Troxler

IA 104 Drafting II **3 (1-4) s**
Prerequisite: IA 103
A study of house planning and construction. Investigation of the factors to be considered by the consumer in building or buying a house including location, building codes, FHA requirements, heating and ventilation, construction details, materials of construction. Laboratory work includes the design and drawing of a set of house plans. Mr. Troxler

IA 107 Woods I **3 (1-4)**
This course is an introduction to the basic problems of production with hand tools and machines. Group and individual problem solving in product design, selection of materials, organization of personnel, and laboratory facilities enable students to participate in a variety of experiences. Mr. Brile

IA 108 Woods II **3 (1-4)**
Prerequisite: IA 107
This is an advanced course which seeks to develop the students' knowledge and creativ ability in solving problems using wood and related materials as the media. An opportunit will be provided to solve tooling problems as well as increase the individual's proficienc with hand and power tools. Mr. Brile

IA 203 Technical Sketching **2 (1-2)**
Required of students in Wild Life and Furniture Manufacturing
The application of drawing practices for the layman. Freehand sketching and instrumen drawing, lettering, pictorial representation, production sketches, template drawing, explode views, shades and shadows. Individual problems and selected graphic representation.
Mr. Troxle

IA 205 Industrial Arts Design **2 (1-2)**
Prerequisites: IA 104, IA 107, IA 206
A study of design as related to industry and the industrial arts laboratory. Creative desig and individual expression through problems involving the utilization of industrial material
Mr. Troxle

IA 206 Metal Processing I **3 (1-4)**
Fundamentals of metalwork. Hand and machine tool applications. Emphasis on layout, orien tation to the lathe, milling machine, shaper, surface grinder, and cut-off operations. Exper ences in bench metal and welding. Study of mass production problems through grou experience. Mr. Moell

IA 207 Metal Processing II **3 (1-4) s**
Prerequisite: IA 206
Fundamentals of foundry and sheet metal in conjunction with experiences of some precision using engine lathe, shaper, milling machine, and surface grinder. Analysis of metal problems in terms of principle applications and machine scheduling. Mr. Moeller

IA 215 Sheet Metal **1 (0-2) f**
A course designed to provide practical experience in the use of tools, materials and processes involved in basic sheet metal fabrication. Mr. Moeller

IA 304 General Shop Organization **2 (1-2) s**
Prerequisites: IA 104, IA 108, IA 207, IA 307
Application of principles of industrial processes to general shop organization and operation. Analysis of products. Methods, techniques of production of laboratory projects including a variety of materials suitable to varying educational levels. Mr. Troxler

IA 306 Graphic Arts **3 (1-4) s**
This course is an introduction to the basic printing areas of letterpress, offset, photo-printing, silkscreen, and bookbinding. Students will be given the opportunity to develop materials for course outlines which may be used when teaching in the secondary schools.
Mr. Briley

IA 307 Basic Electricity **3 (1-4) f**
Prerequisites: PY 211, PY 212
The fundamentals of electricity as applied to resistive, inductive, capacitive and magnetic circuits. Emphasis are upon applications of electrical principles to light and power circuits, automobile circuits, motors, and controls. Mr. Young

IA 308 Basic Electronics **3 (1-4) s**
Prerequisite: IA 307
The fundamentals of electronics as applied to power supply, amplifier and oscillator circuits. Applications of electronic principles as found in the super-hetrodyne radio are studied.
Mr. Young

IA 314 Recreational Arts and Crafts **2 (1-2) s**
Required of juniors in Industrial and Rural Recreation; elective for others
A course designed to give students interested in recreation work an understanding of and experiences in different types of arts and crafts. Emphasis will be given to a wide variety of crafts as adaptable to camps, city, industrial and institutional programs. Mr. Briley

IA 315 General Ceramics **3 (1-4) f s**
This course is designed to give the student an opportunity to work with ceramic materials as a medium of expression and to get experience in the basic manufacturing processes of the ceramic industry. Emphasis will be given to a study of the sources of clay, designing, forming, decorating and firing of ceramic products. Mr. Hostetler

IA 321 Metalwork Technology **2 (1-2) f s**
Prerequisites: IA 206, IA 207 or equivalent
Applications of principles of industrial techniques and processes to the development and construction of products and equipment utilizing a variety of industrial materials. Emphasis will be given to research, problem investigation related to design, function and production procedures. Mr. Moeller

IED 422 Methods of Teaching Industrial Subjects **4(4-0) s**
Prerequisites: ED 344, PSY 304
A study of effective methods and techniques of teaching industrial subjects. Emphasis is given to class organization; student-teacher planning; methods of teaching manipulative skills and related information; lesson planning; shop safety; and evaluation. Teaching problems will be studied and analyzed following directed observations in the public schools.
Mr. Hostetler

ED 444 Student Teaching in Industrial Subjects **6 (2-15) f**
Prerequisite: ED 422
Students in the Industrial Arts and Industrial Education curricula will devote ten weeks during the fall semester to full time, off-campus student teaching in selected public schools throughout the State. They will be assigned to their teaching center in the preceding spring and will report to their supervising teachers when the public schools (to which they are assigned) open in the fall. During the remainder of the term, additional courses will be taken in concentrated form. Staff

IA 465 Independent Study in Industrial Arts **6 f**
A course designed to develop problem-solving ability through research activities in industrial arts. Problems in industrial arts curriculum, method and content are carefully selected, designs or plans of action are prepared, and final papers are presented and defended before a faculty committee. Staff.

IA 480 Modern Industries **3 (3-0) f s**
Prerequisite: Senior standing
An overview of the function and organization of modern industry. Principles of work simplification, motion economy, processing, and scheduling are reviewed. The effects of technological change on labor, management, and consumer are considered. Attention will be focused on contributions of technology to specific industrial processes in machining, forming, fabricating: in relationship to principles, types of equipment and usage areas. Mr. Young:

ED 482 Curriculum Problems in Industrial Arts **2 (1-2) f**
Prerequisites: PSY 304 or six credits in Education
Approximately one-third of the course is directed to developing a working philosophy of industrial arts and the major portion of the course is devoted to planning and organizing learning units in industrial arts. Staff

ED 483 Instructional Aids and Devices **2 (1-2) f**
Prerequisites: PSY 304 or six credits in Education
Analysis of learning units and the preparation of instructional aids and devices.
Staff

IA 484 School Shop Planning and Equipment Selection **3 (3-0) s**
A course for advanced undergraduate students
The physical planning of school shops and laboratories; selection of tools and equipment: Whenever possible, actual or contemplated school buildings will be used for class work.
Mr. Hostetler

Courses for Graduates and Advanced Undergraduates

IA 510 Design for Industrial Arts Teachers **3 (1-4**
Prerequisites: Six hours of drawing and IA 205 or equivalent
A study of new developments in the field of design with emphasis on the relationship o material and form in the selection and designing of industrial arts projects.
Graduate Staf

ED 552 Industrial Arts in the Elementary School **3 (Summer session**
Prerequisites: Twelve credits in Education and consent of instructor
This course is organized to help elementary teachers and principals understand how tool and materials and industrial processes may be used to vitalize and supplement the elementar school children's experiences. Practical children's projects along with the building of class room equipment. Mr. Hostetle

IA 560 (ED 560) New Developments in Industrial Arts Education. **3 or**
Prerequisites: Twelve hours in Education and teaching experience
This course is a study of the new developments in industrial arts education. It is designe to assist teachers and administrators in developing new concepts and new content base on the changes in technology. They will be required to re-evaluate their programs in th light of these new concepts and the new content. Mr. Hostetle

570 Laboratory Problems in Industrial Arts **A maximum of 6 credits**
erequisites: Senior standing, permission of instructor
urses based on individual problems and designed to give advanced majors in industrial s education the opportunity to broaden or intensify their knowledge and abilities through vestigation and research in the various fields of industrial arts, such as metals, plastics, or ramics. Graduate Staff

575 Special Problems in Industrial Arts **A maximum of 6 credits**
erequisite: One term of student teaching or equivalent
ne purpose of these courses is to broaden the subject matter experiences in the areas of dustrial arts. Problems involving experimentation, investigation and research in one or ore industrial arts areas will be required. Graduate Staff

595 (ED 595) Industrial Arts Workshop **3 (Summer session)**
erequisite: One or more years of teaching experience
course for experienced teachers, administrators, and supervisors of industrial arts. The imary purpose will be to develop sound principles and practices for initiating, conducting d evaluating programs in this field. Enrollees will pool their knowledge and practical periences and will do intensive research work on individual and group programs
Graduate Staff

ourses for Graduates Only

619 Seminar in Industrial Arts Education **1 (1-0) f s**
erequisite: Graduate standing
esentation of current literature in the field of Industrial Arts Education; review and dis- ssion of student papers and research problems. Mr. Hostetler

624 Research in Industrial Arts Education **Maximum 6 credits f s**
erequisites: Eighteen credits in Education, permission of instructor
he student will be guided in the selection of one or more research problems and in the ganization of the problems, methods of gathering data, procedure for analyzing data, and e best practice for interpreting and reporting data. Mr. Hostetler

630 Philosophy of Industrial Arts **2 (2-0) f s**
erequisite: Twelve hours in Education
equired of all graduate students in Industrial Arts Education. Current and historical develop- ents in industrial arts; philosophical concepts, function, scope, criteria for the selection d evaluation of learning experiences, laboratory organization, student personnel programs, mmunity relationships, teacher qualifications, and problems confronting the industrial arts ofession. Mr. Hostetler

635 Administration and Supervision of Industrial Arts **2 (2-0) f s**
rerequisite: Twelve hours in Education
study of the problems and techniques of administration and supervision in the improve- ent of industrial arts in the public schools. Selection of teachers and their improvements service and methods of evaluating industrial arts programs. Mr. Hostetler

Industrial Education

ourses for Undergraduates

D 100 Introduction to Industrial Education **2 (2-0) f**
he place of vocational education in a program of public education and the fundamental rinciples upon which this work is based. Mr. Gehres

ED 305 Analysis of Technical Education Programs and Course Construction **3 (3-0)**
Prerequisites: ED 100 and advanced undergraduate standing
Principles and Techniques of selecting and analyzing suitable teaching activities and arrang ing such material into a functional instructional order. Instructional units prepared will b based on an analysis of a technical occupation or activity. A detailed course of study will b prepared. Mr. Gehre

ED 327 History and Philosophy of Industrial-Technical Education **3 (3-0)**
Prerequisite: ED 100
Historical study of trade and technical education movement. Place function and changin concepts of industrial and technical education in American education. Economic, sociologic and psychological aspects. Mr. Hanso

ED 405 Industrial and Technical Education Shop and Laboratory Planning **3 (3-0)**
Prerequisites: Senior standing and 6 hours of drawing or design
Principles and techniques to assist teachers in planning and organizing shop and laborator facilities. Problems of locating and equipping vocational schools; the planning and layor of shops and related technology laboratories and classrooms. Individual and group assign ments on planning and layout of post secondary school buildings. Mr. Gehr.

ED 422 Methods of Teaching Industrial Subjects **4 (4-0)**
Prerequisites: ED 344, PSY 304
A study of effective methods and techniques of teaching industrial subjects. Emphasis is give to class organization; student-teacher planning; methods of teaching manipulative skills an related information; lesson planning; shop safety; and evaluation. Teaching problems wa be studied and analyzed following directed observation in the public schools.
St

ED 440 Vocational Education **2 (2-0)**
Prerequisites: ED 344, PSY 304
A comprehensive study of the types of vocational education of less than college grade, pr vided for through Federal legislation; an evaluation of the effectiveness of the program; an a detailed study of the North Carolina Plan. St

ED 444 Student Teaching In Industrial Subjects **6 (2-15)**
Prerequisite: ED 422
Student in the Industrial Arts and Industrial Education curricula will devote ten weeks duri the fall semester to full time, off-campus student teaching in selected public schools throug out the State. They will be assigned to their teaching center in the preceding spring and w report to their supervising teachers when the public schools (to which they are assigne open in the fall. During the remainder of the term, additional courses will be taken concentrated form. St

ED 483 Instructional Aids and Devices **2 (1-2)**
(See page 278 for description)

Courses for Graduates and Advanced Undergraduates

ED 516 Community Occupational Surveys **2 (2-0)**
Prerequisites: Six credits in Education and consent of instructor.
Methods in organizing and conducting local surveys and evaluation of findings in plann a program of vocational education. Graduate S

ED 521 Organization of Related Study Materials **3 (3-0)**
Prerequisite: ED 422
The principles of selecting and organizing both technical and general related instructio material for trade extension and industrial cooperative training classes.
Graduate S

) 525 Trade Analysis and Course Construction **3 (3-0) f**
erequisites: ED 344, PSY 304
inciples and practices in analyzing occupations for the purpose of determining teaching ntent. Practice in the principles underlying industrial course organization based on occu- ational analysis covering instruction in skills and technology and including course outlines, b sequences, the development of industrial materials and instructional schedules.
Graduate Staff

) 527 Philosophy of Industrial and Technical Education **3 (3-0) f s**
erequisites: ED 422, 440
presentation of the historical development of industrial and technical education; the types programs, philosophy, trends and problems of vocational-industrial education; study of deral and State legislation pertaining to industrial education, practical nurse education and hnical education.
Mr. Hanson

) 528 Principles and Practices in Industrial Cooperative Training **3 (3-0) f s**
erequisites: ED 422, 440
study of the developments, the objectives, and principles of industrial cooperative training. he organization, promotion and management of programs in this area of vocational education.
Graduate Staff

) 529 Curriculum Materials Development **3 (3-0) s**
erequisite: ED 525
lection and organization of curricula used in vocational-industrial and technical education; velopment of curricula and instructional materials.
Mr. Hanson

) 591 Special Problems in Industrial Education **Maximum 6**
erequisites: Six hours of graduate credit and permission of department head
irected study to provide individualized study and analysis in specialized areas of trade, dustrial or technical subjects.
Graduate Staff

ourses for Graduates Only

) 609 Planning and Organizing Technical Education Programs **3 (3-0) f**
erequisites: PSY 304, ED 344, 420, 440, and 516
inciples of planning and organizing technical education programs sponsored by federal vo- tional acts. Professional course for coordinators and directors, with emphasis on the organi- tion of post high school technical education level. Survey of needs, building plans, equipping id maintenance of buildings, financial structure, and personnel organization and manage- ent.
Mr. Hanson

) 610 Administration and Supervision of Vocational Education **3 (3-0) s**
rerequisites: PSY 304, ED 344, 420, 440 or equivalent
dministrative and supervisory problems of vocational education; practices and policies of ederal and State offices; organization and administration of city and consolidated systems.
Mr. Hanson

D 626 Seminar in Industrial Education **Maximum 2**
rerequisite: Graduate standing or permission of the instructor
eviews and reports on topics of special interest to graduate students in Industrial Educa- on. The course will be offered from time to time in accordance with the availability of istinguished professors.
Mr. Hanson

D 627 Research in Industrial Education **Maximum 6**
rerequisites: Eighteen credits in Education and permission of instructor
he student will be guided in the selection of one or more research problems and in the rganization of the problems, methods of gathering data, procedure for analyzing data, and est practice for interpreting and reporting data.
Graduate Staff

Mathematics and Science Education

Courses for Undergraduates

ED 203 Introduction to Teaching Mathematics and Science **2 (2-0)**
A course designed to aid prospective teachers in becoming familiar with the scope and pur poses of secondary education, the qualification and responsibilities of teachers, the relation c the school to the community, and current problems of secondary school teachers.
Mr. Speec

ED 470 Methods of Teaching Mathematics **3 (3-0)**
A study of the purposes, methods, materials, curricula and evaluation practices appropriat for teachers of mathematics at the secondary level. Mr. Speec

ED 471 Student Teaching in Mathematics **6 (2-15) f**
This course is intended to provide the prospective teacher with an opportunity to get exper ence in the skills and techniques involved in teaching mathematics. Each student durin the senior year will spend 10 weeks off-campus in a selected center. In addition to acquirin the necessary competencies for teaching mathematics, the student teachers will also hav an opportunity to become familiar with the total school program and to participate in many community activities as time will permit during the period of student teaching.
Mr. Speec

ED 472 Developing and Selecting Teaching Materials in Mathematics **2 (2-0) f**
Developing and selecting teaching materials in keeping with the new and changing concep of the content and emphasis in high school mathematics is essential for mathematics teache The course will follow the class discussion and demonstration pattern. Students will stu the latest instructional materials and discover or devise materials and aids for increasi the effectiveness of the content and instruction in high school mathematics.
Mr. Spee

ED 475 Methods of Teaching Science **3 (3-0)**
A study of the purposes, methods, materials, curricula and evaluation practices appropri for teachers of physical and natural science at the secondary level. Mr. Shann

ED 476 Student Teaching in Science **6 (2-15)**
This course is intended to provide the prospective teacher with an opportunity to get perience in the skills and techniques involved in teaching science. Each student during senior year will spend 10 weeks off-campus in a selected center. In addition to acquiring necessary competencies for teaching science, the student teacher will also have an opportun to become familiar with the total school program and to participate in as many commun activities as time will permit during the period of student teaching. Mr. Shann

ED 477 Developing and Selecting Teaching Materials in Science **2 (2-0)**
Developing and selecting teaching materials in keeping with the new and changing conce of the content and emphasis in high school science, particularly the experimental and labo tory approach to science teaching. Students will study the latest effectiveness of the content instruction in high school science courses. Mr. Shann

Occupational Information and Guidance

Course for Undergraduates

ED 420 Principles of Guidance **2 (2-0)**
This is a course designed to provide basic principles of guidance for teachers, teacher-co selors, administrators, and others in the school, as well as workers in other areas such the community agency, business, industry, group work, and the like.
Among the topics covered are need for guidance, bases of guidance services; programs studying the individual; counseling for educational, vocational, social, and personal p lems; group procedures in guidance. Emphasis is on the practical application of guid principles and procedures. Mr. Moreh

Courses for Graduates and Advanced Undergraduates

ED 520 Personnel and Guidance Services **3 (3-0)**
Prerequisites: Graduate standing and 6 hours of Education or Psychology
An introduction to the philosophies, theories, principles and practices of guidance and personnel services. Mr. Morehead

ED 524 Occupational Information **3 (0-3)**
Prerequisites: Six hours of Education or Psychology, ED 420 or equivalent
This course is designed to prepare teachers, counselors, business and industrial personnel workers, placement workers, and others to collect, evaluate, and use occupational and educational information. In addition to the study of the usual sources and types of published occupational information, attention will be given to collection of occupational information locally, preparation of the occupational monograph, analysis of job requirements and worker characteristics, occupational trends and factors affecting trends, occupational and industrial structure and classification, and the like. Imparting occupational information to groups and individuals by techniques such as the following are considered: the occupations unit in social studies and other courses, the occupations course, home room activities, introducing occupational information informally in subject matter courses, the resource file, vocational counseling. Mr. Morehead

ED 530 Group Guidance **3 (3-0)**
Prerequisites: Six hours of Education or Psychology, ED 420 or equivalent
This course is designed to help teachers, counselors, administrators, and others who work with groups or who are responsible for group guidance activities, to understand the theory and principles of effective group work, to develop skill in using specific guidance techniques, and to plan and organize group activities in the secondary school and other institutions. The relationship of group activities to counseling and other aspects of guidance services is considered. Methods of evaluating and improving group guidance activities are taken up.
Mr. Morehead

ED 533 Organization and Administration of Guidance Services **3 (3-0)**
Prerequisites: Graduate standing, ED 420 or equivalent
This course is designed for school guidance workers and those preparing for this field. Basic principles and current practices employed in developing, organizing, administering, and supervising guidance services in the elementary and secondary school will be studied. Interrelationship of guidance services with instruction, administrative relationships, utilization of school staff, and evaluation of guidance services will be considered. Mr. Morehead

ED 590 Individual Problems in Guidance **A maximum of 6 credits**
Prerequisite: Six hours graduate work in department or equivalent
Intended for individual or group studies of one or more of the major problems in guidance and personnel work. Problems will be selected to meet the interests of individuals. The workshop procedure will be used whereby special projects and reports will be developed by individuals and by groups. Messrs. Anderson, Morehead

Courses for Graduates Only

ED 631 Educational and Vocational Guidance **3 (3-0) f**
Prerequisites: Nine hours from following fields—Economics, Education, Psychology or Sociology
This course aims to provide training for teachers who are part-time or full time counselors, employment interviewers, social workers and personnel workers, who are aiding individuals with vocational adjustment problems. The course will cover the functions preformed in vocational and educational guidance such as assembling and imparting occupational information, counseling regarding vocational and educational plans, the use of aptitude tests, placement in jobs and follow-up, and procedures in setting up services of vocational and educational guidance in schools, employment offices, and social service agencies.
Mr. Anderson

ED 633 Techniques in Guidance and Personnel **3 (3-0) s**
Prerequisites: Nine hours from following fields—Economics, Education, Psychology or Sociology
This course is designed to aid personnel workers in secondary schools, colleges, employment offices, and social agencies to develop an understanding and to develop skill in using various guidance and personnel techniques. Some of the techniques to be studied intensively are: anecdotal reports, rating scales, observation, records and reports, sociograms, interviewing, counseling and case study procedures. Students will become acquainted with these techniques through lectures, demonstrations, and the study of case histories. Attention will be given to both diagnosis and treatment. Mr. Anderson

ED 641 Field Work in Occupational Information and Guidance **2 to 6 f**
Prerequisite: Advanced graduate standing
A practicum course in which the student undertakes field work in secondary schools, colleges, social service agencies, employment office, and industrial establishments which carry on guidance and personnel work. The student may observe and participate in some personnel service and may study the organization and administration of the programs.
Messrs. Anderson, Morehead

ED 651 Research in Occupational Information and Guidance **Maximum 6 credits f**
Prerequisite: Advanced graduate standing
Qualified students will conduct investigations and research in guidance and personnel. Published reports and techniques in investigation will be analyzed and evaluated.
Messrs. Anderson, Morehead

Psychology

Courses for Undergraduates

PSY 200 Introduction to Psychology **3 (3-0) f**
A study of the general characteristics of human behavior, including motivation, learning, development, emotion, thinking, perception and sensation, and measurement. The objectives are development of the ability to communicate in oral and written form accurately and scientifically about behavior; development of an understanding of a capacity to use scientific ideas and processes as they apply to behavior; an understanding of the behavior of organisms.
Staff

PSY 201 Experimental Analysis of Behavior **3 (2-3) f**
Prerequisite: PSY 200
The objectives of this course are to promote the learning of facts and principles derived from an experimental analysis of behavior; to promote familiarity with laboratory operations used in studying behavior; to foster capability to write and speak effectively about behavior. Topics covered include: acquisition, extinction, spontaneous recovery, generalization, differentiation, secondary reinforcement, chaining. Messrs. Barkley, Cook, Newman

PSY 302 Psychology of Personality and Adjustment **3 (3-0)**
Prerequisite: PSY 200
A study of the factors involved in the development of the normal personality, emphasizing the principal factors controlling human behavior and their relationship to adjustment mechanisms. Mr. Cox

PSY 304 Educational Psychology **3 (3-0)**
Prerequisite: PSY 200
A study of learning and evaluation in the context of educational practice.
Mr. Johnson

PSY 337 Industrial Psychology I **3 (3-0)**
Prerequisite: PSY 200
The application of psychological principles to the problems of industry and business; work methods, fatigue, motivation and morale, job analysis, performance measurement.
Mr. Dreese

Courses for Advanced Undergraduates

PSY 438 Industrial Psychology II **3 (3-0) s**
Prerequisites: PSY 200, PSY 337
The application of psychological principles to the problems of modern industry; with particular emphasis on human relations and supervision. Mr. Miller

PSY 441 Human Factors in Equipment Design **3 (3-0) s**
Prerequisite: PSY 200, PSY 337 recommended
Human factors in the design of machines and other equipment. Items of equipment are understood as extensions of man's capacity to sense, comprehend, and control his environment. Includes problems in the psychology of information, communication, control, and invention. Messrs. Cook, Drewes

PSY 464 Visual Perception for Designers **3 (3-0) f**
Prerequisite: PSY 200
The nature of the seeing process and its relation to architecture, industrial arts, and to the industrial engineering, and textile design fields. Topics include the basis of sight, perception of color and form, vision and illumination, psychological factors in visual design, and a unit of training planned to improve the student's ability to perceive visual form.
Mr. Cook

PSY 475 Child Psychology **3 (3-0) s**
Prerequisite: PSY 200 or PSY 304
The development of the individual child of the elementary school age will be the inclusive object of study in this course. Emphasis will be placed upon the intellectual, social, emotional, and personality development of the child. Physical growth will be emphasized as necessary to an understanding of the psychological development of the pupil. Mr. Barkley

PSY 476 Psychology of Adolescence **2 (2-0) f s**
Prerequisite: PSY 200
Nature and source of the problems of adolescents in western culture; emotional, social, intellectual and personality development of adolescents. Messrs. Barkley, Johnson

PSY 490 Social Psychology **3 (3-0) s**
Prerequisite: PSY 200
The individual in relation to social factors. Socialization, personality development, communication, social conflict and social change. Messrs. Barkley, Miller

Courses for Advanced Undergraduates and Graduates

PSY 501 Experimental Psychology **3 (2-3) f s**
Prerequisite: Nine hours of Psychology
Experimental study of problems in general and theoretical psychology with particular emphasis on sensation and perception. Particular attention is paid to problem formulation, experimental design and experimental method. Effective written and oral performance by the student is a basic objective. Messrs. Barkley, Cook, Newman

PSY 502 Physiological Psychology **3 (3-0) f**
Prerequisites: Twelve hours of Psychology, including PSY 200, PSY 201
A survey of the physiological bases of behavior including the study of coordination, sensory processes, brain functions, emotions, and motivation. Mr. Bernard

PSY 504 Advanced Educational Psychology **3 (3-0) s**
Prerequisite: Six hours in Psychology
A critical appraisal of current psychological findings that are relevant to educational practice and theory. Mr. Johnson

PSY 511 Advanced Social Psychology **3 (3-0) f**
Prerequisites: PSY 200 and 514, additional hours in Psychology
A study of social relationships and their psychological bases; emphasis on those aspects of behavior determined by personal interactions; work will involve analysis of representative research studies, and individual projects. Mr. Miller

PSY 514 Psychological Research Design **1 (1-0) f**
Prerequisite: Graduate standing in Psychology
The objectives of this course are to acquaint students with current developments in theory and research in several areas of psychological interest; to foster capability to derive experimentally testable hypotheses, and experimental tests of these hypotheses; to write and speak effectively about theory and experimentation in psychology. Graduate Staff

PSY 530 Abnormal Psychology **3 (3-0) s**
Prerequisites: PSY 200, PSY 302
A study of the causes, symptomatic behavior, and treatment of the major personality disturbances, emphasis also placed on preventive mental hygiene methods. Mr. Corter

PSY 535 Tests and Measurements **3 (3-0) f s**
Prerequisite: Six hours in Psychology
A study of standard tests with an emphasis on the efficient selection and use of such instruments. Mr. Johnson

PSY 550 Mental Hygiene in Teaching **3 (3-0) f**
Prerequisite: Six hours in Psychology
A survey of mental hygiene principles applicable to teachers and pupils; practical problems in prevention and treatment of psychological problems in schools; case studies and research. Messrs. Barkley, Corter

PSY 565 Industrial Management Psychology **3 (3-0) f s**
Prerequisite: Nine hours of Psychology
A study of the application of behavioral science, particularly psychology and social psychology to organizational and management problems. Mr. Miller

PSY 570 Theories of Personality **3 (3-0) f**
Prerequisite: Nine hours of Psychology
A survey of modern theories of personality with some emphasis on intelligence and cognitive factors. Mr. Corter

PSY 571 Individual Intelligence Measurement **3 (3-0) s**
Prerequisite: PSY 570
A practicum in individual intelligence testing with emphasis on the Wechsler-Bellevue, Stanford-Binet, report writing, and case studies. Mr. Corter

PSY 576 Developmental Psychology **3 (3-0) s**
Prerequisite: Nine hours in Psychology, including PSY 476 or PSY 475
A survey of the role of growth and development in human behavior; particularly of the childhood and adolescent periods. This course will pay particular attention to basic principles and theories in the area of developmental psychology. Mr. Johnson

PSY 578 Individual Differences **3 (3-0)**
Prerequisite: Six hours in Psychology
Nature, extent, and practical implications of individual differences and individual variation. Mr. Barkley

Courses for Graduates Only

PSY 604 Advanced Experimental Psychology: Learning and Motivation **3 (2-3) f or s**
Prerequisite: PSY 501 or equivalent
The objectives of this course are to promote familiarity with the kinds of research currently being conducted within the areas of "learning and motivation;" to foster effective performance in writing, speaking and reading in this area, in the derivation of hypotheses capable of experimental test and in the design of experiments to test them.
Messrs. Cook, Newman

PSY 606 Behavior Theory **3 (3-0) s**
Prerequisites: PSY 200, a course in learning, Experimental Psychology and Statistics
A study of the most fundamental considerations in behavior theory. Such topics as criteria of scientific meaningfulness, the nature of scientific explanation, the application of formal, logical techniques to theory analysis, the nature of probability, operationism, intervening variables, etc., will be covered. The aim of the course is to develop skill in handling theoretical concepts, the ability to analyze and evaluate theories, to deduce hypotheses from them, and to devise means of testing them.
Mr. Cook

PSY 607 Advanced Industrial Psychology I **3 (3-0) f**
Prerequisites: Nine hours of Psychology and Statistics or concurrent with Statistics
Application of scientific methods to the measurement and understanding of industrial behavior.
Messrs. Drewes, Miller

PSY 608 Advanced Industrial Psychology II **3 (3-0) s**
Prerequisite: PSY 607
Application of scientific methods to the measurement and understanding of industrial behavior.
Messrs. Drewes, Miller

PSY 609 Psychological Clinic Practicum **Maximum 9 hours f s**
Prerequisite: Eight hours in Psychology
Clinical participation in interviewing, counseling, psychotherapy and administration of psychological tests. Practicum to be concerned with adults and children.
Mr. Corter

PSY 610 Theories of Learning **3 (3-0) s**
Prerequisite: PSY 604
The objectives of this course are to promote learning of the theories currently used to explain how learning and forgetting occur so that testable consequences of these theories can be derived and so that the theories and their testable consequences are capably written and spoken about.
Messrs. Johnson, Newman

PSY 612 Seminar in Industrial Psychology **3 (3-0) f s**
Scientific articles, analysis of experimental designs in industrial psychology, and study of special problems of interest to graduate students in Industrial Psychology.
Graduate Staff

PSY 613 Research in Psychology **Credits by arrangement**
Individual or group research problems; a maximum of six credits is allowed toward the Master's degree.
Graduate Staff

PSY 635 Psychological Measurement **3 (3-0) s**
Prerequisites: ST 511 or equivalent and 12 hours of Psychology
Theory of psychological measurement. Statistical problems and techniques in test construction.
Mr. Drewes

PSY 672 Personality Measurement **3 (2-3) f s**
Prerequisites: PSY 570, PSY 571
Theory and practicum in individual personality testing of children and adults with emphasis on projective techniques, other personality measures, report writing and case studies.
Mr. Corter

Recreation and Park Administration

Courses for Undergraduates

RPA 152 Introduction to Recreation **3 (3-0) f s**
This course is designed to provide instruction in the areas of history and foundations of recreation including objectives, economic and social aspects, definition and importance; status of organized recreation in our modern society; certain applied principles of recreation; recreation leadership; activities and program planning; and tournament planning and administration. The course is of lecture laboratory technique. Mr. Hines

RPA 153 The Aquatic Program **2 (0-4) f s**
Prerequisite: PE (swimming)
This is a laboratory course including the history of the techniques and methods of teaching swimming, modern methods of teaching diving, officiating, games, pageants, the use of small craft, life-saving techniques, principles of water safety, the organization and administration of water safety programs and the maintenance of the swimming pool and water front.
Mr. Stott

RPA 201 Playground Leadership **3 (2-3) f s**
Prerequisite: RPA 152
Emphasis is placed on the principles, techniques, and activities necessary for effective playground leadership. Special emphasis is given through the following practical laboratory experiences: activities of low organization; contests; relays; acquatic activities; table games; and elementary arts and crafts. Mr. Miller

RPA 207 History and Principles of Park Administration **2 (2-0) f s**
Prerequisite: RPA 152
This course includes the study of the history, present status and the basic principles of operation of parks and park systems in America. Mr. Miller

RPA 253 Principles of Physical Education **3 (3-0) f s**
This course is designed to give the student a professional orientation in physical education and the place of physical education activities in allied and related fields. It introduces the student to the program of physical education—its interpretation in the light of present day needs, its sociological basis, aims and objectives and a sampling of program activities.
Mr. Brantley

RPA 255 Social Recreation **4 (2-4) f s**
Prerequisite: Sophomore status
This course is designed to satisfy the needs of the recreator for conducting social play. Stress is placed on the acquiring of technical knowledge of social activities including rhythmics and square dancing, and the conducting of specific types of activities. Mr. Crawford

RPA 301 Organization and Administration of Physical Education **3 (3-0) f s**
Prerequisite: RPA 253
This course is designed to prepare students to meet the problems of organization and administration of physical education. It presents the solution to many of the problems facing the administrator and teacher in organizing and administering a physical education program with analogies of these problems to other areas in the field of recreation.
Mr. Brantley

RPA 315 Prevention and Care of Athletic Injuries **2 (2-0) f s**
Prerequisite: ZO 213
This course is designed for students in residence and for individuals in-service. Directors of community centers, boys clubs, coaches of athletic teams, athletic directors and others are confronted constantly with the prevention and the care of athletic injuries. The course is of lecture-laboratory technique. Mr. Crawford

RPA 333 First Aid and Safety **2 (1-2) f s**
This course stresses first aid and safety education in relation to the home, school and community. It strongly emphasizes safety principles as applied to activities of the gymnasium, playgrounds and athletic fields. Laboratory will provide practice in first aid skill.
Mr. Crawford

RPA 335 Camping and Outdoor Education **3 (2-2) f s**
Prerequisite: Junior status
This course covers the history of school camping and outdoor education. The scope of this course is to provide the student with a background of principles, organization and administrative techniques, and camping skills to be utilized in a school operated program.
Mr. Stott

RPA 353 Camp Organization and Leadership **3 (2-2) f s**
Prerequisites: RPA 153 and RPA 201
This course surveys the development of organized camping and the educational, health, and recreational objectives of camping. Program planning and leadership training in community, private, agency and school camping is emphasized. Laboratory will provide practice in camp-craft skills. Mr Stott

RPA 354 Personal and Community Hygiene **3 (3-0) f s**
Prerequisite: Junior status
This course presents the essential present-day knowledge of personal and community health. Emphasis is placed upon health problems, disease prevention, communicable diseases and their control, public health administration, school and industrial hygiene and various other health problems confronting the individual and community. The course presents valuable and interesting health information to college men and women in order that they might live more intelligently in terms of newer health concepts and also be better prepared to assume their responsibilities as citizens of their respective communities. Mr. Brantley

RPA 355 Sports in Recreation **4 (2-4) f s**
Prerequisite: RPA 152
This course provides for group instruction and laboratory experience in a variety of sports applicable to a recreation setting. Emphasis is given to problems involved in the organization and administration of a community sports program. Officiating techniques applicable to recreation sports are utilized. Mr. Brantley

RPA 360 Individual Corrective and Adapted Activities **3 (3-0) f s**
Prerequisites: ZO 212, 213
This course provides students with: methods to motivate the atypical individual to not only his physical condition but also his outlook on life to utilize modern educational principles and sport activities which will satisfy the handicapped individual's needs, interest, and capacity. Mr. Crawford

RPA 365 Methods and Materials in Health and Physical Education **3 (3-0) f s**
Prerequisite: RPA 301
This course presents to the prospective physical activity instructor methods and materials of instruction; also the course provides study in the areas of healthful school living health service, and health instruction. Mr. Brantley

Courses for Advanced Undergraduates

RPA 405 Principles and Practices of Recreation **3 (3-0) f s**
Prerequisite: RPA 415
A study of existing practices of recreation, their operation, methods of finance, scope, and problems are emphasized. The inter-relationship and inter-dependence of all forms of organized recreation are stressed. Mr. Hines

RPA 415 Park Maintenance and Operation **3 (3-0) f s**
Prerequisite: RPA 152
This course deals with methods of operation of various park facilities for public use; interpretive and public use programs; information and education; park personnel administration; protection and law enforcement; preventive maintenance; job planning and scheduling; modern maintenance techniques and maintenance materials. Mr. Stott

RPA 451 Facility and Site Planning **3 (0-6) f s**
Prerequisite: RPA 415
This course includes the history of park and recreation facility development and trends in recreation facility planning. Emphasis is placed upon the planning principles involved in the design and layout of recreation areas and recreation buildings. Field trips will enable the student to see the various types of recreation facilities. Mr. Stott

RPA 452 Recreation Administration **3 (3-0) f s**
Prerequisite: RPA 470
This course deals with the internal organization of a recreation department; financing; accounting and financial procedure; budget making and control; records, reports and filing; program planning and control; personnel policies and organization; and public relations. Mr. Hines

RPA 470 Supervised Practice **6 (9 weeks) Summer**
Prerequisites: RPA 353, 355
This course is intended to provide the prospective recreation director with an opportunity to acquire experience in the skills and techniques involved in the organization and administration of recreation activities in an established program. Each student prior to his senior year will spend 9 weeks off-campus in a selected location. (A minimum of 225 contact hours are required) The student will have the opportunity to observe the activities and practices of the recreation executive, to organize and conduct activities under supervision, to observe activities and practices of experienced recreation activity leaders and to observe the maintenance and operation of facilities. Mr. Miller

RPA 471 Organizing the Recreation Program **2 (2-0) f s**
Prerequisite: RPA 470
This course includes the types of recreation opportunities to be made available to individuals, groups or communities to be served and the methods of providing these opportunities. Activities to be considered are classified as arts and crafts; dance; drama; games, sports and athletics; hobbies; music; outdoor recreation; reading, writing and speaking; social recreation; special events and voluntary service. The lecture-discussion technique is used. Outside studies and assigned readings with reports are required. Mr. Miller

RPA 472 Observation and Field Experience **2 (0-6) f s**
Prerequisite: RPA 470
This course is designed to provide the student with the opportunity to observe, appraise and evaluate: the operation of program activities; teaching methods; administrative, supervisory and organizational techniques; procedures and conduct of advisory and commission meetings; professional conferences and society meetings. Students will be expected to complete this entire gamut. By use of field experience the student will be expected to prepare written reports of observations. Only those experiences approved by the recreation faculty shall be accepted. Mr. Miller

Courses for Graduates and Advanced Undergraduates

RPA 501 Special Problems in Recreation **3 (2-2) f s**
Prerequisite: RPA 470
A survey of specific problems in recreation. Aims to develop critical analysis. Forms a basis for the organization of research projects, for the compilation and organization of material in a functional relationship and for the foundation of policies. Follows the seminar procedure. Mr. Hine

Electrical Engineering

Courses for Undergraduates

EE 201 Elementary Circuits and Fields **4 (2-5) f s**
Corequisite: MA 201
Required of sophomores in Electrical Engineering
Fundamental laws of electric circuits. Introduction to transient and steady state analysis. Problem drill and laboratory exercises. Staff

EE 202 Elementary Circuits and Fields **4 (2-5) s**
Prerequisites: EE 201, MA 201
Required of sophomores in Electrical Engineering
A continuation of EE 201. Introduction to magnetic circuits, magnetic and electric fields, energy conversion and two-port active elements. Problem drill and laboratory exercises. Staff

EE 301, 302 Intermediate Circuits and Fields **4 (2-5) f**
3 (2-2) s
Prerequisites: EE 202, PY 202, and MA 202
Required of juniors in Electrical Engineering
An intermediate treatment of lumped-constant alternating-current circuits in the steady state. Single-and three-phase circuits. Discussion of electric and magnetic fields, distributed constants, and traveling waves. The theory of transmission lines at power and audio frequencies. Filters and impedance matching. One three hour laboratory per week is included in the first semester. Staff

EE 305 Electrical Machinery **4 (2-5) f**
Prerequisite: EE 202
Required of juniors in Electrical Engineering
A classroom and laboratory study of the principles, performance, and characteristics of direct-current and alternating-current machinery. Staff

EE 306 Electrical Machinery **4 (3-3) s**
Prerequisites: EE 301 and EE 305
A continuation of EE 305 into more advanced phases of the theory of alternating and direct current machinery. Staff

EE 310 Illumination **3 (2-3) s**
Prerequisite: EE 301 or EE 320 or EE 331
A study of the principles involved in the production and utilization of light from artificial sources; of the requirements for good lighting; and of the design of lighting installations for schools and industry. Mr. Winkler

EE 314 Electronics **4 (2-5)**
Prerequisite: EE 301
A study of active vacuum, gas, and solid state devices as elements of electric circuits. Analysis is made of linear and non-linear representation and operation. Mr. Manning

EE 320 Elements of Electrical Engineering **4 (3-3) f s**
Prerequisites: MA 202 and PY 202
Required of seniors in MEA, AGE, MIC, CHE, MIG, CE
Principles, characteristics, and operation of electric equipment and systems. Theory and problems in applied electricity, motor characteristics, industrial applications, and electronics. Mr. Smiley

EE 331, 332 Principles of Electrical Engineering **4 (3-3) f s**
Prerequisites: MA 202 and PY 202
Required of seniors in Industrial Engineering and Mechanical Engineering
Basic concepts, electrical power generation and utilization, circuit elements, single and polyphase a.c. circuits, transformers, rotating electrical machines. Fundamentals of electronics and control circuits. Staff

EE 350 Electric Power Utilization in Manufacturing Processes **3 (2-3) s**
Prerequisite: PY 212
Introduction to basic electrical theory; d-c and a-c circuits and measurements; study of d-c motors and of single-phase and polyphase utilization equipment; basic control systems and brief introduction to principles of automatic control. Application examples will be drawn from the technologies of particular interest to the students in the class. Mr. Smiley

Courses for Advanced Undergraduates

EE 401 Advanced Circuits and Fields A **3 (2-2) f**
Prerequisites: EE 302, MA 301
Required of seniors in Electrical Engineering
Transient analysis of electric circuits by the Laplace transform method, the study of transient and sinusoidal steady state response in terms of poles and zeros of network functions.
Staff

EE 402 Advanced Circuits and Fields B **3 (2-2) s**
Prerequisites: EE 302 and MA 301
Required of seniors in Electrical Engineering
A study of classical electric and magnetic field theory and its application to the problems of electrical engineering. Consideration of electrostatics, magnetostatics, radiation, and guided waves. Staff

EE 411 Electrical Engineering Senior Seminar **1 (0-2) f**
Prerequisite: Senior standing
Required of seniors in Electrical Engineering
Weekly meetings for the delivery and discussion of student papers on topics of current interest in Electrical Engineering. Staff

EE 430 Essentials of Electrical Engineering **4 (3-3)**
Prerequisite: EE 301 or EE 332
Not available to undergraduates in Electrical Engineering
Essential theory of electric circuits, including electron tubes, solid state devices, transformers and rotating machines as needed to supply the electrical background for instrumentation and control theory. Intended primarily for graduate students who do not have an electrical engineering undergraduate degree. Staff

EE 431 Electronic Engineering **3 (2-3) f**
Prerequisites: EE 302, EE 314
Departmental elective for seniors
Comprehensive coverage of circuits and equipment using electronic devices; variable frequency effects; amplifiers, oscillators, modulators, detectors, wave-shaping circuits, generators of non linear waveforms; basic pulse techniques; principles of electronic analogue computers. Emphasis on quantitative analysis and engineering design. Mr. Barclay

EE 432 Communication Engineering **3 (2-3) s**
Prerequisite: EE 431
Departmental elective for seniors in Electrical Engineering
Application of electronic circuits and equipment to radio and wire communication systems. Elements of complete systems, wave propagation, antennas, transmitters, receivers, television, radar, electronic navigation systems, noise, special applications. Mr. Barclay

EE 433 Electric Power Engineering **3 (2-3) f**
Prerequisites: EE 302 and EE 305
Departmental elective for seniors in Electrical Engineering
A study of industrial power supply and power factor correction; direct- and alternating-current motor characteristics, starting methods, dynamic braking and speed control; motor applications, and industrial control apparatus. Mr. Bell

EE 434 Power System Analysis **3 (2-3) s**
Prerequisites: EE 302 and EE 305
Departmental elective for seniors in Electrical Engineering
Analysis of problems encountered in the long-distance transmission of electric power. Line parameters of the method of geometric mean distances. Circle diagrams, symmetrical components, and fault calculations. Elementary concepts of power system stability. Applications of digital computers to power-system problems. Mr. Stevenson

EE 435 Elements of Control **3 (2-3) f**
Prerequisites: EE 314 and EE 305; or EE 430
Departmental elective for seniors in Electrical Engineering
Introductory theory of open and closed loop control. Functions and performance requirements of typical control systems and system components. Dynamic analysis of error detectors, amplifiers, motors, demodulators, analogue components and switching devices. Component transfer characteristics and block diagram representation. Mr. Peterson

EE 438 Instrumentation in Nuclear Technology **3 (2-3) s**
Prerequisites: Either EE 430 or EE 301, EE 305 and EE 314; also MA 301
Required course in Nuclear Engineering, Instrumentation Option curriculum
Radiation detectors, pulse amplifiers, pulse shapers, amplitude discriminators, counters, coincidence circuits. Mr. Manning

EE 440 Fundamentals of Digital Systems **3 (3-0) s**
Prerequisites: EE 314 or EE 430
Departmental elective for seniors in Electrical Engineering
The basic theory of digital computation and control. Introduction to number systems, data handling, relay algebra, switching logic, memory circuits, the application of electronic devices to switching circuits, and the design of computer control circuits. Mr. Bell

Courses for Graduates and Advanced Undergraduates

EE 503 Linear Network Theory **3 (3-0) f**
Prerequisites: Senior standing in Electrical Engineering with "B" average in Electrical Engineering and Mathematics or EE 430
Analysis of linear networks with emphasis on the system functions of the network in the frequency domain and response in the time domain.

EE 506 Dynamical Analogies **3 (3-0) s**
Prerequisites: EE 301 or EE 331; EM 312 or EM 301; MA 301; "B" average in Electrical Engineering, Engineering Mechanics, and Mathematics
A study of dynamic systems in various branches of engineering and science with emphasis on the similarities that exist among such integrated groups of devices. Analogous elements and quantities in these fields as determined from equations basic to each. Analytical formulation of system problems in acoustical, electrical, mechanical, and related fields and their solution by analog methods. Use of electronic analog computers for the solution of system problems. Mr. Eckels

EE 507 Electromagnetics **3 (3-0) f**
Prerequisites: Senior standing in Electrical Engineering with "B" average in Electrical Engineering and Mathematics or EE 430
Basic principles of electromagnetic field theory in vector analysis formulation, including static electric and magnetic fields, Maxwell's equations and applications to guided waves.

EE 512 Communication Theory **3 (2-3) s**
Prerequisites: EE 431, "B" average in Electrical Engineering and Mathematics
The frequency and time domain, modulation, random signal theory, autocorrelation, basic information theory, noise, communication systems. Mr. Barclay

EE 516 Feedback Control Systems **3 (3-0)**
Prerequisites: EE 401 and EE 435
Departmental elective for seniors in Electrical Engineering
Study of feedback systems for automatic control of physical quantities such as voltage, speed and mechanical position. Theory of regulating systems and servo-mechanisms. Steady state and transient responses. Evaluation of stability. Transfer function loci and root locus plots. Analysis using differential equation and operational methods. System and compensation an introduction to design. Mr. Peterso

EE 517 Control Laboratory **1 (0-3)**
Corequisite: EE 516
Laboratory study of feedback systems for automatic control of physical quantities such a voltage, speed and mechanical position. Characteristics of regulating systems and servo-mechanisms. The laboratory work is intended to contribute to an understanding of the theor developed in EE 516, Feedback Control Systems. Mr. Peterso

EE 520 Fundamentals of Logic Systems **3 (3-0)**
Prerequisite: EE 314 or EE 430
Boolean algebra, logic circuits, systematic minimization, block diagrams, logic systems in com puters, diode and transistor logic, pulse operation, counters, multivibrators, cascaded system sequential systems. Mr. Be

Courses for Graduates Only

EE 605, 606 Electrical Engineering Seminar **1 (1-0) f**
Prerequisite: Graduate standing in Electrical Engineering
A series of papers and conferences participated in by the instructional staff, invited guest and students who are candidates for advanced degrees. Mr. Ecke

EE 611, 612 Electric Network Synthesis **3 (3-0) f**
Prerequisite: EE 501
A study of modern network theory, with the emphasis on synthesis, based on the work c Brune, Bode, Guillemin Bott and Duffin, Foster and many others. Both the realization prob lem and the approximation problem will be treated. Mr. Hoadle

EE 613 Advanced Feedback Control **3 (3-0)**
Prerequisite: EE 516
An advanced study of feedback systems for the control of physical variables. Analysis c follower systems and regulators. Mathematical and graphical description of systems. Stabilit theory and performance criteria. Frequency response and root locus methods of analysis System compensation and design. Introductory analysis of non-linear systems.
Mr. Peterso

EE 615 Electromagnetic Waves **4 (3-3)**
Prerequisite: EE 502
Maxwell's equations applied to a study of the propagation of energy by electromagneti waves. Vector and scaler retarded potentials, propagation in free space and material medi guided electromagnetic waves, common waveguides, skin effects, resonant cavities. Micro wave network theory applied to measurement problems. Mr. Schafe

EE 616 Microwave Electronics **4 (3-3)**
Prerequisite: EE 615
Frequency limitations of conventional electron tubes. Microwave power generation and contro by interaction of electromagnetic fields with charged particles and molecular energy level and by non-linear reactances. Applications in klystrons, magnetrons, traveling-wave tube masers, and reactance amplifiers. Measurement problems and techniques in microwave regio
Mr. Barcla

EE 617 Pulse Switching and Timing Circuits **3 (3-0) s**
Prerequisites: EE 501 and EE 512
Tube and transistor circuit techniques for the production, shaping, and control of nonsinusoidal wave forms. Fundamental circuits needed in pulse information systems, instrumentation, and computers. Mr. Barclay

EE 618 Antennas and Propagation **4 (3-3) s**
Prerequisite: EE 615
Electromagnetic wave theory applied to antennas and antenna arrays with emphasis on microwave frequencies. Calculation and measurement of directional characteristics, gain, field intensity, propagation via the ionosphere over various terrains, obstacle gain, gain height theory, forward scatter and other topics. Mr. Schafer

EE 621 Electron Devices **3 (3-0) s**
Prerequisite: EE 615
Internal operation of electron tubes and transistors; similarities and differences stressed. Electrical conduction through vacuum and semi-conductors. Space charge, junction and diffusion effects. Characteristics of tubes and semiconductor devices at low frequencies and in various environments, parameters, and equivalent circuits of active devices.
Mr. Schafer

EE 637 Circuit Analysis of Power Systems **3 (3-0) f**
Prerequisite: EE 514
An advanced treatment of symmetrical components applied to unsymmetrical systems, and simultaneous faults. Mr. Stevenson

EE 638 Power System Stability **3 (3-0) s**
Prerequisite: EE 514
A study of the principal factors affecting stability and of the method of making stability calculations. Illustrations of studies made on actual power systems. Mr. Stevenson

EE 641 Advanced Digital Computer Theory **3 (3-0) s**
Prerequisite: EE 520
A study of the circuits and components of modern digital computers, including basic logic systems, codes, advanced systems of circuit logic, vacuum tube, transitor, and magnetic components. Memory devices, counters, converters, adders, accumulators, imputs, outputs, and computer control systems will be analyzed. Mr. Bell

EE 643 Advanced Electrical Measurements **2 (2-0) s**
Prerequisites: EE 501, EE 431
A critical analysis of circuits used in electrical measurements, with special attention to such topics as balance convergence, effects of strays, sensitivity, the use of feedback in electronic devices, and automatic measuring systems. Mr. Hoadley

EE 645, 646 Advanced Electromagnetic Theory **3 (3-0) f s**
Prerequisites: EE 615 or PY 503; MA 512
A comprehensive study of electromagnetic theory with emphasis on field theory applications. Charges in both uniform and accelerated motion, field equivalence principles, anisopropic media, ferrite media, variational methods for waveguide discontinuities, periodic structures including Floquet's theorem, integral transform and function theoretical techniques, solid state theory applied to quantum electronic devices. Mr. Schafer

EE 650 Electrical Engineering Research **Credits by arrangement**
Prerequisites: Graduate standing in Electrical Engineering and approval of adviser
Graduate Staff

EE 661, 662 Special Studies in Electrical Engineering **3 (3-0) f s**
This course provides an opportunity for small groups of advanced graduate students to study, under the direction of qualified members of the professional staff, advanced topics in their special fields of interest. Graduate Staff

Engineering

E 100 Introduction to Engineering **1 (1-0) f s**
Introduces the student to the profession of engineering and the characteristics and requirements of the study of engineering. Mr. Adams

E 500 Engineering Analysis **3 (3-0)**
Prerequisites: Senior standing and selection for Honors Programs in Engineering
This is an engineering "case method" experience, making use of the principles of engineering, physics and mathematics. Professors in Engineering and certain key individuals from industry will work singly with the professor in charge to introduce challenging engineering situations and to stimulate student analysis.

Engineering Honors

EH 300 Contemporary Trends In Engineering and Science **1 (1-0) f s**
Prerequisite: For juniors in the Engineering Honors Program
Representatives from varied fields of engineering and science introduce and discuss topics of current significance in their areas of interest.

EH 344 Rigid Body Dynamics I **3 (3-0) f s**
Prerequisite: For members of the Engineering Honors Program or by permission of the instructor
The study of the concepts and principles relating to the kinematics and kinetics of particles and rigid bodies. Illustration of the consequences and applications of the principles through problems of ballistics, orbital motion, vibrations, etc. The vector treatment is used extensively.

EH 345 Strength of Materials **3 (3-0) f s**
Prerequisites: EM 311, EM 341. For members of the Engineering Honors Program or by permission of the instructor
Introduction to the behavior of deformable solids. Development of relationships among loads, stresses, strains, and displacements. Mathematical representation and analysis of the behavior of shells, beams, shafts, columns, etc.

EH 346 Fluid Mechanics **3 (3-0) s**
Prerequisites: EM 312 or EH 344, MA 301. For members of the Engineering Honors Program or by permission of the instructor
Study of the concepts and principles relating to fluid mechanics. Equilibrium of liquids and gases, kinematics and dynamics of frictionless fluids. Motion of viscous fluids. Dynamics of gases. Flow measurement techniques.

EH 371 Thermodynamics I **3 (3-0) f**
Prerequisite: For members of the Engineering Honors Program or by permission of the instructor
A study of the basic principles and concepts of thermodynamics. The First and Second Laws are studied with emphasis on the generality and consequences of the basic laws. The mathematics of property relationships as well as properties of working substances are investigated. Applications of the principles to diverse fields such as elasticity, electromagnetism, propulsion are presented to emphasize generality.

EH 372 Thermodynamics II **3 (3-0) s**
Prerequisites: EH 371. For members of the Engineering Honors Program or by permission of the instructor
Thermodynamics of compressible fluid flow, normal shock relations, generalized conservation equations, nozzle flow, one dimensional flows, thermodynamic equilibrium, free energy functions, Gibbs phase rule, and generalized criteria for equilibrium. Thermodynamics of chemically reactive systems, stoichiometry, standard states, heats of reation and formation, equilibrium composition, adiabatic flame temperature, dissociation. Introduction to Statistical Thermodynamics, thermodynamics of electromagnetic fields, thermodynamics of radiation.

EM 401 Special Topics in Engineering **1-4 f s**
Prerequisite: For members of the Engineering Honors Program or by permission of the instructor
Special projects in various phases of engineering.

Engineering Mechanics

Courses for Undergraduates

EM 200 Introduction to Mechanics **3 (3-0) f s**
Prerequisite: MA 301
An introduction to the principles and concepts which form the basis for studies in dynamics, rigid mechanics, and fluid mechanics. The nature and properties of force systems and stress fields. The motion of particles and description of deformation of continuous media. The role of Newton's laws, the concepts of continuity and equilibrium, and the conservational principles in problems in mechanics.

EM 301 Solid Mechanics I **3 (3-0) f s**
Prerequisite: EM 200
Introduction to the mechanics of deformable solids. Development of the equations which describe the linear elastic solid. Approximate solutions and solutions governed by the theory of elasticity to problems involving prescribed force systems, states of motion, or energy inputs.

EM 302 Solid Mechanics II **3 (3-0) f s**
Prerequisite: EM 301
Continuation of EM 301. Equations for thin plates. Introduction to the theory of plasticity. Theories of yielding, plastic stress-strain relationships, and two dimensional problems in plastic behavior.

EM 303 Fluid Mechanics I **3 (3-0) f s**
Prerequisite: EM 200
Development of the basic equations of fluid mechanics in general and specialized form. Application of these specialized equations to a variety of topics including (1) fluid statics, (2) inviscid, incompressible fluid flow, and (3) viscous, incompressible fluid flow.

EM 304 Fluid Mechanics II **3 (3-0) f s**
Prerequisite: EM 303
Continuation of EM 303. Further applications of the basic equations of fluid mechanics to (1) boundary layer analysis, (2) laminar and turbulent flows and (3) compressible fluid flow. Introduction to experimental methods in fluid mechanics.

EM 341 Mechanics A (Statics) **2 (2-0) f s**
Prerequisites: PY 201 or PY 211, MA 201 or MA 211
Forces, resultants and equilibrium of concurrent, parallel and non concurrent non parallel force systems; statics applied to engineering problems and the solution of stress in simple cases. Centroids and moments of inertia.

EM 342 Mechanics B (Dynamics) **2 (2-0) f s**
Prerequisite: EM 341 or EM 200
The kinematic and kinetic study of motion of particles and rigid bodies; absolute and relative motion. Methods of force, mass and acceleration; work and energy impulse and momentum.

EM 343 Strength of Materials A **2 (2 0) f s**
Prerequisite: EM 200 or EM 341
Axial and shear stresses and strains; pure torsion of circular shafts; external shears and moments; the distribution of internal shearing and bending stresses; introduction to deflection theory; column theory; design of axially loaded columns.

EM 401 Experimental Mechanics I **3 (0-6) f**
Prerequisites: EM 301, 303
A course in the principal experimental methods employed in the analysis of contemporar problems of engineering in which mechanics dominates. Special emphasis is given to thos phenomena which give rise to instruments for measurement of prime mechanical variable Experimental analysis of mechanical fields and interpretation of date are major topics.

EM 402 Experimental Mechanics II **3 (0-6) f**
Prerequisite: EM 401
Selected experiments which illustrate basic phenomena of mechanics in engineering systems A particular emphasis is the experimental synthesis of such systems and the evaluation o their behavior as designed.

EM 430 Fluid Mechanics **2 (2-0) f**
Prerequisite: EM 342
Fluid statics, kinematics, Bernoulli equation, momentum, free surface flow, viscosity, pip friction, drag on submerged bodies, lift, elastic wave propagation.

Courses for Graduates and Advanced Undergraduates

EM 501, 502 Continuum Mechanics I, II **3 (3-0) f**
Prerequisites: EM 301; 303; ME 301; MA 405
The concepts of stress and strain are presented in generalized tensor form. Emphasis is place on the discussion and relative comparison of the analytical models for a series of continu including the linear elastic solid, the perfect fluid and the viscous (Newtonian) fluid. Th underlying thermodynamic principles are presented, the associated boundary value problem are formulated and selected examples are used to illustrate the theory.

EM 503 Theory of Linear Elasticity **3(3-0) f**
Prerequisites: EM 301; MA 301
The differential equation approach employed in development of the equations representin the behavior of a linear elastic solid. The elastic problem formulated in two and three dimen sions and various coordinate systems. Application of the theory illustrated through selecte problems.

EM 504 Mechanics of Ideal Fluids **3 (3-0) f**
Prerequisite: EM 430 or EM 304; Corequisite: MA 515
Basic equations of ideal fluid flow; potential and stream functions; vortex dynamics; bod forces due to flow fields; method of singularities in two-dimensional flows; analytical dete mination of potential functions; conformal transformations; free-streamline flows.

EM 505 Mechanics of Viscous Fluids I **3 (3-0)**
Prerequisite: EM 430 or EM 304; Corequisite MA 532
Equations of motion of a viscous fluid (Navier-Stokes Equations); general properties of th Navier-Stokes equations; some exact solutions of the Navier Stokes equations; boundary laye equations; some approximate methods of solution of the boundary layer equations; lamina boundary layers in axi-symmetric and three dimensional flows; unsteady laminar boundar layers.
(Offered in fall semester of 1962 63)

EM 506 Mechanics of Compressible Fluid I **3 (3-0)**
Prerequisites: EM 430 or EM 304; ME 302; Corequisite: MA 532
Introduction to compressible fluid flow; isentropic, one-dimensional flow; Rayleigh and Fann line flows; generalized one-dimensional flow; normal shock waves; introduction of mult dimensional, compressible flow.
(Offered in the fall semester of 1963-64)

EM 507 Systems Analysis **3 (3-0)**
Prerequisites: EM 301; 303; MA 511
A course in the design of engineering systems in which mechanics dominates.
(Offered in the fall semester of 1963-64)

EM 508 Systems Synthesis **3 (3-0) s**
Prerequisite: EM 507
A course in the design of engineering systems in which mechanics dominates.
(Offered in the fall semester of 1963-64)

EM 509 Space Mechanics I **3 (3-0) f**
Prerequisites: EM 302; EM 304; Corequisite: MA 511
The application of mechanics to the analysis and design of orbits and trajectories. Trajectory computation and optimization; space maneuvers; re-entry trajectories; interplanetary guidance.
(Offered in the fall semester of 1962-63)

EM 510 Space Mechanics II **3 (3-0) s**
Prerequisites: EM 509; MA 511
Continuation of EM 509. The analysis and design of guidance systems. Basic sensing devices; the characteristics of an inertial space; the theory of stabilized platforms; terrestrial inertial guidance.
(Offered in the spring semester of 1962-63)

EM 511 Theory of Plates and Shells **3 (3-0) s**
Prerequisites: EM 301 accompanied by MA 511
A modern study of the theory of plates and shells. Topics are selected from problems involving membranes; folded plates, circular and rectangular slabs, domes, cylindrical shells and hyperbolic paraboloids. Solutions are obtained by both classical and modern numerical methods.
(Offered in the spring semester of 1962-63)

EM 551 Advanced Strength of Materials **3 (3-0) f**
Prerequisites: EM 301
Stresses and strains at a point; rosette analysis; stress theories, stress concentration and fatigue; plasticity; inelastic, composite and curved beams; prestress energy methods shear deflections; buckling problems and column design; and membrane stresses in shells.

EM 552 Elastic Stability **3 (3-0) f**
Prerequisites: MA 301; MA 405; EM 551
A study of elastic and plastic stability. The stability criterion as a determinant. The energy method and the theorem of stationary potential energy. The solution of buckling problems by finite differences and the calculus of variations. The application of successive approximations to stability problems. Optimization applied to problems of aeroelastic and civil engineering structures.
(Offered in the fall semester of 1963-64)

EM 555 Dynamics I **3 (3-0) f**
Prerequisites: EM 301; MA 405
The theory of vibrations from the Lagrangian formulation of the equations of motion. Free and forced vibrations with and without damping, multiple degrees of freedom, coupled motion, normal mode vibrations, wave propagation in solid bodies.
(Offered in the fall semester of 1963-64)

EM 556 Dynamics II **3 (3-0) s**
Prerequisites: EM 301; MA 405
The dynamics of particles and rigid bodies by the use of formulations of the laws of mechanics due to Newton, Euler, Lagrange, and Hamilton. Accelerated reference frames, constrains, Euler's angles, the spinning top, the gyroscope, precession, stability, phase space, and nonlinear oscillatory motion.
(Offered in the spring semester of 1963-64)

Courses for Graduates Only

EM 601, 602 Unifying Concepts in Mechanics I, II **3 (3-0) f·**
Prerequisite: PY 601
Generalized treatment of the fundamental equations and boundary value problems of co tinuous and non continuous media. Use is made of contemporary developments in irreversit thermodynamic, statistical mechanics, and electrodynamics to provide a unified foundatic for the development of principles governing the dynamics and thermodynamic behavior elastic, plastic and visco-elastic solids, viscous fluids and rheological media.
(Offered in the fall and spring semesters of 1962-63)

EM 604 Theory of Plasticity **3 (3-0)**
Prerequisite: MA 503
Development of the equations representing the plastic behavior of deformable solids. Yie conditions and plastic stress-strain relations. Plane strain theory, hyperbolic equations as slip line fields. Selected problems to illustrate the theory.
(Offered in the spring semester 1963 64)

EM 605 Plastic Limit Analysis **3 (3-0**
Prerequisite: EM 503
Determination of the load carrying capacity of perfectly plastic structures including frame plates, and shells. Emphasis on the underlying principles and general methods of analy for bodies involving three dimensional states of stress.
(Offered in the spring semester of 1962-63)

EM 611 Mechanics of Compressible Fluids II **3 (3-0**
Prerequisite: EM 506
Continuation of EM 506; linearized theory of two-dimensional, compressible flow; method characteristics for two dimensional supersonic flow; oblique shock waves; unsteady one-dime sional flow; shock-wave boundary layer interactions; transonic flow.
(Offered in the spring semester of 1963-64)

EM 612 Mechanics of Vicsous Fluids II **3 (3-0**
Prerequisite: EM 505
Continuation of EM 505; phenomenological theories of turbulence; turbulent flow in du and pipes; turbulent boundary layer with and without pressure gradient; compressible bou dary layer with and without pressure gradient; compressible boundary layer; boundary la control; free viscous flow.
(Offered in the spring semester of 1962-63)

EM 695 Experimental Methods in Mechanics **Maximum 6 credits**
Prerequisite: Consent of instructor
The study of specialized experimental techniques utilized in contemporary research in areas of Mechanics.

EM 697 Seminars in Mechanics **Maximum 3 credits**
Prerequisites: Graduate standing and consent of adviser
The discussion and development of theory relating to contemporary research in the front areas of Mechanics.

EM 698 Special Topics in Mechanics **Maximum 9 credits**
The study, by small groups of graduate students under the direction of members of faculty, of topics of particular interest in various advanced phases of mechanics.

EM 699 Research in Mechanics **Maximum 6 credits**
Individual research in the field of Mechanics.

English

Freshman English

ENG 111 Composition and Rhetoric **3 (3-0) f s**
Required of all freshmen
Intensive study and practice in the basic forms and principles of expository communication; conferences.

ENG 112 Composition and Reading **3 (3-0) f s**
Required of all freshmen
Continued practice in expository writing; research paper; introduction to literary types; collateral reading; conferences.
Note: Qualified students will be allowed to register for ENG 112 and will be given credit for both 111 and 112 upon successful completion of the latter. Eligibility for 112 will be based on a predetermined score on the Verbal Aptitude section of the SAT plus a composition to be written at the first or second class meeting of the 112 section.

Writing

ENG 211 Business Communications **3 (3-0) f s**
Prerequisite: ENG 112
Practical application of the principles of composition to effective business communications, including basic types of correspondence and reports. Special attention will be paid to vocabulary building, and work will be given in oral business communications.

ENG 215 Principles of News and Article Writing **3 (3-0) f s**
Prerequisite: ENG 112
Introduction to the writing of simple news articles; class criticism of non technical newspaper and magazine articles.

ENG 216 Advanced Article Writing **3 (3-0) s**
Prerequisites: ENG 112 and 215 or equivalent
A continuation of ENG 215, with intensive practice in writing and criticizing non-technical articles.

ENG 222 Advanced Composition (Creative Writing) **3 (3-0) s**
Prerequisite: ENG 112
A course in creative writing especially designed for students who have demonstrated ability; emphasis on short prose fiction.

ENG 223 Vocabulary Building **3 (3-0) s**
Prerequisite: ENG 112
A system of increasing the student's mastery of useful words as found in the best modern English prose.

ENG 321 Scientific Writing **3 (3-0) f s**
Prerequisite: ENG 112
Intensive practice in writing technical and scientific reports, articles for journals, and business letters relating to technical reports.

ENG 424 Modern English Usage **3 (3-0) f s**
Prerequisite: ENG 112
An intensive study of English grammar with particular emphasis on contemporary usage. A brief survey of the historical development of the language will be included.

Speech

ENG 231 Basic Speaking Skills **3 (3-0) f**
Prerequisite: ENG 112
Training in the fundamentals of public speaking; supplementary training in some aspec of group discussion (panel, forum, symposium or committee) and in the techniques of goc listening.

ENG 332 Argumentation and Persuasion **3 (3-0)**
Prerequisite: ENG 231 or equivalent
Analysis, brief drawing and evidence, and methods of proof and refutation; fundamentals conviction; naturalness and forcefulness, extempore speeches, debates and discussions.

ENG 333 Public Address and Extemporaneous Speaking **3 (3-0)**
Prerequisite: ENG 231 or equivalent
Public speaking for special occasions, including speech of introduction, committee-roo speech, after-dinner speech, speech at professional conventions, political speech, formal sa talk.

ENG 334 Oral Reading **3 (3-0)**
Prerequisites: ENG 112 and 231, or approval of the department
Training in the analysis and presentation of printed materials, technical and semi-technic for platform, radio, and television. Emotional reactions to add color and interest; expressi body and voice; correction of faulty habits.

ENG 336 Parliamentary Practice **3 (3-0) f**
Prerequisite: ENG 112
(Not to be counted toward the fulfillment of any requirement in languages, humanities social sciences without specific authorization.)
Rules and customs of assemblies, including organization, motions; participation in and co duct of meetings; parliamentary strategy.

ENG 337 Group Discussion **3 (3-0)**
Prerequisites: ENG 112 and 231, or approval of the department
The theory and practice of leading and taking part in such groups as panels, forums, sy posiums, conferences and committees. Oral and written assignments. Frequent recordings.

Literature

Note: ENG 112 is prerequisite to all courses in literature.

ENG 205 Reading for Discovery **3 (3-0)**
A study of selected masterworks drawn from American, English and European literature w emphasis on the great themes and on the approach of the creative artist to basic ideas. Western culture.

ENG 361 Backgrounds of English Civilization (I) **3 (3-0**
A reading course in English literature from the Anglo Saxon invasions to the Roma period, with an emphasis on the contributions of English life and thought to Western Civ zation.

ENG 362 Backgrounds of English Civilization (II) **3 (3-0**
English literature from the Romantic period to the present day. This course may be tal either as a continuation of ENG 361 or as an independent course.

ENG 365 The American Mind (I) **3 (3-0**
The development of American thought and civilization as reflected in American literat from the colonial settlements through the New England revival of the nineteenth century.

NG 366 The American Mind (II) **3 (3-0) s**
The background of contemporary American literature and thought, from Mark Twain to Hemingway and Faulkner. This course may be taken either as a continuation of ENG 365 or as an independent course.

NG 375 Southern Writers **3 (3-0) s**
An introduction to Southern culture as revealed in poetry and short fiction from Poe to the present day. Readings in the Southern essay dealing with social, political, and literary problems.

NG 382 Short Prose Fiction **3 (3-0) f**
The study of selected short stories by the most representative of contemporary British and American writers.

NG 460 Literature of Scientific Thought **3 (3-0) f s**
Chief documents of scientific thought from Aristotle to the present day with emphasis on literary values.

NG 468 Major American Writers **3 (3-0) f s**
Concentrated study of the writings of Emerson, Thoreau, Melville, and Whitman as they exemplify the spirit of American individualism.
(Students may not receive credit for both ENG 365 and ENG 468.)

NG 471—The Novel **3 (3-0) f s**
Intensive analysis of some of the most influential English, American, and Continental novels chosen to illustrate the structure and the development of the form.

NG 480 Modern Drama **3 (3-0) s**
A study of the development of modern drama as a form for the expression of social and humanistic ideas through a systematic examination of the plays of Ibsen, Shaw, and Eugene O'Neill.

NG 485 Shakespeare **3 (3-0) s**
A study of the principal plays with emphasis on reading Shakespeare for enjoyment.

NG 496 Literature of the Western World **3 (3-0) f**
Readings from selected great books from the Homeric period of Greek literature to the Renaissance in Europe. Emphasis on the contributions of this literature to modern thought.

NG 497 Literature of the Non-Western World **3 (3-0) s**
Study of a selected group of translations from the literature of Persia, India, China, and Japan as they reflect cultural backgrounds.

NG 498 Contemporary Literature **3 (3-0) s**
A study of selected examples of American, British, and Continental writing from 1890 to the present day with reference to changing literary forms and themes.

NG 499 Literary Analysis (Senior Seminar) **3 (3-0) f s**
Prerequisites: ENG 112 and departmental approval
A flexible course in reading and criticism designed to synthesize the student's preceding work in literature and to provide a capstone for his undergraduate program.

Entomology

Courses for Undergraduates

NT 301 Introduction to Forest Insects **3 (2-2) f**
An introductory course covering the fundamentals of classification, development, habit, and control of forest insects. Mr. Farrier

ENT 312 Introduction to Economic Insects 3 (2-2) f o:
A basic course, covering the fundamentals of insect classification, development, food hab and controls. Mr. Bi

ENT 322 Beekeeping 3 (2-
Prerequisite: Consent of instructor
A basic course dealing with the place of the honeybee in our agricultural economy; the col and its components; management; manipulation; honey production, care and marketing Mr. Step

Courses for Graduates and Advanced Undergraduates

ENT 501-502 Insect Morphology 3 (1-4)
Prerequisite: ENT 301 or 312
Covers general morphology, external and internal, of the insects and their relatives. ENT will deal primarily with external morphology and ENT 502 with internal morphology. (be offered 1963-64 and alternate years.) Mr. Yo

ENT 506 Chemistry of Insecticides 3 (2-
Prerequisites: ENT 312, CH 203
A study of the critical chemical, physical, and biological properties of compounds used insect control. This course is directed toward obtaining fundamental knowledge of scientific principles underlying modern methods of plant protection including details of ac methods of insecticide application. (Will be offered 1963 64 and alternate years). Mr. Gut

ENT 511 Systematic Enotomology 3 (1-
Prerequisite: ENT 301 or 312
A somewhat detailed survey of the orders and families of insects, designed to acquaint student with these groups and develop in the student some ability in the use of keys, des tions, etc. (Will be offered 1963 64 and alternate years.) Mr. Yo

ENT 531 Insect Ecology 3 (2
Prerequisite: ENT 301 or 312 or equivalent
The influence of environmental factors on insect development, distribution, and abund (Will be offered 1963 64 and alternate years.) Mr. I

ENT 541 Immature Insects 4 (2
Prerequisite: ENT 301 or 312 or equivalent
A study of the characteristics of the immature forms of the orders and principal famili insects. (Will be offered 1962-63 and alternate years.) Messrs. Rabb, Ne

ENT 551, 552 Applied Entomology 3 (2-2
Prerequisite: ENT 301 or 312
An advanced course in which the principles of applied entomology are studied in respe the major economic insect pests. Methods of determining and examining insect damage economic importance of insects, and the chief economic pests of man, food, and fibe studied as well as laws and regulations pertaining to insects and insecticides. (Will be o 1962-63 and alternate years.) Mr. M

ENT 561 Literature and History of Entomology 3 (3
Prerequisite: ENT 301 or 312 or equivalent
A general course intended to acquaint the student with literature problems of the scie mechanics of the library and book classification, bibliographies of the zoological sci abstract journals, forms of bibliographies, forms of literature, preparation of scientific p taxonomic indexes and literature (with a historical background) and history of the de ment of zoological science from ancient to modern times with emphasis on entomology. be offered 1963-64 and alternate years.) Mr. F

NT 571 Forest Entomology **3 (2-2) f**
rerequisite: ENT 301 or 312
study of methods of identification of forest pests, the factors governing their abundance
ıbits, and control. (Will be offered 1963-64 and alternate years.) Mr. Farrier

NT 582 (ZO 592) Medical and Veterinary Entomology (Parasitology) **3 (2-3) s**
erequisite: ENT 301 or 312
study of the morphology, biology and control of the parasitic anthropods of man, domestic
d wild animals. (Will be offered 1963-64 and alternate years.)
Messrs. Harkema, Farrier

NT 590 Special Problems **Credits by arrangement**
erequisites: Graduate standing and consent of the instructor
iginal research on special problems in entomology not related to a thesis problem, but
signed to provide experience and training in research. Graduate Staff

NT 592 Acarology **3 (2-2) s**
erequisite: ENT 301 or 312, or ZO 103
systematic survey of the mites and ticks with emphasis on identification, biology and con-
l of the more common and economic forms attacking material, plants and animals including
n. (Will be offered 1962-63 and alternate years.) Mr. Farrier

ourses for Graduates Only

T 602 Principles of Taxonomy **3 (1-4) s**
erequisite: ENT 511
course introducing the methods and tools used in animal taxonomy, designed to promote
better understanding of taxonomic literature, and provide a foundation for taxonomic
earch. (Will be offered 1962-63 and alternate years.) Mr. Young

T 611 Insect Physiology **4 (3-2) f**
requisite: ENT 312, ENT 502, CH 451, or equivalent
e course deals with the physiology and biochemistry of insects. The function of the differ-
organ systems and the intermediary metabolism of insects will be considered. Laboratory
k will include techniques of current importance in physiological research. (Will be offered
2-63 and alternate years.) Mr. Hodgson

T 622 Insect Toxicology **4 (2-4) s**
requisite: ENT 312, CH 426 or equivalent
e course deals with the relationship of chemical structure to toxicity in insects. The bio-
mical mechanisms involved in toxication and de-toxication will be stressed as well as
siological explanation of the chemical poisoning of insects. The biochemical, behavioral,
morphological explanation of resistance to insecticides will be studied. Laboratory work
olves cholinesterase inhibition, dehydrochlorination of DDT by resistant houseflies, com-
ative toxicity of insecticides, and bioassay methods. (Will be offered 1962-63 and alternate
rs.) Mr. Guthrie

T 680 Seminar **1-1 f s**
requisite: Graduate standing in Entomology or closely allied fields
cussion of entomological topics selected and assigned by Seminar Chairman.
Graduate Staff

T 690 Research **Credits by arrangement**
requisite: Graduate standing in Entomology or closely allied fields
ginal research in connection with thesis problem in entomology. Graduate Staff

Experimental Statistics

Courses for Undergraduates

ST 302 Machine Techniques for Data Processing **2 (1-2)**
The use of conventional IBM punch card machines with special emphasis on the processin of data using a stored program calculator. Mr. Verlinde

ST 311 Introduction to Statistics **3 (2-2) f**
This course will relate general statistical concepts to everyday life and will emphasize givin perspective to these concepts in place of developing skill. Quantitative descriptions of popu lations, sampling ideas, techniques of making inferences about populations from samples an the uncertainties involved in such inferences. Formulation and testing of hypotheses, elemen tary and basic statistical techniques. Messrs. McVay, Monro

ST 361 Introduction to Statistics for Engineers I **3 (3-0) f**
Prerequisite: College Algebra
Survey of statistical techniques useful to engineers and physical scientists. Includes elementa probability, frequency distributions, estimation of means and standard deviations, samplin variation, control charts, elementary least squares curve fitting.
Messrs. Hader, Granda

ST 362 Introduction to Statistics for Engineers II **3 (2-2)**
Prerequisite: ST 361
Continuation of ST 361. Additional and more advanced statistical methodology for engineers and physical scientists. Includes least squares method for fitting polynomials and multip regression; chi-square tests; sampling acceptance inspection; introduction to analysis of va ance and design of experiments. Messrs. Hader, Granda

ST 421, 422 Introduction to Mathematical Statistics **3 (3-0) f**
Prerequisite: MA 212
Elementary mathematical statistics primarily for students not intending to take further wo in theoretical statistics. Includes introduction to probability, common theoretical distri tions, moments, moment generating functions, sampling distributions, (F, t, chi-square), e mentary estimation and hypothesis testing concepts, bivariate distributions, simple and mul ple linear regression, analysis of variance, and elementary design of experiments. St

Courses for Graduates and Advanced Undergraduates

ST 501, 502 Basic Statistical Analysis **3 (3-0)**
Prerequisite: ST 311 or equivalent or graduate standing
Basic concepts of statistics; random variables, distributions, statistical measures, estimati tests of significance, analysis of variance, elementary design and sampling, factorial exp ments, multiple regression, analysis of discrete data, and other topics. Intended primarily statistics majors and Ph.D. minors and not intended as a service course for other departme
Mr. St

ST 511 Experimental Statistics for Biological Sciences I **3 (3-0)**
Prerequisite: ST 311 or graduate standing
Basic concepts of statistical models and use of samples; variation, statistical measures, dis butions, tests of significance, analysis of variance and elementary experimental design, gression and correlation, chi-square. Messrs. Monroe, Rawli

ST 512 Experimental Statistics for Biological Sciences II **3 (3-0)**
Prerequisite: ST 511 or equivalent
Covariance, multiple regression, factorial experiments, individual degrees of freedom, inc plete block designs, experiments repeated over space and time. Mr. Ma

T 513 Experimental Statistics for Social Sciences I **3 (3-0) f**
rerequisite: ST 311 or graduate standing
asic concepts in collection and analysis of data. Variability of sample data, distributions, onfidence limits, chi-square, t test, analysis of variance, regression, correlation, analytic and escriptive surveys, experimental designs, index numbers. Mr. McVay

T 514 Experimental Statistics for Social Sciences II **3 (3-0) s**
rerequisite: ST 513 or equivalent
xtension of basic statistical concepts to social experiments and surveys; sampling from finite opulations and estimating using unrestricted, stratified, systematic, and multistage selections; nalysis of variance continued; multiple regression; covariance; experimental designs.
Mr. Proctor

T 515, 516 Experimental Statistics for Engineers **3 (3-0) f s**
rerequisite: ST 361 or graduate standing
eneral statistical concepts and techniques useful to research workers in engineering, textiles, ood technology, etc. Probability, distributions, measurement of precision, simple and multiple egression, tests of significance, analysis of variance, enumeration data, sensitivity data, life esting experiments and experimental design. Mr. Hader

T 521 Basic Statistical Inference **3 (2-2) s**
rerequisites: MA 522 and MA 511
requency distributions and moments; sampling distributions; introductory theory of point nd interval estimation; tests of hypotheses. Mr. Grandage

T 522 Basic Theory of Least Squares and Variance Components **3 (2-2) f**
rerequisies: ST 521 and MA 405
heory of least squares; multiple regression; analysis of variance and covariance; experimental esign models; factorial experiments; variance component models.
Mr. Anderson

T 591 Special Problems **1-3 credits by arrangement f s**
evelopment of techniques for specialized cases, particularly in connection with thesis and ractical consulting problems. Graduate Staff

ourses for Graduates Only

T 611, 612 Intermediate Statistical Theory **3 (3-0) f s**
rerequisites: ST 521, MA 512 and MA 405
his course will provide the additional theory, above that of ST 521, needed for many dvanced theory courses. Many of the topics of ST 521 will be developed more rigorously, ith more attention paid to mathematical aspects. Advanced probability theory; limit theorems, istribution theory, multinormal distributions. Statistical decision theory, theory of estimation, onfidence regions, theory of tests of hypotheses, sequential tests, non parametric methods.
Mr. Hall

T 621 Statistics in Animal Science **3 (3-0) f**
rerequisite: ST 502 or equivalent
ources and magnitudes of errors in experiments with animals, experimental designs and ethods of analysis adapted to specific types of animal research, relative efficiency of alternate esigns, amount of data required for specified accuracy, student reports on selected topics.
ffered in fall of 1963-64 and alternate years. Mr. Lucas

T 622 Principles of Biological Assays **3 (2-2) s**
See ANS 622)

T 623 Statistics in Plant Science **3 (3-0) f**
rerequisite: ST 502 or equivalent
rinciples and techniques of planning, establishing, and executing field and greenhouse ex- eriments. Size, shape and orientation of plots; border effects; selection of experimental aterial; estimation of size of experiments for specified accuracy; scoring and subjective tests; ubsampling plots and yields for laboratory analysis. Mr. Mason

ST 626 Statistical Concepts in Genetics **3 (3-0)**
Prerequisite: GN 512; Corequisite: ST 502 or equivalent
Factors bearing on rates of change in population means and variances, with special referen to cultivated plants and domestic animals; selection, inbreeding, magnitude and nature genotypic and non-genotypic variability; experimental and statistical approaches in t analysis of quantitative inheritance. Mr. Cockerha

ST 631 Theory of Sampling Applied to Survey Design **3 (3-0)**
Prerequisites: ST 422; ST 502 or equivalent
Basic theory of sampling from a finite population. Confidence limits and estimation optimum sample size, comparison of different sample designs, methods and probabilities f selection and methods of estimation, choice of a sampling unit, double sampling, matche samples. Messrs. Proctor, Koc

ST 641 (RS 641) Statistics in Sociology **3 (3-0)**
Prerequisite: ST 513 or equivalent
The application of statistical methods in sociological research. Emphasis on selecting appr priate models, instruments and techniques for the more frequently encountered proble and forms of data. Mr. Hamilt

ST 651 (AGC 651) Econometric Methods I **3 (3-0)**
Prerequisites: ST 421; ST 502 or equivalent; AGC 641
The role and uses of statistical inference in agricultural economic research; measureme problems and their solutions arising from the statistical model and the nature of the dat limitations and interpretation of results of economic measurement from statistical techniqu. Topics include the problems of specification, aggregation, identification, multicollinearity an autocorrelation. Attention also is given to expectations models and simultaneous stochast equations. Mr. Walla

ST 652 (AGC 652) Econometric Methods II **3 (3-0)**
Prerequisites: ST 422 and AGC 551
Techniques for problem analysis in agricultural economics; attention to analysis of tim series data; non-parametric inference; experimental design in economic research; estimatio of parameters in production functions and in simultaneous models; selected special topics. Mr. Anders

ST 661 Advanced Special Problems **1-3 credits by arrangement**
Prerequisites: ST 502 or equivalent; ST 522
Any new advance in the field of statistics which can be presented in lecture series as uniq opportunities arise, including (a) theory of sampling applied to survey design and (b) analy of messy data. Graduate Staff, Visiting Professo

ST 671 Advanced Topics in Least Squares and Variance Components **3 (3-0)**
Prerequisites: ST 502 or equivalent; ST 522
Use of non-balanced designs to estimate variance components; comparison of estimators; pro lems with finite populations. Least squares procedures for non-standard conditions; unequ variances, correlated errors, non-additivity, measurement errors, non-normality. Function relationships. Factorial experiments with continuous factor levels; incomplete blocks. Mr. Anders

ST 672 Special Advanced Topics in Statistical Analysis **3 (3-0)**
Prerequisites: ST 502 or equivalent; ST 522
Enumeration data; covariance; non-linear models; discriminant functions and other mul variate techniques. Mr. Monr

ST 674 Advanced Topics in Construction and Analysis of Experimental Designs **3 (3-0)**
Prerequisites: ST 502 or equivalent; ST 522
Inter-block analysis of incomplete blocks designs, partially balanced designs, confoundin data collected at several places and times, multiple factor designs, change-over trials, analy of groups of means. Graduate St

r 681 Seminar **1 (1-0) f s**
: maximum of two credits is allowed toward the master's degree, but any number toward the octorate. Graduate Staff

r 691 Research **Credits by arrangement f s**
: maximum of nine credits is allowed toward the master's degree; no limitation on credits i doctorate programs. Graduate Staff

Food Science

:ourses for Undergraduates

; 301 Food Composition **3 (2-3) f**
rerequisite: CH 220 or 221
asic principles and procedures for the analysis of moisture, ash, carbohydrate, fat and pro-in contents of foods. Measurement of certain physical characteristics of foods.
Mr. Warren

; 303 (ANS 303) Meat and Meat Products **3 (2-3) s**
rerequisite: CH 351
udy of live animal and carcass relationship, dressing percentages and cut-out values. Slaughter-g, cutting, curing, freezing and handling of meat and meat products for commercial and ome use. Mr. Blumer

; 309 (ANS 309) Meat Selection **1 (0-6) f**
etailed consideration of factors involved in selection of carcasses and wholesale cuts of beef, ork and lamb. Practice in identification of wholesale and retail cuts. Mr. Craig

; 331 (AGE 331) Food Engineering **3 (2-3) s**
rerequisite: PY 211 or 221
asic engineering principles applicable, wholly or in part, to food processing. Forms of energy d how they can be altered in state, composition, direction or force to fulfill the processing quirements. Latest means of energy conversion to affect efficient and practical applications power, heat, refrigeration and irradiation. Instruments and controls for processing with plicable principles of fluid flow, heat transfer, air-vapor relationships, filtration, separation d materials handling by mechanical and flotation methods. Mr. Jones

; 401 Market Milk and Related Products **3 (2-3) f**
rinciples of processing, distribution and quality control of fluid milk and related products.
Mr. Warren

; 403 Ice Cream and Related Frozen Dairy Foods **3 (2-3) s**
rerequisite: FS 401
hoice, preparation and processing of ingredients and freezing of ice cream and other frozen esserts. Mr. Warren

; 404 (PO 404) Poultry Products **3 (2-3) f**
rerequisites: CH 101 and ZO 103
election, processing, grading and packaging poultry meat and eggs. Factors involved in preser-ation of poultry meat and eggs. Mr. Fromm

S 410 Food Products Evaluation **3 (2-3) s**
rerequisite: ST 361
comprehensive study of problems encountered in new food product development and con-umer acceptance. A study of the nature of sensory responses with emphasis on taste, smell nd appearance (color) as related to foods; design and methodology of small and large con-umer panel testing; and the application of appropriate mathematical procedures to food cceptance testing and methodology. Mr. Hoover

Courses for Graduates and Advanced Undergraduates

FS 502 Food Chemistry **3 (3-0)**
Prerequisite: CH 220 or 221
The basic composition, structure and properties of food, and the chemistry of changes oc curring during processing and utilization of the food. Interpret and integrate widely pub lished data in the food field with basic principles of chemistry. Mr. Auran

FS 503 Food Analysis **3 (1-6)**
Prerequisites: CH 215, CH 351 and FS 502
A study of the principles, methods and techniques necessary for quantitative physical an chemical analyses of food and food products. Results of analysis will be studied and evaluate in terms of quality standards and governing regulations. Mr. Auran

FS 505 (BO 505) Food Microbiology **3 (2-3)**
Prerequisite: BO 412
The relationship of habitat to the occurrence of microorganisms on foods; environmenta factors affecting the growth of various microorganisms in foods; microbiological action i relation to food spoilage and food manufacture; physical, chemical and biological destructio of microorganisms in foods; methods for microbiological examination of food stuffs; an public health and sanitation bacteriology. Mr. Spec

FS 506 Advanced Food Microbiology **3 (0-9)**
Prerequisite: FS 505 or consent of instructor
Ecology and physiology of microorganisms important in the manufacture and deteriorati of various classes of foods; the identification of representative species of such microorganism isolated from natural environments; principles of nutrition, symbiosis and bacteriophag activity in culture maintenance for food production. Mr. Spec

FS 511 Food Science Seminar **1 (1-0)**
Prerequisite: Senior or graduate standing and consent of instructor
A review and discussion of scientific articles, progress reports in research and special problem of interest. Graduate Sta

FS 512 Special Problems in Food Science **1-3 (arranged) f**
Prerequisite: Senior or graduate standing and consent of instructor
Analysis of scientific, engineering and economic problems of current interest in foods. Th scientific appraisal and solution of a selected problem. The problems are designed to provid training and experience in research. Graduate Sta

FS 521, 522 Technology of Fruit and Vegetable Products **3 (2-2) f**
Prerequisite: BO 412
Comprehensive treatment of principles and methods of preservation of fruits and vegetable including studies of commercial plant operations, and visits to food processing plants.
Mr. Hoove

Courses for Graduates Only

FS 601 Seminar in Food Science **1 (1-0) f**
Preparation and presentation of scientific papers, progress reports of research and specia topics of interest in foods. Graduate Sta

FS 602 Special Research Problems in Food Science **Credits by arrangeme**
Directed research in a specialized phase of food science designed to provide experience i research methodology and philosophy. Graduate Sta

FS 603 Research in Food Science **Credits by arrangeme**
Original research preparatory to the thesis for the Master of Science or Doctor of Philosoph degrees. Graduate Sta

Forestry

Courses for Undergraduates

FOR 52 Small Private Forest Management **3 (2-3) s**
Growing, harvesting and marketing timber products under small private ownership conditions. For Agricultural Institute students. Mr. Dyson

FOR 101 Introduction to Forestry **1 (1-0) f**
The profession of forestry, its scope and opportunities; conservation of natural resources.
Mr. Preston

FOR 201 Wood Structure and Properties **3 (2-3) s**
Identification, structure, properties and uses of woods of economic importance in the United States. This course is a condensation of FOR 202, 203 with less emphasis. Mr. Carter

FOR 202 Wood Structure and Properties I **3 (1-4) f**
The macro- and micro-structure of wood is emphasized in this introductory course. As related to wood structure, the physical properties and uses of several commercially important coniferous and deciduous woods are also studied. The techniques of hand lens and microscope identification of wood are covered. Mr. Thomas

FOR 203 Wood Structure and Properties II **3 (2-3) s**
Prerequisites: FOR 202, PY 211
Physical properties of wood, specific gravity relationships, wood in relation to moisture, wood in relation to heat, sound, light, electricity, combustion; introduction to strength properties of wood. Mr. Rice

FOR s204 Silviculture **3 credits**
Sophomore Summer Camp
Growth and development of forest stands; reproduction counts, type mapping thinning, and weeding; establishment and measurement of sample plots. Staff

FOR s205 Wood Machining Practicum **1 credit**
Sophomore Summer Practicum
Prerequisite: FOR 203
Laboratory exercises in machining of wood. Staff

FOR s206 Wood Drying Practicum **1 credit**
Sophomore Summer Practicum
Laboratory exercises in wood drying. Staff

FOR s207 Gluing Practicum **1 credit**
Sophomore Summer Practicum
Laboratory exercises in gluing wood and preparation of particle board. Staff

FOR s208 Wood Finishing Practicum **1 credit**
Sophomore Summer Practicum
Laboratory exercises in wood finishing. Staff

FOR s209 Plant Inspections **1 credit**
Sophomore Summer Practicum
Inspection of wood-using plants. Staff

FOR s210 Mensuration Practicum **2 credits**
Sophomore Summer Practicum
Laboratory exercises in mensuration. Staff

FOR s211 Logging and Milling Practicum **2 cred**
Sophomore Summer Practicum
Practical exercises in logging and milling. St

FOR s212 Graphic Methods **1 cre**
Sophomore Summer Practicum
Laboratory exercises in appropriate graphic methods. St

FOR 219 Forest Economy and Its Operation **3 (2-2**
Multiple use concept of forestry; economic principles underlying production; investment pro
lems; factors which influence demand for forest products. Mr. Dys

FOR s264 Protection **3 cred**
Sophomore Summer Camp
Protection practices relating to fire, insects and disease. St

FOR s274 Mapping and Mensuration **3 cred**
Sophomore Summer Camp
Collection of field data for stand and yield tables, stem analysis, timber surveys, basic me
suration, forest mapping. St

FOR s284 Utilization **1 cre**
Sophomore Summer Camp
Trips to wood industries; expositions on manufacturing processes.

FOR 301 Wood Processes I **4 (3-2**
Prerequisites: FOR 203, 209
The processes of drying, gluing and finishing wood. Processes of reconstituting wood as fiv
board, hardboard and particle board. Basic requirements of various procedures and materi
Factors in selecting production methods. Mr. Car

FOR 302 Wood Processes II **4 (3-2**
Prerequisites: FOR 203, 209
The theories and techniques of converting raw wood into usable products by milling, vene
ing and chipping round wood. Included also is the processing of finished lumber, dimensi
stock, plywood and other wood products. Mr. Car

FOR 321, 322 Pulp and Paper Technology **3 (3-0)**
Brief survey of the physical and chemical characteristics of wood and cellulose. Chemis
and technology of the major mechanical, chemical and semi-chemical processes employed
the manufacture of pulp and paper. Mr. Hitchit

FOR 342 Fiber Analysis **3 (1-4**
Fiber microscopy; the determination of fiber measurement, quality, variation and identity
pulpwood. Mr. Barefo

FOR 361, 362 Silvics **3 (2-3)**
Prerequisite: Summer Camp
Site, soil and other environmental factors in relation to the establishment, growth, and
velopment of seedlings, trees and timber stands; the influence of forest vegetation on si
ground water, and micro climate. Messrs. Maki, Pe

FOR 372 Mensuration **3 (2-2**
Prerequisite: FOR s274
The measurement of timber, both standing and felled; log rules form factors, stem analy
and growth; methods of making volume, growth, and stand tables; increment and yield studi
development of stand and yield tables from field data. Mr. Bry

FOR 401 Wood Preservation **2 (1-3**
Factors causing wood deterioration; preservative materials and treatments; wood by-produ
from mill and forest waste. Mr. Car

FOR 403 Paper Process Analysis **3 (0-6) s**
Manufacture of several types of papers with particular attention to stock preparation, sizing, filling and coloring. The finished products are tested physically and chemically and evaluated from the standpoint of quality and in comparison with the commercial products they are intended to duplicate. Mr. Hitchings

FOR 404 Management Analysis **3 (1-6) s**
Application of management, logging, silvicultural and utilization practices on assigned areas. Each student must make a forest survey of an individual area and submit a record.
Messrs. Lammi, Miller

FOR 405 Forest Inventory **3 (1-6) s**
Timber estimating and data compilation. Messrs. Lammi, Miller

FOR 411, 412 Pulp and Paper Unit Processes **3 (3-0) f s**
Principles of operation, construction and design of process equipment employed in the pulp and paper industry. Mr. Cook

FOR 413 Paper Properties and Additives **4 (1-9) f**
Physical, chemical and microscopical examination of experimental and commercial papers and evaluation of the results in terms of the utility of the product tested; evaluation and identification of dyestuffs and the development of color formulas.
Messrs. Cook, Landes

FOR 422 Forest Products **3 (3-0) f**
Prerequisites: FOR 201, CH 203 or 426
The source and method of obtaining derived and manufactured forest products other than timber. Mr. Carter

FOR 423 Logging and Milling **3 (2-3) f**
Timber harvesting and transportation methods, equipment and costs; safety and supervision; manufacturing methods with; log and lumber grades. Mr. Barefoot

FOR 432 Merchandising Forest Products **2 (2-0) f**
Principles and practices in the distribution and marketing of the products obtained from wood; organization and operation of retail, concentration and wholesale outlets.
Mr. Carter

FOR 434 Wood Operations I **3 (2-3) f**
Prerequisites: FOR 301, 302
Organization of manufacturing plans producing wood products including company organization, plant layout, production planning and control. Analysis of typical manufacturing operations in terms of processes, equipment, size and product specification. The organization and operation of Wood Products markets. Mr. Barefoot

FOR 435 Wood Operations II **3 (2-3) s**
Prerequisites: FOR 301, 302
The application of the techniques of operations analysis to management decision making in the wood products field. Choice of products to manufacture. Allocation of production resources. Development of product distribution systems. Mr. Barefoot

FOR 441 Design of Wood Structures **3 (2-3) s**
Prerequisite: EM 341
Strength and related properties of commercial woods; standard A.S.T.M. strength tests; toughness; timber fastening; design of columns; simple, laminated and box beams; trusses and arches. Mr. Thomas

FOR 444 Introduction to Quality Control **3 (2-3) s**
Prerequisite: ST 361
A study of methods used to control quality of manufactured wood products. Control charts for variable and attributes. Acceptance sampling techniques. Mr. Barefoot

FOR 461 Paper Converting **1 (1-0)**
A survey of the principal processes by which paper and paper board are fabricated into th utilitarian products of everyday use. Mr. Land

FOR 462 Artificial Forestation **2 (1-3)**
Production collection, extraction, and storage of forest tree seeds; nursery practice; fiel methods of planting. Mr. Ma

FOR 463 Plant Inspections **1 (0-3)**
One week inspection trips covering representative manufactures of pulp and paper an paper making equipment. Sta

FOR 471 Pulping Process Analysis **4 (1-9)**
Preparation and evaluation of the several types of wood pulp. The influence of the varior pulping and bleaching variables on pulp quality and studied experimentally and these da evaluated critically. Mr. Hitchin

FOR 481 Pulping Processes and Products **2 (2-0)**
Prerequisites: FOR 202, CH 203 or 221
Fiber manufacturing process and equipment; wall, insulation and container board product manufacture of roofing felts; pulp products manufacturing; resin treated and specialty pro ucts, lignin and wood sugar products. Mr. Land

FOR 482 Pulp and Paper Mill Management **2 (2-0)**
A survey of the economics of the pulp and paper industry is followed by a study of th work of the several departments of a paper mill organization and the functions of the exec tives who administer them. Mr. Coo

FOR 491 Senior Problems **Credits arrange**
Problems selected with faculty approval in the areas of management or technology. Sta

FOR 492 Senior Problems **Credits arrange**
Problems selected with faculty approval in the areas of management or technology. Sta

Courses for Graduates and Advanced Undergraduates

FOR 501 Forest Valuation **3 (2-2)**
Prerequisite: FOR 372
The theory and techniques of valuation of forest land, timber stands, and forest practic as investments and for appraisals of damage. Risks and hazards in forestry as they app to forest investments, forest insurance, and forest taxation. Mr. Brya

FOR 511 Silviculture **3 (3-0)**
Prerequisites: FOR 361, BO 421
The principle and application of intermediate and reproductive methods of cutting; co trolled burning, silvicides and other methods of hardwood control. The application of silv cultural methods in the forests of the United States. Mr. Mill

FOR 512 Forest Economics **3 (3-0)**
Prerequisites: FOR 372, EC 201
Economics and social value of forests; supply of, and demands for forest products; lat use; forestry as a private and a public enterprise; economics of the forest industries. Mr. Lamr

FOR 513 Tropical Woods **2 (1-3)**
Prerequisites: FOR 203, 301
Structure, identification, properties, characteristics and use of tropical woods, especially tho used in plywood and furniture. Mr. Barefo

:OR 521, 522 Chemistry of Wood and Wood Products **3 (2-3) f s**
'rerequisites: FOR 202, CH 215, 426, PY 212
undamental chemistry and physics of wood and wood components; pulping principles; electri-
al and thermal properties. Mr. Stamm

:OR 531 Forest Management **3 (2-3) f**
'rerequisite: FOR 372; Corequisite: FOR 511
Management of timber lands for economic returns; the normal forest taken as the ideal; the
pplication of regulation methods to the forest. Mr. Bryant

:OR 532 Forest Management **3 (3-0) s**
Continuation of FOR 531

OR 533 Advanced Wood Structure and Identification **2 (1-3) f**
rerequisite: FOR 202
dvanced microscopic identification of the commercial woods of the United States and some
opical woods; microscopic anatomical features and laboratory techniques.
Mr. Barefoot

OR 553 Forest Photogrammetry **2 (1-3) s**
rerequisites: FOR 372, 531
nterpretation of aerial photographs, determination of density of timber stands and area
apping. Mr. Bryant

OR 571 Advanced Forest Mensuration **3 (2-2) f**
rerequisites: ST 311, FOR 372
tudy of cyclical variation in growth of individual trees and stands; analysis of stand struc-
ures in even-aged versus all-age stands; general concepts of growing stock levels on yields;
valuation of growth prediction methods. Mr. Bryant

OR 572 Forest Policy **3 (3-0) f**
rerequisites: EC 201, FOR 219; Corequisite: FOR 531
nalysis of the forest policies of the United States and selected foreign countries; criteria for
eir evaluation; appraisal of current policies and alternatives. Mr. Lammi

OR 573 Methods of Research in Forestry **Credits arranged**
erequisite: Senior or graduate standing
esearch procedures, problem outlines, presentation of results; consideration of selected
udies by forest research organizations; sample plot technique.
Staff

OR 591 Forestry Problems **Credits arranged**
rerequisite: Senior or graduate standing
ssigned or selected problems in the field of silviculture, logging, lumber manufacturing, pulp
chnology, or forest management. Staff

ourses for Graduates Only

)R 601 Advanced Forest Management Problems **Credits arranged**
erequisite: Graduate standing
irected studies in forest management. Graduate Staff

)R 603 Technology of Wood Adhesives **3 (3-0) f or s**
erequisites: CH 425, 426; FOR 433
he fundamentals of adhesives as applied to wood-to-wood and wood-to-metal bonding. Tech-
ology of adhesives. Preparation and use of organic adhesives. Testing of adhesives and evalua-
n of quality of adhesives and bonded joints. Mr. Hart

FOR 604 Timber Physics **3 (3-0) f or s**
Prerequisite: FOR 441
Density, specific gravity and moisture content variation affecting physical properties; physics of drying at high and low temperatures; thermal, sound, light and electrical properties of wood. Messrs. Ellwood, Hart

FOR 605 Design and Control of Wood Processes **3 (3-0) f or s**
Prerequisite: FOR 604
Design and operational control of equipment for processing wood. Mr. Ellwood

FOR 606 Wood Process Analysis **3 (3-0) f**
Prerequisites: FOR 512, 604
Analysis of wood processes through the solution of comprehensive problems involving the physics of temperature and moisture relations. Mr. Ellwood

FOR 607 Advanced Quality Control **3 (3-0) s**
Prerequisites: FOR 606, ST 515
Advanced statistical quality control as applied to wood processing. Mr. Hart

FOR 611 Forest Genetics **3 (3-0) f or s**
Prerequisites: GN 411 and permission of instructor
Application of genetic principles to silviculture, management and pulp utilization. Emphasis is on variations in wild populations, on the bases for selection of desirable qualities and on fundamentals of controlled breeding. Mr. Zobel

FOR 621 Advanced Wood Technology Problems **Credits arranged**
Prerequisite: Graduate standing
Specific forestry problems that will furnish material for a thesis. Graduate Staff

FOR 671 Problems in Research **Credits arranged**
Prerequisite: Graduate standing
Specific forestry problems that will furnish material for a thesis. Graduate Staff

FOR 681 Graduate Seminar **1 (1-0) f or s**
Prerequisite: Graduate standing in Forestry or closely allied fields
Presentation and discussion of progress reports on research, special problems and outstanding publications in forestry and related fields. Graduate Staff

Genetics

Courses for Undergraduates

GN 301 Genetics in Human Affairs **3 (3-0) f s**
Fundamental principles of genetics will be presented at a level not requiring prerequisite courses in biological sciences but sufficient for an understanding of the relation of genetics to society and technology. A survey will be given of current knowledge of inheritance of human traits. Mr. Bostian

Courses for Advanced Undergraduates

GN 411 The Principles of Genetics **3 (2-2)**
Prerequisites: BO 103, ZO 103
An introductory course. The physical basis of inheritance; genes as units of heredity and development; qualitative and quantitative aspects of genetic variation. Mr. Bostian

Courses for Graduates and Advanced Undergraduates

GN 503 (ANS 503) Genetic Improvement of Livestock **3 (2-3) f s**

GN 512 Genetics **4 (3-2) f**
Prerequisite: GN 411
Intended for students desiring more thorough and detailed training in fundamental genetics with some attention to physiological aspects. (Students conduct individual laboratory problems.)
Mr. Grosch

GN 513 Cytogenetics I **4 (3-2) f**
Prerequisite: GN 512 or with consent of instructor
The chromosomes as vehicles of heredity. Mitosis and meiosis as bases of genetic stability and recombination. Structural and numerical aberrations and their effect upon the breeding systems of plants and animals. Interspecific hybrids and polyploids. Lectures and laboratory.
Mr. Gerstel

GN 520 (PO 520) Poultry Breeding **3 (3-0) f**

GN 532 Biological Effects of Radiation **3 (3-0) s**
Prerequisite: ZO 103 or with consent of instructor
Qualitative and quantitative effects of radiations (other than the visible spectrum) on biological systems, to include both morphological and physiological aspects in a consideration of genetics, cytology, histology, and morphogenesis.
Mr. Grosch

GN 540 Evolution **3 (3-0) f**
Prerequisite: GN 411
The facts and theories of evolution in plants and animals. The causes and consequences of organic diversity.
(Offered in 1962-63 and alternate years)
Mr. Smith

GN 541 (CS 541, HS 541) Plant Breeding Methods
Prerequisites: GN 512. and either ST 511 or consent of instructor
Principles and methods of plant breeding.
Staff

GN 542 (CS 542 or HS 542) Plant Breeding Field Procedures **2 (0-4)**
Summer session

GN 550 Experimental Evolution **3 (3-0) s**
Prerequisites: GN 512 and either GN 513 or consent of instructor
Experimental evolution deals primarily with micro-evolutionary processes examined at the inter- and intra-specific population level. A review of the results from experimental population studies and analyses of natural populations concerning variation patterns and adaptation, natural selection, polymorphism, introgression, population breeding structure, isolating mechanism, etc., is made and interpreted in relation to Neo-Darwinian concepts of the origin of species.
(Offered in 1963-64 and alternate years.)
Mr. Mettler

Courses for Graduates Only

GN 602 (ANS 602) Population Genetics in Animal Improvement **3 (3-0) f**

GN 607 (PP 607) Genetics of Fungi **3 (3-0) f**
Prerequisite: GN 513 or graduate standing in Botany and Zoology
Review of major contributions in fungus genetics with emphasis on principles and theories that have evolved in recent developments.
(Offered in 1962-63 and alternate years.)
Mr. Nelson

GN 611 (FOR 611) Forest Genetics **3 (3-0) f s**

GN 614 Cytogenetics II **3 (0-6)**
Prerequisite: GN 513 or consent of instructor
Laboratory and discussion. The cytogenetic analysis of natural and experimental materi plant and animal. Assigned exercises and student projects. The course provides the stude with a working knowledge of cytogenetic procedure.
(Offered in 1963-64 and alternate years.) Mr. Smi

GN 626 (ST 626) Statistical Concepts in Genetics **3 (3-0)**

GN 631 Mathematical Genetics **3 (3-0)**
Prerequisites: GN 512 and ST 511 or consent of instructor
History of mathematical biology, role of mathematical concepts in the development of gene science, theory of genetic recombination, dynamics of genetic population.
(Offered in 1963-64 and alternate years.) Mr. Kojir

GN 633 Physiological Genetics **3 (3-0)**
Prerequisite: GN 512
Recent advances in physiological genetics. Attention will be directed to literature on t nature and action of genes, and to the interaction of heredity and environoment in the expr sion of the characteristics of organisms. Mr. Gros

GN 641 Colloquium in Genetics **2 (2-0) f**
Prerequisites: Graduate standing and consent of instructor
Informal group discussion of prepared topics assigned by instructor. Graduate St

GN 651 Seminar **1 (1-0) f,**
Prerequisite: Graduate standing

GN 661 Research **Arrang**
Prerequisite: Graduate standing
Original research related to the student's thesis problem. A maximum of six credits for t master's degree; by arrangement for the doctorate. Graduate St

GN 671 Special Problems in Genetics **1 to 3**
Prerequisites: Advanced graduate standing and consent of instructor
Special topics designed for additional experience and research training. Graduate St

Geological Engineering

Courses for Undergraduates

MIG 101 Earth Science **3 (3-0**
Elective. Not to be taken after MIG 120
Introductory course in General Geology; changes in the earth, and underlying physical life processes.

MIG 120 Physical Geology **3 (2-3)**
Dynamic processes acting on and within the earth; materials and makeup of the ear crust; emphasis on engineering and agricultural applications in the southeast. Lectures, labo tories and field trips.

MIG 220 Physical-Historical Geology **4 (3-3**
Prerequisite: CH 101
A broad introductory survey of earth materials, processes, and history. Common mine and rocks. Effect of solar, gravitational, chemical, and internal thermal energy in transfo ing crustal constitution, structure, position, and surface form. Measurement and subdivi of geologic time. The time scale. Geosynclinal and tectonic cycles. Typical major geol events in North America. Evolution of the main fossil groups.

3 222 Historical Geology **3 (2-3) f**
requisite: MIG 120
ronologic account of the geological events during the development of the earth's crust, inly in North America. Evolution and environmental significance of the principal fossil mal and plant groups.

3 323 Paleontology **3 (2-3) f**
requisite: MIG 220 or 222
dy of fossil life forms, with major emphasis on classification and structure of the inverte-te animals and their application to problems of correlation of strata. Lectures, laboratories l field trips.

3 331 Crystallography and Optical Microscopy **4 (2-4) f**
requisites: CH 103 and PY 202
e crystalline state, elements of morphologic crystallography, space lattice structure, and tal chemistry. Crystal symmetry, systems, classes, and common forms. Atomic and ionic king, coordination number, polymorphism, isomorphism, twinning, zoning, exsolution and lacement effects. Techniques and underlying optical theory for identifying minerals with polarizing microscope. Determination of index of refraction and birefringence; isotropic, axial, or biaxial character; optic angle, sign, and orientation. Adjunct apparatus for statis-l and petrographic studies.

3 351 Tectonic Structures **3 (2-3) f**
requisite: MIG 220
olication of the principles of mechanics to an understanding of rock deformation. Analysis fracture, solid flow, and fluid flow structures imposed on igneous, sedimentary and amorphic rock masses by internal crustal forces and gravitiational movements Stress-in relations of rocks and minerals under surface conditions, and the modification of be-ior which result from pore solutions and increase of confining pressure, temperature, and e.

3 415 Mineral Exploration and Evaluation **3 (2-3)**
requisites: MIG 440, MIG 452
olication of the principles of geology, geophysics, and geochemistry to the discovery and luation of mineral deposits. Design of mineral exploration and development programs d on knowledge of the unique thermodynamic, geochemical, and tectonic features that trol mineral formation and concentrations in well known mining districts, especially those ding ferrous, base, and precious metals. Review of economic and technological factors rning the value of mineral deposits.

3 440 Endogenic Materials and Processes **4 (3-3)**
requisites: MIG 220, MIG 331
erals, rocks, and mineral deposits that are formed at high temperatures and pressures by tallization or solidification of molten magma, or by solid state recrystallization of older s. Application of principles of thermodynamics and of phase-rule chemistry, and the lts of modern high pressure-temperature laboratory research on the stability fields of talline phases, to an understanding of igneous and metamorphic rocks. Identification, sification, occurrence, origin, and economic value of the principal igneous and metamor-rocks.

3 452 Exogenic Materials and Processes **4 (3-3) f**
requisites: MIG 220, MIG 331
tification, classification, geologic occurrence, origin, and economic value of minerals, rocks, mineral deposits formed by physical, chemical, and biological processes at low tempera-s and pressures at and near the earth's surface. Hydrodynamics of sediment transport deposition, settling velocities and size sorting, chemical and biochemical precipitation n aqueous solutions. Principles of division of stratified terranes into natural units, cor-tion of strata, identification of depositional environments, and facies analysis.

3 461 Engineering Geology **3 (3-0) f**
requisite: MIG 120 or 220
application of geologic principles to engineering practice; analysis of geologic factors processes affecting specific engineering projects.

MIG 462 Geological Surveying **3 (1-6**
Prerequisites: MIG 351, MIG 440, MIG 452
Methods of field observation and use of geologic surveying instruments in surface and unde ground work; representation of geologic features by maps, sections and diagrams. Lectur laboratories and field work.

MIG 465 Geological Field Procedures **6 Summ**
Prerequisite: MIG 351 or special permission
A six week summer field course. Practical field procedures and instruments commonly us to procure geologic data for evaluating mineral deposits, solving engineering problems volving earth materials, and drawing scientific conclusions. Observation of geologic phenome in their natural setting. Large and intermediate scale geologic mapping of surface featu and large scale mapping underground in mine workings.

MIG 472 Elements of Mining Engineering **3 (2-3**
Prerequisites: MIG 220 and at least Junior standing in Geological Engineering
Introduction to mining; surface and underground methods of development and productio explosives, drilling and blasting; ore loading, transport, and hoisting; drainage and venti tion; mine surveying and sampling; fire assaying; mining law, organization, administratio and safety. Lectures, laboratory and field inspections.

MIG 481, 482 Senior Seminar **1 (1-0)**
Reports and discussion of current professional topics.

Courses for Graduates and Advanced Undergraduates

MIG 522 Petroleum Geology **3 (3-0**
Prerequisites: MIG 330, PY 202
Properties, origin and modes of occurrence of petroleum and natural gas. Geologic and e nomic features of the principal oil and gas fields, mainly in the United States.
Mr. Le

MIG 552 Exploratory Geophysics **3 (2-3**
Prerequisites: MIG 351, PY 202
Fundamental principles underlying all geophysical methods; procedure and instruments i volved in gravitational, magnetic, seismic, electrical, and other methods of studying geolo cal structures and conditions. Spontaneous potential, resistivity, radioactivity, temperatu and other geophysical logging methods. Study of applications and interpretations of resu
Mr. Le

MIG 571, 572 Mining and Mineral Dressing **3 (2-3)**
Prerequisite: MIG 472
Principles of the mineral industry; mining laws, prospecting, sampling, development, drilli blasting, handling, ventilation and safety; administration; surveying, assaying; preparati beneficiation and marketing. S

MIG 581 Geomorphology **3 (2-3**
Prerequisite: MIG 452
A systematic study of land forms and their relations to processes, stages of development, adjustment to underlying structure. Lectures, map interpretations, and field trips.
Mr. Bro

Courses for Graduates Only

MIG 611, 612 Advanced Economic Geology **3 (3-0)**
Prerequisites: MIG 440 and 452
Detailed study of the origin and occurrence of specific mineral deposits. Regional correlatio
Graduate S

3 632 Microscopic Determination of Opaque Minerals **3 (0-6) s**
requisite: MIG 331
ntification of metallic, opaque minerals in polished sections by physical properties, etch
ctions and microchemical tests. Laboratories. Mr. Brown

3 642 Advanced Petrography **3 (1-4) s**
requisites: MIG 331 and 440
plication of the petrographic microscope to the systematic study of the composition and
gin of rocks; emphasis on igneous and metamorphic rocks. Mr. Parker

3 681, 682 Seminar **1 (1-0) f s**
requisite: Graduate standing
ntific articles, progress reports and special problems of interest to geologists and geologi-
engineers discussed. Graduate Staff

3 691 Geological Research **3 or 6**
requisite: Permission of the instructor
tures, reading assignments, and reports; special work in Geology to meet the needs and
erests of the students. Thesis problems. Graduate Staff

History and Political Science

urses in History for Undergraduates

201 The Ancient World **2 (2-0) f**
istory of ancient times from the rise of civilization in Egypt and Babylonia to the decline
Rome in the fifth century. Emphasis is placed upon the evolution of cultures and civili-
ons, and upon the development of art, science, literature, and philosophy.

202 The Medieval World **2 (2-0) s**
: political, economic, social and cultural developments from the decline of the Roman
pire in the West to the emergence of the modern period.

205 The Modern Western World **3 (3-0) f s**
istory of major movements in the Western World from the Renaissance to the present.

225, 226 Modern Europe **3 (3-0) f s**
tudy of political, economic, social, intellectual, and international movements in Europe
n the end of the Middle Ages to the present, with an introduction covering the medieval
od. The course divides at 1789. The semesters may be taken separately.

245, 246 History of European Civilization **3 (3-0) f s**
istory of European civilization from the Golden Age of Greece to the present. Those social,
tical, and economic currents most influential in the formation of modern society are
rwoven through the principal periods of cultural expression.

251 The United States Through Reconstruction **3 (3-0) f**
udy of major historical developments in the growth of the American nation through the
tical phases of the Reconstruction period following the Civil War.

252 The United States Since Reconstruction **3 (3-0) f s**
udy of major historical developments in the growth of the American nation beginning with
nomic and social phases of the Reconstruction period following the Civil War.

261 The United States in Western Civilization **3 (3-0) f s**
analysis of major developments in American history, with American history considered as
of the historical development of modern western civilization.

HI 301, 302 American Economic History **3 (3-0)**
A history of economic institutions and customs in the United States from the time of transfer to the New World of European economic customs to the present. The course divides 1860. The semesters may be taken separately.

HI 306 North Carolina History **2 (2-(**
The political, social and economic developments of North Carolina from colonial beginnings the present.

HI 321 International Relations Since 1870 **3 (3-(**
Prerequisite: HI 205 or an acceptable substitute
A study of the relations between the major countries of the world since 1870. In addition to history of actual diplomatic relations, crises and settlements, attention is given to the ca of the various international crises. The course also includes study of the development of inte tional organizations and the various points of conflict between international law and organ tion and the sovereignty of independent governments.

HI 351 British History **3 (3-0)**
A study of the political, social, economic, and cultural past of the British Isles from Ro times to the present. Emphasis is placed on the position of Britain in Europe, her colo expansion, and on the connection between British and early American history.

HI 375 Latin America **3 (3-(**
Prerequisite: HI 205 or HI 252 or an acceptable substitute.
A study of the main currents of Latin American development from 1492 to the present The histories of leading countries including Brazil, Argentina, Colombia, Peru, and Mexico be emphasized to show political, economic, and social trends as experienced during the conq colonization and independence, and, especially, the national period since 1830.

HI 401 Russian History **3 (3-**
This course presents the major trends in Russian social, political, economic, and cultural tory, with emphasis on the nineteenth and twentieth centuries. USSR policy is studied in lation to the full sweep of Russian history.

HI 402 Asia and the West **3 (3-**
A history of Asia from the mid nineteenth century to the present, with emphasis on A nationalism and conflict with the imperial powers.

HI 409 Colonial America **2 (2-**
A study of the development of the American colonies in the seventeenth and eighteenth turies, with special emphasis on European backgrounds.

HI 411 The American Revolution and the Confederation **3 (3-**
The historical steps in the establishment of the United States as an independent nation. conflict with Great Britain after 1763 leading to the declaring of independence; the mil and diplomatic aspects of the war for American independence; the peace negotiations the peace settlement of 1783; the domestic problems and foreign relations in the imme post-war years; the establishment of government in the new nation terminating with adoption of the Constitution of 1787.

HI 412 Recent United States History **3 (3-0)**
A study of the main currents in American political, economic, social, and diplomatic histo the twentieth century.

HI 422 History of Science **3 (3-**
A study of the evolution of science from antiquity to the present with particular attention to the impact of the scientific thought upon selected aspects of western civilization. course provides a broad perspective of scientific progress and shows the interrelationshi science and major historical developments.

433 American Agricultural History **3 (3-0) f**
storical developments of agricultural activity in the United States from the transfer of stern European agriculture to America to the present, with particular emphasis on the torical place and importance of agriculture in American life.

461 The Soviet Union (Same as EC, PS 461) **3 (3-0) f**
erequisites: One semester of Economics and PS 201 or HI 205 or acceptable substitute
. analysis of the structure and function of the major Soviet economic, political and social titutions with special stress on the historical roots and continuity of Russian civilization. e course is presented in three equal phases of approximately five weeks each, covering ssian history, Soviet government, and Soviet economy.

ourses for Graduates and Advanced Undergraduates

534 (Same as RS 534) Farmers' Movements **3 (3-0) s**
erequisite: Three credits in American history, American government, sociology or a related social science
history of agricultural organizations and movements in the United States and Canada prinally since 1865, emphasizing the Grange, the Farmers' Alliance, the Populist revolt, the Far's Union, the Farm Bureau, the Equity societies, the Nonpartisan League, cooperative maring, government programs and present problems. Mr. Noblin

ourses in Political Science for Undergraduates

201 The American Governmental System **3 (3-0) f s**
study of the American federal system, integrating national and state government, with emasis on constitutional principles, major governmental organs, governmental functions, and politics and machinery of elections. Some attention is given to other types of political tems, and comparisons are made where relevant throughout the course.

202 County and Municipal Government **3 (3-0) f s**
survey of the organization and functions of the diverse rural and urban governments in United States, emphasizing current problems and attempts to solve them.

301 Comparative Political Systems **3 (3-0) f**
analytical study of the federal and unitary systems and the presidential, parliamentary, l authoritarian plans of government, with special attention to the governments of the ited Kingdom, France, Germany, Italy, and the Soviet Union.

322 Contemporary World Politics **3 (3-0) f s**
study of the pattern of international life, the instruments of national policy, the controls on international behavior, and the major problems in international relations since World r II, including the development of the United Nations and various regional arrangements. ention is given to the national interests and foreign policies of the states belonging to the stern and Soviet blocs, with emphasis on the position of the United States.

376 Latin American Government and Politics **3 (3-0) s**
analysis of Latin American governmental structures, political parties and ideologies, with phasis on the period since 1910 in Mexico, Cuba, Bolivia, Chile, Argentina, Brazil, Peru, l Venezuela. Agrarian reform, social revolution, nationalism, and relations with the United tes will be stressed within the Latin American political context.

401 American Parties and Pressure Groups **3 (3-0) f s**
er a brief survey of those features of American government essential to an understanding the political process, the course proceeds to examine the American electorate and public nion and devotes its major attention to the nature, organization, and programs of pressure ups and political parties and to their efforts to direct opinion, gain control of government, l shape public policy. Special attention is given to party organization and pressure group ivity at the governmental level and to recent proposals to improve the political party as an trument of responsible government.

PS 406 Problems in State Government 3 (3-0
Prerequisite: PS 201 or an acceptable substitute.
Selected problems arising from the operation of legislative, administrative, and judi machinery. In addition to acquiring a comprehensive view of these problems each student make an intensive study of a special phase of one of them. Special attention will be given North Carolina.

PS 431 International Organization 3 (3-
Prerequisite: PS 201 or HI 205 or an acceptable substitute
A study of the evolving machinery and techniques of international organization in the pres century with particular emphasis on recent developments. The actual operation of internatio organization will be illustrated by the study of selected current international problems.

PS 452 The Legislative Process 3 (3-
A study of the formulation of public policy from the institutional and behavioral viewpoi Important current legislative problems at the congressional and state legislative levels will selected and will serve as a basis for analyzing the legislative process.

PS 461 (Same as EC, HI 461) The Soviet Union 3 (3-

Courses for Graduates and Advanced Undergraduates

PS 501 Modern Political Theory 3 (3-
Prerequisite: PS 201 or HI 205 or an acceptable substitute.
A study of the state and its relationship to individuals and groups, approached through reading of selected passages from the works of outstanding philosophers from the sixtee century to the present. Mr. Holtzm

PS 502 Public Administration 3 (3-0)
Prerequisite: PS 201 or PS 202 or an acceptable substitute
A study of the principles and problems of administration in a democracy, including such m ters as organization, personnel, fiscal management, relationship to the legislative and jud functions, control of administrative agencies and policies and public relations.
Mr. B

PS 510 (Same as EC 510) Public Finance 3 (3-0)
Prerequisite: EC 201 or EC 205
A survey of the theories and practices of governmental taxing, spending, and borrowing, cluding intergovernmental relationships and administrative practices and problems.
Mr. B

PS 512 American Constitutional Theory 3 (3-0)
Prerequisite: PS 201 or an acceptable substitute
Basic constitutional doctrines, including fundamental law, judicial review, individual rights political privileges, and national and state power. Special attention is given to the applica of these doctrines to the regulation of business, agriculture, and labor and to the rights guarded by the First, Fifth, and Fourteenth Amendments to the Constitution.
Mr. E

PS 610 Applied Principles of Public Administration 2-4 by arrangeme
Prerequisite: PS 502 or an acceptable substitute.
An advanced course in administrative principles and methods. Students will perform indivi or group research, under supervision, in specific administrative topics within the con of those public agencies which function in their respective fields of technology. Mr. B

PS 620 Problems in Political Science 2-4 by arrangeme
Prerequisite: Advanced graduate standing
An independent advanced research course in selected problems of government and pol The problems will be chosen in accordance with the needs and desires of the students r tered for the course. Graduate

Horticultural Science

urses for Undergraduates

201 Principles of Horticulture **3 (3-0) f s**
ention will be directed to the basic principles involved in the application of these principles he production, processing and utilization of fruit, vegetable, and ornamental corps. Atten- will also be given to the economic importance and distribution of horticultural enterprises.
Mr. Gardner

211, 212 Ornamental Plants **3 (1-5) f s**
requisite: BO 103
ribution, botanical characters and relationships, adaptation and usage of ornamental trees, bs, vines, and herbaceous plants. Mr. Randall

301 Plant Propagation **3 (2-2) s**
requisite: BO 103
tudy of principles, methods, and practices in seedage, cuttage, division, budding, grafting, other methods of propagation. Consideration will also be given to scion and stock relation s and dormancy. Mr. Randall

342 Landscape Gardening **3 (2-3) f**
application of the principles of design to the landscaping of small properties and the select- and planting of trees, shrubs, flowers, and lawn grasses. Students will be required to work detailed landscape plans. Visitations will be made to outstanding homes and gardens.
Mr. Randall

411 Nursery Management **3 (2-3) f**
requisites: BO 103 and SSC 200
principles and practices involved in the production, management, and marketing of field- wn and container-grown nursery plants. Field trips will be taken.
Messrs. Cannon, Randall

421 Fruit Production **3 (2-3) f**
requisites: BO 103 and SSC 200
tudy of identification, adaptation, and methods of production and marketing of the ncipal tree and small fruits. Modern practices as related to selection of sites, nutritional re- rements, management practices, and marketing procedures will be discussed. Mr. Correll

432 Vegetable Production **3 (2-3) s**
requisites: BO 103 and SSC 200
tudy of the origin, importance, distribution, botanical relationships, and principles of duction and marketing of the major vegetable crops. Mr. Miller

441 Floriculture I **3 (2-3) f**
requisites: BO 103 and SSC 200
scope and importance of the commercial flower industry; the basic principles and prac- s involved in the production and marketing of flowers grown in the greenhouse and in field. Mr. Randall

442 Floriculture II **3 (2-3) s**
requisites: BO 103 and SSC 200
nciples and methods of production of commercial flower crops in the greenhouse and in field, including fertilization, moisture, temperature, and light relationships, insect and ase control, and marketing of cut flowers and pot plants. Mr. Randall

471 Arboriculture **3 (2-3) s**
requisites: BO 103 and SSC 200
tudy of the principles and practices in the care and maintenance of ornamental trees and bs, such as pruning, fertilization, control of insects and diseases, and tree surgery. Field s will be taken. Mr. Cannon

HS 481 Breeding of Horticultural Plants **3 (2-2)**
Prerequisite: GN 411
The application of genetic and other biological sciences to the improvement of horticultur crops. Messrs. Galletta, Henderso

Courses for Graduates and Advanced Undergraduates

HS 501 Research Principles **Credits by arrangeme**
Prerequisite: Permission of instructor
Investigation of a problem in horticulture under the direction of the instructor. The studen obtain practice in experimental techniques and procedures, critical review of literature an scientific writing. The problem may last one or two semesters. Credits will be determined b the nature of the problem, not to exceed a total of 4 hours. Graduate Sta

HS 541 (GN 541 or CS 541) Plant Breeding Methods **3 (3-0)**
Prerequisite: GN 512; Recommended: ST 511
An advanced study of methods of plant breeding as related to principles and concepts inheritance. Messrs. Haynes, Timotl

HS 542 (GN 542 or CS 542) Plant Breeding Field Procedures **2 (0-4)**
Prerequisite: HS 541 or CS 541 or GN 541 **In summer sessio**
Laboratory and field study of the application of various plant breeding techniques ar methods used in the improvement of economic plants. Messrs. Harvey, Hayn

HS 552 Growth of Horticultural Plants **3 (2-3)**
Prerequisite: BO 421
A study of the effect of nutrient-elements, water, light, temperature and growth substances horticultural plants. Mr. Schram

HS 562 Post-Harvest Physiology **3 (3-0)**
Prerequisite: BO 421
A study of chemical and physiological changes that occur during handling, transportation, a storage which affect the quality of horticultural crops. Consideration will be given to pre- a post harvest conditions which influence these changes. Messrs. McCombs, Balling

HS 581 Senior Seminar **1 (1-0) f**
Prerequisite: Senior standing in Horticulture
Presentation of scientific articles, progress reports in research, and special problems in hor culture and related fields. Mr. Gardn

Courses for Graduates Only

HS 621 Methods and Evaluation of Horticultural Research **3 (3-0)**
Prerequisite: Graduate standing
Principles and methods of research in the field of horticulture and their application to t solution of current problems. Critical study and evaluation of scientific publications. Co pilation, organization, and presentation of data. Mr. Cochr

HS 641 Research **Credits by arrangeme**
Prerequisites: Graduate standing in Horticulture, consent of chairman
Original research on specific problems in fruit, vegetable, and ornamental crops. Thesis p pared should be worthy of publication. A maximum of 6 credits is allowed toward the M ter of Science degree; no limitation on credits in doctorate program. Graduate St

HS 651 Seminar **1 (1-0) f**
Prerequisite: Graduate standing
Presentation of scientific articles and special lectures. Students will be required to present o or more papers. Attendance of all graduate students is required. Graduate St

Industrial Arts

(See Education)

Industrial Education

(See Education)

Industrial Engineering

Courses for Undergraduates

E 201 Industrial Engineering I 3 (3-0) f s
rerequisite: Sophomore standing
.n intensive and integrated study of the factory as a producing unit. History of manufacturing; rganization structure; analysis of products; establishment and evaluation of processes; motion udy; plant layout; production planning, scheduling, and control. Course will include solution f case problems and plant visits.

E 202 Industrial Engineering II 3 (2-3) f s
rerequisite: IE 201
ontinuation of IE 201

E 217 Machine Tools 1 (0-2) f s
rerequisite: Sophomore standing
ne session two hours each week consisting of lecture, demonstrations, and student projects. imensional control, press forming, power cutting of metals including turning, milling, shapng and finishing. Selection and use of cutting tools, speeds, and feeds.

E 218 Metal Forming 1 (0-2) f s
rerequisite: Sophomore standing
ne session two hours each week consisting of lecture, demonstrations, and outside assignments. urvey of metals, pattern making, foundry practice, die and permanent mold casting, forging, as cutting, gas and arc welding.

E 224 Wood Working Equipment 3 (3-0) s
lasswork covers the description of cutting, sanding and assembly equipment, and an explanaon of the type of operation done by each kind of equipment. The theory of cutting and anding and cutterhead and saw design are covered.

E 241 Welding Laboratory 1 (0-3) f s
rerequisite: IE 218 or permission of instructor
. study of mechanization as applied to oxygen cutting, to the various types of shielded metal rcs and to gas welding. Jigs, fixtures, and positioners. Selection of welding process. Joint degn and welding costs. Welds and stress distribution.

E 269 Welding and Pipe Shopwork 1 (0-3) f s
undamentals of welding, both arc and gas, cutting equipment; safety in the use of equipment; pplication of low temperature and non-ferrous alloys; cutting, threading, reaming, and erecon of iron pipe; copper tubes and fittings in heating and air conditioning work.

E 301 Engineering Economy 3 (3-0) s
rerequisite: Junior standing
riteria and techniques of engineering economy for management decisions in relation to conomy of design, economy of selection, and economy of operation. Study of effects of dereciation policies and machine replacement considerations. Emphasis on problem solving nd development of detailed project economy studies.

IE 303 Industrial Engineering III **4 (3-3) f**
Prerequisite or corequisite: IE 202
An intensive and integrated course in methods of obtaining maximum effectiveness from the human resources used in the factory; principles of personnel administration, time study and rate setting, job evaluation and wage incentives, principles of control of labor and other costs

IE 304 Industrial Engineering IV **4 (3-3) s**
Prerequisite: IE 303
Continuation of IE 303

IE 310 Industrial Safety **2 (2-0) f s**
A course in the causes and prevention of industrial accidents.

IE 322 Furniture Design and Construction **2 (0-6)**
An introduction to furniture drawing and construction. Detailed drawings and bills of material are made by the students from samples and from designers sketches. In construction emphasis is placed upon satisfactory performance under variable atmospheric moisture, upon adequate strength and rigidity and upon low cost.

IE 326 Furniture Manufacture and Processing **4 (3-3)**
Prerequisite: IE 322; Corequisites: IE 332 or IE 202, FOR 203
A study of the production methods of the Furniture Industry. Class work includes the production procedures from the yard through the machine, cabinet, finishing, upholstering, and shipping departments. The laboratory period is supplemented by visits to furniture plants. Particular attention is paid to production rates by departments, based on number of men and supervisors, the quality of product produced, and equipment used.

IE 327 Furniture Marketing **2 (2-0)**
Study of basic factors bearing on selection of ideal location, equipment, and organization to serve a specific market with a specific factory. In addition to lectures, each student will select one project for which he will work out a solution for correlating product and market.

IE 328 Manufacturing Processes **3 (2-3)**
Prerequisites: IE 217, IE 218
The basic processes of conversion of raw materials into producer and consumer goods. The cost reduction aspects of machine tools, jigs, and fixtures in volume productions. Study of industrial trends to meet needs of an expanding economy. Selected problems illustrating a wide variety of manufacturing situations.

IE 332 Motion and Time Study **4 (3-3) f**
Prerequisite: Junior standing; Corequisite: EC 425
Principles and techniques of motion and time study, detailed study of charting operator movements; micromotion study. Predetermined time data and its applications; stopwatch time study with emphasis on rating, allowances and standard data theory and practice.

IE 334 Motion and Time Study **3 (0-3)**
A course designed for non-industrial engineering students. Principles and techniques of motion and time study. Types and uses of predetermined time systems; stopwatch time study, principles and methods of rating, application of allowances and standard data.

IE 341 Furniture Plant Layout and Design **3 (2-3)**
Prerequisite: IE 326
Problems in industrial plant design with special reference to furniture manufacture; building structures, equipment location, space utilization, layout for operation and control; allied topics in power utilization, light, heat, ventilation, and safety. Laboratory period.

IE 343 Plant Layout and Materials Handling **4 (3-3)**
Prerequisites: IE 328, IE 332
Problems in plant arrangement and layout to obtain most effective utilization of men, material and machines as related to space and costs. Includes consideration of heat, light, ventilation, organization, control, material flow and handling, working conditions, safety, and other factors as they affect the most satisfactory layout of the plant.

IE 346 Furniture Design and Construction **2 (2-0) f**
Prerequisite: IE 322
Lecture and laboratory work on the design and construction of modern and period furniture. The course emphasizes construction features that are economical of labor and materials and are adaptable to mass production. The course covers the use of new engineering materials and their effect on furniture construction.

IE 350 Mechanisms and Machine Design **3 (2-3) s**
Prerequisites: IE 217, IE 218; Corequisite: EM 343
Fundamental principles of stress, strain, deflection of beams, combined stresses and strains, shafts, spring, gears, linkages, and cams, with emphasis on applications to jig and fixtures design and special tooling.

IE 401 Industrial Engineering Analysis **3 (3-0) f**
Prerequisites: IE 304, MA 301, MA 405, ST 362
An introductory course in some of the more recently developed operations research techniques; applications of analysis of variance, multiple correlation and other statistical methods, queueing theory, linear programming; graphical methods of solutions; information theory and servomechanisms in Industrial Engineering. A balance will be sought between theory and practical applications.

IE 402 Industrial Engineering Analysis **3 (3-0) s**
Prerequisite: IE 401
Continuation of IE 401

IE 404 Introduction to Tool Engineering **3 (2-3) s**
Prerequisites: IE 217, IE 218, EM 343
The development of effective production process design through a study of theory and characteristics of material removal and forming processes; with emphasis on quality requirements of the product, operations study, and the economics of tooling.

IE 408 Production Control **3 (2-3) f**
Prerequisite: Senior standing
Planning, scheduling, and dispatching of production in manufacturing operations; conversion of sales requirements into production orders; construction of production budgets and their relation to labor, materials and machines; laboratory project involving the development and operation of the production control system of a typical plant.

IE 420 Manufacturing Controls **3 (3-0) f**
Prerequisite: IE 301
Theory and methodology for developing and maintaining profitable manufacturing operations. Development of principles and procedures for control of materials, manpower, and costs. Special attention to production and inventory control, equipment utilization, wage classification and cost reduction programs.

IE 425 Sales and Distribution Methods **2 (2-0) s**
An analysis of the distribution of industrial and consumer products; the effect of increased productivity on sales and distribution channels; development and marketing of new products, merchandising and packaging. Sales training and sales engineering programs.

IE 430 Job Evaluation and Wage Administration **3 (2-3) s**
Prerequisite: Senior standing
Job analysis, classification and specification. Grading, ranking, factor comparsion and point systems of job evaluation in determining equitable rates for job content. Wage surveys and merit rating. Utilization of time standards in design, installation, and operation of financial incentive plans. Comparison of various wage and salary plans. Effect of wage payment methods on industrial relations practices.

IE 443 Quality Control **3 (2-2) f**
Prerequisite: ST 361
Economic balance between cost of quality and value of quality, and techniques for accomplishing this balance. Organization for, specification and utilization of quality controls. Statistical theory and analyses as applied to sampling, control charts, tolerance determination, acceptance procedures and control of production.

IE 451, 452 Seminar **1 (1-0) f s**
A weekly meeting of senior students to assist the transition from a college environment to that of industry. Lectures, problems, presentation of papers, and outside speakers. Employment practices and procedures useful in job finding.

Courses for Graduates and Advanced Undergraduates

IE 515 Process Engineering **3 (3-0) f**
Prerequisites: IE 401, IE 443
The technical process of translating product design into a manufacturing program. The application of industrial engineering in the layout, tooling, methods, standards, costs, and control functions of manufacturing. Laboratory problems covering producer and consumer products.

IE 517 Automatic Processes **3(3-0) f**
Prerequisites: IE 401, IE 443
Principles and methods for automatic processing. The design of product, process, and controls. Economic, physical, and sociological effects of automation.

IE 521 Control Systems and Data Processing **3 (3-0) f**
Prerequisite: IE 401
This course is designed to train the student in the problems and techniques required for systematic control of the production process and the business enterprise. This includes training in the determination of control factors, the collection and recording of data, and the processing evaluation, and use of data. The course will illustrate the applications and use of data processing equipment and information machines in industrial processes. Case problems will be used extensively.

IE 531 Quantitative Job Evaluation Methods **3 (3-0-**
Prerequisite: IE 401
A study of statistical and mathematical methods of testing and designing job evaluation plans. Ranking, contingency, and analysis of variance methods of testing plans and rating performance. Multiple regression and linear programming methods of designing plans.

IE 543 Standard Data **3 (3-0)**
Prerequisites: ST 361 or ST 515, one course in motion and time study
Theory and practice in developing standard data from stopwatch observations and predetermined time data; methods of calculating standards from data; application of standard data in cost control, production planning and scheduling, and wage incentives.

IE 546 Advanced Quality Control **3 (3-0)**
Prerequisite: IE 304 or ST 362
The statistical foundation of Quality Control are emphasized in this course as well as its economic implications. Mathematical derivation of most of the formulas used are given. Sampling techniques are treated extensively and many applications of this powerful technique are explained.

IE 551 Standard Costs for Manufacturing **3 (3-0)**
Prerequisites: One course in accounting and one course in motion and time study
The development, application and use of standard costs as a management tool; use of industrial engineering techniques in establishing standard costs for labor, material, and overhead. Analysis of variances and setting of budgets. Measures of management performance.

581 Project Work **2 to 6 f s**
vestigation and report on an assigned problem for students enrolled in the fifth year curculum in Industrial Engineering.

ourses for Graduates Only

621 Inventory Control Methods **3 (3-0) f s**
erequisites: IE 402, IE 521, MA 511
study of inventory policy with respect to reorder sizes, minimum points, and production hedules. Simple inventory models with restrictions, price breaks, price changes, analysis of ow-moving inventories. Introduction to the smoothing problem in continuous manufacturing. pplications of linear and dynamic programming and zero-sum game theory.

651 Special Studies Industrial Engineering **Credits by arrangement**
erequisite: Graduate standing
he purpose of this course is to allow individual students or small groups of students to take studies of special areas in Industrial Engineering which fit into their particular program d which may not be covered by existing industrial engineering graduate level courses. The rk would be directed by a qualified staff member who has particular interest in the area vered by the problem. Such problems may require individual research and initiative in the plication of industrial engineering training to new areas or fields.

671 Seminar **1-1**
minar discussion of industrial engineering problems for graduate students. Case analyses d reports.

691 Industrial Engineering Research **Credits by arrangement**
raduate research in Industrial Engineering for thesis credit.

International Student Orientation

0 100 Introduction to the United States **1 credit f**
equired of all International students.

Landscape Architecture

ourses for Undergraduates

A 301, 302 Landscape Design I, II **5 (3-9) f s**
erequisite: ARC 202
equired of third year students in Landscape Architecture
he landscape survey, investigation, and analysis. Use of first and second year design principles specific landscape architecture problems. Covers the small scale design section in the complete third, fourth, and fifth year landscape cycle. Messrs. Moore, Thurlow

A 311, 312 Landscape Construction I, II **4 (2-6) f s**
equired of third year students in Landscape Architecture
he physical elements of landscape design, particularly earthwork, grading, quantities, conruction, horizontal and vertical alignment of roads, and principles of statics. Lecture and boratory work dealing with landscape structural analysis and materials, surface drainage d run off, under drainage; external lighting, water supply, waste, sanitation treatment, and re protection. Mr. Clarke

LA 401, 402 Landscape Design III, IV **6 (3-9) f, s**
Prerequisite: LA 302
Required of students in Landscape Architecture
Regional survey investigation and analysis. Site planning and environmental design. Covers the medium scale design section in the complete third, fourth, and fifth year design cycle. (Correlation with LA Construction and LA Planting Design courses.)
Messrs. Moore, Thurlow

LA 421, 422 Planting Design **4 (2-6) f, s**
Prerequisites: HS 212, LA 302, LA 312
Required of students in Landscape Architecture
The appraisal of plants as objects and their orderly arrangement for landscape effect. Techniques for recording design, specifications, and cost estimates. (Correlation with Landscape Design and Landscape Construction courses.) Mr. Moore

LA 501, 502 Landscape Design V, VI **6,8 (4-8) f, s**
Prerequisite: LA 402
Required of fifth year students in Landscape Architecture
Large scale landscape design and ecological planning, analysis, and investigation. At least one research or thesis project. Messrs. Moore, Thurlow

LA 511 Landscape Construction III **4 (2-6)**
Prerequisite: LA 312
Required of fifth year students in Landscape Architecture
Landscape structures, materials, and construction from LA 312. Office practice, procedures, ethics, and law; contracts, specifications, and bidding. Mr. Thurlow

Mathematics

Courses for Undergraduates

MA 101 Algebra and Trigonometry **5 (4-2) f**
Algebraic properties of real numbers; algebra of sets, mappings, functions and graphs. Properties of the complex number field. Applications to systems of equations both linear and quadratic. Other topics in algebra including inequalities, variation, binomial theorem, progressions, theory of equations and determinants. Trigonometric functions of a general angle, identities and multiple angle relations, inverse trigonometric functions, graphs, solution of triangles by logarithms and slide rule with emphasis on the laws of sines and cosines.

MA 102 Analytic Geometry and Calculus I **4 (3-2) f**
Prerequisite: MA 101
Required of freshmen in the Schools of Engineering and Physical Sciences and Applied Mathematics. The first of three semesters of a unified course in analytic geometry and calculus. Topics include rectangular coordinates in the plane, graphs and equations of lines, algebraic curves, including the conic sections and others examined by general discussion methods. Also introduced are functions, limits, continuity, differentiation of algebraic functions with applications of derivatives and differentials.

MA 111 Algebra and Trigonometry **4 (3-2) f**
Properties of real numbers and basic postulates, algebra of sets, functions and graphs, complex numbers. Linear and quadratic systems of equations. Inequalities, variation, progressions, binomial theorem, theory of equations and determinants. Trigonometric functions, identities, slide rule and logarithm solution of right and oblique triangles.
(Students are to take either MA 101 or MA 111, but not both)

MA 112 Analytic Geometry and Calculus A **4 (3-2) f**
Prerequisite: MA 111 or MA 101
A unified course, beginning with elementary ideas in analytic geometry and calculus, with the introduction of additional work in trigonometry where needed; rectangular and polar coordinate systems, fundamental locus problems, lines and conic sections, curve tracing, the derivative, with applications to geometry and elementary practical problems.

MA 122 Mathematics of Finance and Elementary Statistics **4 (3-2) f s**
Prerequisite: MA 101 or MA 111
Simple and compound interest, annuities and their applications to amortization and sinking fund problems, installment buying, calculation of premiums of life annuities and life insurance, elementary statistics.

MA 201 Analytic Geometry and Calculus II **4 (3-2) f s**
Prerequisite: MA 102 with a minimum grade of C)
Required of sophomores in the Schools of Engineering and Physical Sciences and Applied Mathematics. The second of three semesters of a unified course in analytic geometry and calculus. Topics include indefinite and definite integrals of algebraic functions and their applications; differentiation of transcendental functions; polar coordinates, parametric equations, curvilinear motion and curvature; formal integration; integration by parts, substitution, and partial fractions.

MA 202 Analytic Geometry and Calculus III **4 (3-2) f s**
Prerequisite: MA 201
Required of sophomores in the Schools of Engineering and Physical Sciences and Applied Mathematics. The third of three semesters of a unified course in analytic geometry and calculus. Topics include areas, volumes, lengths of curves, centroids, moments of inertia in rectangular and polar coordinates; approximate integration, improper integrals, indeterminate forms; infinite series and expansion of functions; solid analytic geometry and partial differentiation, multiple integrals in rectangular, cylindrical and spherical coordinates.

MA 211, 212 Analytic Geometry and Calculus B, C **3 (2-2) f s**
Prerequisite: MA 112
An integrated course in the fundamentals of calculus, including formal differentiation and integration. Basic applications to geometry, rates, maxima and minima, areas, volumes, first and second moments and centroids are included. Additional topics from analytic geometry, not covered in MA 112, are introduced as needed as a basis for calculus.

MA 215 Introduction to Finite Mathematics **3 (3-0) f s**
This course includes the following related topics: Elementary symbolic logic and truth tables, introduction to sets and subsets, other number systems, the partitioning of sets, introduction to probability theory and finite Stochastic processes, elementary linear programming and game theory.

MA 301 Differential Equations I **3 (3-0) f s**
Prerequisite: MA 202
First order equations with variables separable; Euler's method of approximate solution; physical and geometrical applications. Linear equations of first order; applications. Linear equations of higher order with constant coefficients, solution by repeated linear first order equations, variation of parameters, undetermined coefficients, operators. Systems of equations; scaling variables, applications to networks and dynamical systems. Introduction to series solutions; solutions by use of analog computer.

MA 302 Theory of Equations **3 (3 0) f**
Prerequisite: MA 202
Algebraic equations; isolation of roots, numerical approximations to roots, the Graeffe method; application of approximation procedures to transcendental equations; systems of linear equations, determinants and introduction to matrix theory.

MA 303 Differential Equations and Infinite Series **4 (4-0) s**
Prerequisite: MA 202 (Superior Student Program)
Infinite series and Taylor expansions. First order equations with variables separable; Euler's method of approximate solution; physical and geometrical applications. Linear equations of first order; applications. Linear equations of higher order with constant coefficients, solution by repeated linear first order equations, variation of parameters, undetermined coefficients, operators. Systems of equations; scaling variables, applications to networks and dynamical systems. Introduction to series-solutions; solutions by use of analog computer; non linear differential equations; dimensional analysis.
(Students are to take either MA 301 or 303, but not both.)

MA 335 Programming for Digital Computers **1 (0-3) f**
Prerequisites: MA 201 or MA 211 and junior standing
Programming for digital computers. Construction and use of flow charts, use of a compiler and assembly program and machine language instructions.

Courses for Advanced Undergraduates

MA 401 Intermediate Differential Equations **3 (3-0) f**
Prerequisite: MA 301
Theory of linear independence of solutions of linear differential equations, variation of parameters, superposition integral, simultaneous linear differential equations by transform methods, series solutions, special functions (Bessel, Legendre, etc.), orthogonal functions, and partial differential equations by separation of variables.

MA 403 Fundamental Concepts of Algebra **3 (3-0)**
Prerequisite: MA 202 or MA 212
Integers; integral domains; rational numbers; fields, rings, groups. Boolean algebra.

MA 404 Fundamental Concepts of Geometry **3 (3-0)**
Prerequisite: MA 202 or MA 212
Foundations of geometry; laws of logic; affine geometry; geometric transformations; homogeneous coordinates; comparison of Euclidean and non-Euclidean geometries.

MA 405 Introduction to Determinants and Matrices **3 (3-0) f**
Prerequisite: MA 202 or MA 212
Properties of determinants, theorems of Laplace and Jacobi, systems of linear equations. Elementary operations with matrices inverse, rank, characteristic roots and eigenvectors. Introduction to algebraic forms.

MA 421 Theory of Probability I **3 (3-0) f**
Prerequisite: MA 301 or consent of department
Definitions, discrete and continuous sample spaces, combinatorial analysis, Stirling's formula, simple occupancy and ordering problems, conditional probability, repeated trials, compound experiments, Bayes' theorem, binomial, Poisson and normal distributions, the probability integral, random variables, expectation.

MA 433 History of Mathematics **3 (3-0)**
Prerequisite: MA 202 or MA 212
Evolution of the number system; trends in the development of modern mathematics; lives and contributions of outstanding mathematicians.

MA 441 Advanced Calculus I **3 (3-0) f**
Prerequisites: MA 301 and, preferably, a B-average in all mathematics courses
Vectors, differential calculus of functions of several variables, vector differential calculus.

MA 491 Reading in Honors Mathematics **2 to**
Prerequisites: Membership in Honors Program and permission of department chairman
This is a reading course for exceptionally able students at the junior and senior levels. It will follow the English precedent in university education so that the student will read in some area of advanced mathematics, will present a written report of his reading, and will stand an examination on it.

Courses for Graduates and Advanced Undergraduates

MA 512 Advanced Calculus II **3 (3-0) f**
Prerequisite: MA 511
Vector integral calculus, infinite series, integral calculus of functions of several variables.

MA 513 Advanced Calculus III **3 (3-0) f s**
Prerequisite: MA 512
Functions of a complex variable, partial differential equations, Fourier series.

MA 514 Methods of Applied Mathematics **3 (3-0) s**
Prerequisite: MA 512
Introduction to difference equations, integral equations, and calculus of variations.

MA 516 Principles of Mathematical Analysis **3 (3-0) f**
Prerequisite: MA 512
The real number system, elements of set theory, limits, continuity, differentiation, Reimann-Stieltjes integration, sequences of functions, fundamentals of Lebesque theory, topological and metric spaces.

MA 517 Introduction to Point-Set Topology **3 (3-0) s**
Prerequisite: MA 516
A study of basic set-theoretic and general topological notions of modern mathematics. Topics include set theory and cardinal numbers, topological spaces, metric spaces, and elementary discussion of function spaces.

MA 523 Theory of Probability II **3 (3-0) s**
Prerequisites: MA 405 and MA 522
Binomial, Poisson, and normal distributions, law of large numbers, recurrent events renewal theory, Markov chains. Characteristic function and distribution functions, simple stochastic processes. Introduction to game theory and linear programming.

MA 527 Numerical Analysis I **3 (3-0) f s**
Prerequisite: MA 511
Numerical solution of equations, introduction to the theory of errors, finite-difference tables and the theory of interpolation, numerical integration, numerical differentiation, and elements of difference calculus.

MA 528 Numerical Analysis II **3 (3-0) s**
Prerequisite: MA 527
Difference operators, summation procedures, numerical solution of ordinary differential equations, least-squares polynomial approximation, and Gaussian quadrature.

MA 532 Differential Equations II **3 (3-0) s**
Prerequisite: MA 511
Phase-plane concepts; elementary critical points and stability theory; second order linear equations with variable coefficients; general linear autonomous systems; forced oscillations of linear systems; the method of Frobenius; Bessel, Legendre and hypergeometric functions; regular singular points; Sturm-Liouville systems; eigenvalue problems and generalized Fourier expansions; existence and uniqueness theorems.

MA 536 Logic for Digital Computers **3 (3-0) f**
Prerequisite: MA 511
Introduction to logic and formal languages of digital computers, algorithms, compilers, and heuristic programming.

MA 537 Non-numeric Uses of Computers **3 (3-0) s**
Prerequisite: MA 536
The use of computers in problems not involving numerical analysis. Formal differentiation and integration, algebraic models, combinatorics, theorem proving and decision making. Problems of mechanical translation. Special computers.

MA 555 (PY 555) Principles of Astrodynamics **3 (3-0)**
Prerequisites: MA 511, either PY 401 or EM 312
The differential equations of motion in two-body problems and their integrals; orbit theory; integrals of the n-body problem; differential equations of motion of natural and artificial satellites and their approximate solutions. Mr. Musen

Courses for Graduates Only

MA 602 Partial Differential Equations **3 (3-0) s**
Prerequisite: MA 512
Ordinary differential equations in more than two variables, partial differential equations of the first order, partial differential equations of the second order, Laplace's equation, the wave equation, the diffusion equation.

MA 605 Non-Linear Differential Equations **3 (3-0) f**
Prerequisites: MA 512, MA 532
Phase plane and phase space concepts; existence and uniqueness theorems; continuity, analytic and differentiability properties of solution; properties of linear systems; stability in non-linear systems; topological methods; perturbations of periodic solutions; asymptotic methods and resonance problems. Mr. Struble

MA 608 Integral Equations **3 (3-0)**
Alternate summers
Prerequisites: MA 512, MA 532
Linear Volterra intergral equations of the first and second kinds. Relationship to linear differential initial value problems. Special Volterra equations of the convolution type. Singular Volterra equations. Linear Fredholm integral equations of the first and second kind. Basic theory. Symmetric kernels. Hilbert-Schmidt theory (generalizations). Mr. Winton

MA 611 Complex Variable Theory and Applications I **3 (3-0) f**
Prerequisite: MA 512
Elementary functions; analytic functions and Cauchy-Riemann equations; conformal mapping and applications; Taylor and Laurent series; contour integration and residue theory; the Schwarz-Christoffel transformation. Mr. Bullock

MA 612 Complex Variable Theory and Applications II **3 (3-0) s**
Prerequisite: MA 611
Conformal mapping and applications to flow phenomena; multiple-valued functions and Riemann surfaces; further applications of residue theory; analytic continuation; infinite series and asymptotic expansions; elliptic functions and other special functions in the complex domain; structure of functions. Mr. Bullock

MA 615 Theory of Functions of a Real Variable I **Alternate years 3 (3-0) f**
Prerequisite: MA 512
Sets and spaces; continuity and differentiability of real functions. Mr. Harrington

MA 616 Theory of Functions of a Real Variable II **Alternate years 3 (3-0) s**
Prerequisite: MA 615
Measure, measurable sets and functions, theory of Lebesque integration.
Mr. Harrington

MA 621 Introduction to Modern Abstract Algebra **3 (3-0) f**
Prerequisite: MA 512
A study of the abstract structure and properties of groups, rings and ideals, and fields.
Messrs. Nahikian, Park, Wahab

MA 622 Vector Spaces and Matrices **3 (3-0) s**
Prerequisite: MA 511
A study of vector spaces and their relation to the theory of matrices. Matrix inversion, linear transformations, including similarity and orthogonal transformations, canonical forms. Properties of the characteristic and reduced characteristic function. Elementary divisors and functions of matrices. Applications to systems of differential equations.
Messrs. Nahikian, Park, Wahab

MA 625 Introduction to Differential Geometry **Alternate summers 3 (3-0)**
Prerequisite: MA 512
Theory of curves and surfaces in 3-dimensional euclidean space with special reference to those properties invariant under the rigid body motions. Messrs. Levine, Winton

MA 632 Operational Mathematics I **3 (3-0) f**
Corequisite: MA 513 or MA 611
Laplace transform with theory and application to problems in ordinary and partial differential equations arising from engineering and physics problems; Fourier integral and Fourier transforms and applications. Messrs. Cell, Harrington

MA 633 Operational Mathematics II **3 (3-0) s**
Prerequisite: MA 632
Extended development of the Laplace and Fourier transforms and their uses in the solution of problems in ordinary and partial differential equations and in difference equations; Sturm-Liouville systems; advanced theory in ordinary and partial differential equations; other infinite and finite transforms and their applications. Messrs. Cell, Harrington

MA 635 Mathematics of Computers **3 (3-0) s**
Prerequisites: MA 528, MA 512, MA 335; Corequisite: MA 405 or MA 622
The development of methods for the solution of selected problems involving matrices; integral rational equations; ordinary and partial differential equations. Particular attention is paid to the question of convergence and stability; examples solved on the IBM 650.

MA 641 Calculus of Variations **Alternate summers 3 (3-0)**
Prerequisite: MA 512
The simplest problem of the calculus of variations in detail; variable endpoints; isoperimetric problems; Hamilton's principle; least action principle; introduction to the theory of linear integral equations of the Volterra and Fredholm types. Mr. Winton

MA 651 Expansion of Functions **Alternate summers 3 (3-0)**
Prerequisites: MA 611, 633 or equivalent
Expansion of functions of one or more variables in Taylor series; asymptotic series; infinite products, partial fractions, continued fractions, series of orthogonal functions; applications in ordinary partial differential equations, difference equations and integral equations.
Messrs. Cell, Harrington

MA 655 Mathematics of Astrodynamics I **3 (3-0)**
Prerequisite: MA 532 or MA 605
Two-body problem and its integrals, differential equations of the disturbed planetary motion, disturbing function (potential of the disturbed motion), literal and numerical methods for expansion of the disturbing function, perturbation of the first and second order, methods of Hansen, Hill, and Brouwer, theory of resonance. Mr. Musen

MA 656 Mathematics of Astrodynamics II **3 (3-0)**
Prerequisite: MA 655
Theories of artificial satellites, influence of the sun and moon on the motion of artificial satellites, orbit stability, lunar theories. Mr. Musen

MA 661 Tensor Analysis I **3 (3-0) f**
Prerequisite: MA 512
The basic theory, tensor algebra, tensor calculus; invariants of quadratic differential forms; covariant differentiation; geometric applications, Reimannian spaces; generalized vector analysis. Mr. Levine

MA 662 Tensor Analysis II **3 (3-0) s**
Prerequisite: MA 661
Continuation of MA 661. Physical applications; dynamics, Legrange's equations, the geometry of dynamics, cofiguration spaces. Further applications to electromagnetic theory and elasticity.
Mr. Levine

MA 681 Special Topics in Analysis **up to 6 hours credit**

MA 683 Special Topics in Algebra **up to 6 hours credit**

MA 685 Special Topics in Numerical Analysis **up to 6 hours credit**

MA 687 Special Topics in Geometry **up to 6 hours credit**

MA 689 Special Topics in Applied Mathematics **up to 6 hours credit**
The above courses, MA 681-MA 689, afford opportunities for graduate students to study advanced topics in mathematics under the direction of members of the graduate staff. These will on occasion consist of one of several areas such as, for example, advanced theory of partial differential equations, topology, mathematics of plasticity or of viscoelasticity, mathematics of orbital mechanics.

MA 691 Research in Mathematics **Credits by arrangment**
Prerequisites: Graduate standing and approval of adviser
Individual research in the field of mathematics.

Mathematics and Science Education

(See Education)

Mechanical Engineering

Courses for Undergraduates

ME 101, ME 102 Engineering Graphics I, II **2 (1-3) f s**
Corequisite: MA 101 or MA 111
The objective of these courses is to teach the student the proper methods, techniques, and procedures of expression and interpreting data in this medium of communication. Theories and common practices are used to emphasize instrument practice, geometrical construction, freehand technical sketching, completion of prepared worksheets, sections, projections, auxiliary views, pictorial views, diagramatic sketches and drawings using standard symbols, charts and graphs, and blueprint reading. Special emphasis will be placed upon visualization in the analysis and solution of geometrical magnitudes represented by points, lines, planes, and solids; intersection and development of flat and curved surfaces.

ME 301 Engineering Thermodynamics I **3 (3-0) f s**
Prerequisites: MA 202 and PY 201
A study of energy and energy transformations; the First and Second Laws applied to systems and to control volumes; thermodynamic properties of systems; property changes occurring resulting from charges in state; availability of energy.

ME 302 Engineering Thermodynamics II **3 (3-0) s**
Prerequisite: ME 301
A continuation of engineering thermodynamics I for Mechanical Engineering juniors. Thermodynamics of mixtures; chemical thermodynamics; thermodynamics of fluid flow; vapor and gas cycles; applications to compressors, internal combustion engines, steam and gas turbines, refrigeration.

ME 303 Engineering Thermodynamics III **3 (3-0) s**
Prerequisite: ME 301
A continuation of engineering thermodynamics I for non-Mechanical Engineering juniors. Thermodynamics of mixtures; thermodynamics of fluid flow; heat transfer; vapor and gas cycles and applications.

ME 304 Fundamentals of Heat Power **3 (3-0) f**
Prerequisite: PY 211
Energy and energy transformations, including a brief discussion of measurements of quantities involved. Properties of working substances, particularly steam. Elementary combustion of fuels. Steam power cycles and applications to steam turbines. Elements of heat transfer.

ME 305 Mechanical Engineering Laboratory I **1 (0-3) f**
Corequisite: ME 301
Theory and principles involved in instrumentation and measurements. Limitation and sources of error of each technique studied. Utilization of the instrumentation in predetermined situations that exhibit the essential characteristics of the instrumentation. Consideration of transient and steady state techniques. Areas of study: pyrometric measurements, piezo measurements and measurements of flow properties.

ME 306 Mechanical Engineering Laboratory II **1 (0-3) s**
Prerequisite: ME 305; Corequisites: EM 301 and ME 312
A continuation of ME 305 with emphasis on measurements of kinematic quantities, measurements of thermophysical properties and energy measurements. Treatment of experimental data.

ME 311 Kinematics **3 (3-0) f**
Corequisite: EM 301
Required of juniors in Mechanical Engineering
The application of the principles of kinematics to the field of Mechanical Engineering.

ME 312 Dynamic Analysis **3 (3-0) s**
Prerequisites: ME 311 and MA 301
Required of juniors in Mechanical Engineering
The application of rational dynamics to the field of mechanical engineering; the science of motions resulting from any force, and of the forces required to produce motions.

ME 352 Aerodynamics **3 (3-0) s**
Prerequisites: EM 200 and MA 301
Fundamental concepts underlying experimental aerodynamics, the aerodynamicist's data, elementary flow theory, Reynolds number and the effect of viscosity, Mach number and compressibility, finite wing theory.

ME 361 Aerospace Technology **3 (3-0) s**
Prerequisites: PY 202, EM 301, and MA 301
An introduction to the principles of flight in and beyond the atmosphere. Includes the elements of aerodynamics of flight, the reentry problem, flight dynamics, guidance and control, power generation in space, manned and unmanned space flight and life support systems.

ME 401 Power Plants **3 (3-0) f s**
Prerequisite: ME 302
Required of seniors in Mechanical Engineering
A study of the basic technical principles of the transformation of energy into useful forms and the study of the fundamental sciences leading to engineering decisions of selection and arrangement of energy transforming equipment. Various types and kinds of plants. Energy balance and significance upon the proper selection of elements in the power plan. Economic selection of components. Factors affecting the cost of power and the elements which enter into the problems arriving at monetary electric rates.

ME 405 Mechanical Engineering Laboratory III **1 (0-3) f**
Prerequisite: ME 306
Experimental analysis of engineering systems. Selection of appropriate instrumentation and analysis of predetermined small scale engineering systems designed for flexibility and wide variation of parameters. Experiments cover the gamut of mechanical engineering activity.

ME 406 Mechanical Engineering Laboratory IV **1 (0-3) s**
Prerequisite: ME 405
Individual or small group investigation of an original problem. A project type of program.

ME 410 Jet Propulsion **3 (3-0) s**
Prerequisite: ME 302 and ME 352 or EM 303
Application of fundamental principles of thermodynamics and the mechanics of a compressible fluid to the processes of jet-propulsion and turbo-propeller aircraft; the effect of performance of components on performance of engine; analysis of engine performance parameters.

ME 411 Machine Design I **3 (3-0) f**
Prerequisites: ME 312 and EM 301
Required of seniors in Mechanical Engineering
Basic principles of the mechanical sciences applied to the analysis of machines, devices, and mechanical systems. State of stress, state of strain, elasticity, working stresses, stress concentration, fatigue, impact and shock, plasticity, thermal stress, wear, lubrication and contact stress.

ME 412 Machine Design II **3 (3-0) s**
Prerequisite: ME 411
Required of seniors in Mechanical Engineering
Synthesis of machines, devices, and mechanical systems. The specification of systems, formulation of region of design, synthesis of elements, complete analysis of the ensemble, evaluation and closure of the design. Project activity with research emphasis.

ME 421 Aerospace Propulsion Systems **3 (3-0) s**
Prerequisites: ME 361 and ME 302
A study of propulsion systems and their relation to the various flight regimes and space missions. The principles of thrust generation, the control, and the performance of various propulsion systems will be considered.

ME 435 Industrial Automatic Controls **3 (3-0) f or s**
Prerequisites: ME 301 and MA 301
Introduction to concept of automatic controls; fundamentals of two-position, proportional, floating and rate modes of control with a graphical and analytical presentation of each. Theoretical considerations of the process and an introduction to system analysis.

ME 441 Technical Seminar **1 (1-0) f or s**
Prerequisite: Graduating senior standing
Meetings once a week for the delivery and discussion of student papers on topics of current interest in Mechanical Engineering.

ME 446 Performance of Hypervelocity Vehicles **3 (3-0) s**
Prerequisites: ME 361, ME 352
The application of the aerospace sciences to the estimation of the performance stability and control of hypervelocity vehicles.

ME 451 Introduction to Rocketry **3 (3-0) f or s**
Prerequisites: ME 301 and 352 or equivalent
Basic principles of rocket propulsion. Consideration of the significance and use of parameters such as specific impulse, characteristic velocity, thrust coefficient. General description of liquid, solid and hybrid power plants. Performance calculations and design considerations.

ME 453 Applied Aerodynamics **3 (3-0) f**
Prerequisite: ME 352
Determination of design data, tunnel wall and ground effect interference corrections, spanwise and chordwise load distributions, performance estimation, and stability and control analysis. Attention is given to transonic and supersonic aerodynamics.

ME 465, 466 Aerospace Engineering Laboratory **1 (0-3) f s**
Prerequisite: ME 361
Laboratory experience in wind tunnel experimentation, structural testing, environmental testing, and instrumentation for flight in and beyond the atmosphere.

ME 469 Spacecraft Structures **3 (3-0) f**
Prerequisites: ME 361 and EM 301
To provide the basic structural background necessary to the design of light weight structures for flight in and beyond the atmosphere.

ME 471 Aircraft and Missile Design **3 (1-6) f**
Prerequisites: ME 361, ME 352
Elements of the design of modern aircraft and high-speed missile configuration to meet prescribed aerodynamic, structural, performance, and stability specifications.

ME 472 Spacecraft Design **3 (1-6) s**
Prerequisite: ME 361
A study of flight requirements leading to determination of flight criteria and the specifications of spacecraft systems. The application of aerospace sciences to the design of spacecraft.

Courses for Graduates and Advanced Undergraduates

ME 501 Steam and Gas Turbines **3 (3-0) f**
Prerequisites: ME 302 and EM 303 or ME 352
Fundamental analysis of the theory and design of turbomachinery flow passages: control and performance of turbomachinery; gas-turbine engine processes.

ME 502 Heat Transfer **3 (3-0) f or s**
Prerequisites: ME 301 and MA 301
A study of the fundamental laws of heat transfer by conducting convection and radiation; steady and unsteady states heat transfer.

ME 503, 504 Elements of Nuclear Power Generation I, II **3 (3-0) f s**
Prerequisite: CHE 521
Engineering analysis and calculations involved in the elements of nuclear power generation including ideal and actual power cycles, prime movers and appurtenances. Elements of the cost of power and the engineering economics of selection of equipment. The nuclear reactor development and status as a source of power including a critical review of recent developments.

ME 507, 508 Internal Combustion Engine Fundamentals **3 (3-0) f s**
Prerequisite: ME 302
The fundamentals common to internal combustion engine cycles of operation. The Otto engine: carburetion, fuel distribution, flame propagation, normal and knocking combustion, throttling, pumping, valve and spark timing, and altitude effects; the Diesel engine: injection and spray formation fuel rating, atomization, penetration, diesel knock, combustion, precombustion, and scavenging as applied to reciprocating and rotary engines.

ME 515 Experimental Stress Analysis **3 (2-3) f**
Prerequisite: ME 312
Theoretical and experimental techniques of strain and stress analysis, with experimental emphasis on electrical strain gages and instrumentation, brittle coatings, grid methods, and photoelasticity. Laboratory includes a full experimental investigation and report of a problem chosen by the student under the guidance of the instructor.

ME 516 Photoelasticity **3 (2-3) s**
Prerequisite: ME 515
Two and three-dimensional photoelasticity; the stress-optic law, isochromatics, isoclinics, stress trajectories, fractional orders of interference; three dimensional techniques, oblique incidence, rotational and thickness effects; determination of principal stresses at interior points; laboratory investigations.

ME 517 Lubrication **3 (2-3) s**
Prerequisite: EM 303
The theory of hydrodynamic lubrication; Reynold's equation, the Sommerfield integration, effect of variable lubricant properties and energy equation for temperature rise. Properties of lubricants. Application to design of bearings. Boundary lubrication.

ME 521 Aerothermodynamics **3 (3-0) f or s**
Prerequisites: ME 301, MA 301 and EM 303 or ME 352
An examination of the basic concepts of gas dynamics such as the continuum, domain of applicability of continuum, acoustic velocity, compressibility effects, and the conservation laws. Analysis of one dimensional flows such as isentropic flow, diabatic flow, flow with friction, the normal shock. An introduction to the vector formulation of multi-dimensional problems.

ME 541, 542 Aerodynamic Heating **3 (3-0) f s**
Prerequisites: MA 511 and ME 521 or equivalent
A detailed study of the latest theoretical and experimental findings of the compressible laminar and turbulent boundary layers with special attention to the aerodynamic heating problem; application of theory in the analysis and design of aerospace hardware.

ME 545, 546 Project Work in Mechanical Engineering I, II **2 (0-4) f or s**
Individual or small group investigation of a problem stemming from a mutual student faculty interest. Emphasis is placed on providing a situation for exploiting student curiosity.

ME 551 Flying Qualities **3 (3-0) f**
Prerequisite: ME 352
Evaluation of flying qualities of airplanes, important factors and criteria for design, analysis of stick fixed and stick free control and stability, maneuvering stability, lateral controllability, and stick force determination.

ME 552 Aircraft Applied Loads **3 (3-0) f**
Prerequisite: ME 453
Determination of aerodynamics loads, maneuvering and gust loads, V g diagram, spanwise distributions on unswept and swept wings, dynamic flight loads. Consideration of the load modifications in the transonic flight range.

ME 553 Propeller and Rotary Wing Design **3 (3-0) s**
Prerequisite: ME 453
A study of the design of aircraft propellers and rotary wing theory and design. Discussion of problems of performance evaluation, control and stability, as applied to rotating wing aircraft.

ME 554 Advanced Aerodynamic Theory **3 (3-0) s**
Prerequisite: ME 352
Development of fundamental aerodynamic theory. Emphasis upon mathematical analysis and derivation of equations of motion, airfoil theory and comparison with experimental results. Introduction to supersonic flow theory.

ME 562 Advanced Aircraft Structures **3 (3-0) s**
Development of methods of stress analysis for aircraft structures, special problems in structural design, stiffened panels, rigid frames, indeterminate structures, general relaxation theory.

ME 571 Air Conditioning **3 (3-0)**
Prerequisite: ME 302
A fundamental study of summer and winter air conditioning including temperature, humidity, air velocity and distribution.

ME 572 Refrigeration **3 (3-0)**
Prerequisite: ME 302
A thermodynamic analysis of the simple, compound, centrifugal and multiple effect compression systems, the steam jet system and the absorption system of refrigeration.

ME 581, 582 Hypersonic Aerodynamics **3 (3-0) f**
Prerequisites: MA 512 and ME 352 or equivalent
A detailed study of the latest theoretical and experimental findings in hypersonic aerodynamics.

Courses for Graduates Only

ME 601 Advanced Engineering Thermodynamics **3 (3-0)**
Prerequisite: ME 302 or ME 303
First and Second Laws; theory of variable specific heats; general equations of thermodynamic characteristic equations of state; reduced coordinates; prediction of properties of gases and vapors; chemical equilibrium; metastables; thermodynamics of fluid flow.

E 602 Statistical Thermodynamics **3 (3-0) s**
erequisites: ME 601 and MA 511
ndamental principles of kinetic theory, quantum mechanics, statistical mechanics and ir-versible phenomena with particular reference to thermodynamics systems and processes. The nclusions of the classical thermodynamics are analyzed and established from the micro-opic viewpoint.

E 603 Advanced Power Plants **3 (3-0) f**
erequisite: ME 401
critical analysis of the energy balance of thermal power plants; thermodynamics and onomic evaluation of alternate schemes of development; study of recent developments in e production of power.

E 605 Aerothermochemistry **3 (3-0) s**
erequisites: ME 601 and MA 511 or equivalent
generalized treatment of combustion thermodynamics including derivation of thermo-namics quantities by the method of Jacobians, criteria for thermodynamic equilibrium, mputation of equilibrium composition and adiabatic flame temperature. Introduction to assical chemical kinetics. Conservation equations for a reacting system, detonation and de-igration. Theories of flame propagation, flame stabilization, and turbulent combustion.

E 606 Advanced Gas Dynamics **3 (3-0) s**
erequisites: ME 521, ME 601 and MA 511
he general conservation equations of gas dynamics from a differential and integral point of ew. Hyperbolic compressible flow equations, unsteady one dimensional flows, the non-ear problem of shock wave formation, isentrophic plane flow, flow in nozzles and jets, rbulent flow.

E 608 Advanced Heat Transfer I **3 (3-0) f**
erequisite: ME 502 or equivalent
ndamental aspects, from an advanced viewpoint, will be considered in the conduction of at through solids, convection phenomena, and the measurement and prediction of appro-iate physical properties. Boundary value problems arising in heat conduction will be ex-nined and both numerical and function solution techniques developed. Internal and ex-rnal boundary layer analyses will be made on a variety of representative convection situa-ons.

E 609 Advanced Heat Transfer II **3 (3-0) s**
rerequisite: ME 608
dvanced topics in the nonisothermal flow of fluids through channels will be investigated r slug, laminar, transitional and turbulent conditions. The influence of mass transfer on ow and heat transfer processes will be considered. Radiation exchange processes between lid surfaces and solid surfaces and gasses both stationary and moving will be discussed.

E 610 Advanced Topics in Heat Transfer **3 (3-0) f**
rerequisite: ME 609
his course constitutes a study of recent developments in heat transfer and related areas. It anticipated that the course content will change from semester to semester.

E 611, 612 Advanced Machine Design I, II **3 (3-0) f s**
rerequisite: ME 412
inematics of mechanical media, the stress tensor, the tensor of strains, elasticity, plasticity, me-dependent behavior; theories of failure, working stresses; shock and steady dynamic load-g, creep, stress concentration, thermal stress, contact stresses; energy theories, finite differ-nce and relaxation methods, hydrodynamic lubrication. Application to the design of machine rames, shafts, bearings, gears, springs, cams, etc.

E 613 Mechanics of Machinery **3 (3-0) f**
rerequisites: ME 312 and MA 512
ector dynamics, d'Alembert's principle, Lagrange's equations, rigid kinematics, Euler's angles, igid rotation, Coriolis accelerations; the inertia tensor. Application to mechanisms, gyro-opes, guidance and control systems, rotating and reciprocating devices.

ME 614 Mechanical Transients and Machine Vibrations **3 (3-0)**
Prerequisites: ME 312 or EM 545 and MA 512
Dynamic loads in mechanical media are considered in two categories—steady vibrations an transient shock and impact. The Lagrange equations and the wave equation are employ to study internal stresses and displacements in mechanical devices which result from su loading.

ME 615 Aeroelasticity I **3**
Prerequisites: MA 541, ME 411 or ME 459, ME 521
Deformations of aero structures under static and dynamic loads, natural mode shapes an frequencies; two and three dimensional incompressible flow, wings, and bodies in unstea flow; statis aeroelastic phenomena.

ME 616 Aeroelasticity II **0**
Prerequisites: MA 511, ME 615
Flutter; dynamic response phenomena such as transient landing stresses, gusts, continuo atmospheric turbulence; aeroelastic model theory, model design and construction.

ME 617 Plates and Shells in Mechanical Design **3 (3-0)**
Prerequisites: MA 511 and ME 611
The concept of members which are thin in one dimension, that is, plates and shells, applied to mechanical design with particular emphasis on type of loading, conditions service, and compliance of the member to its environment.

ME 631 Applications of Ultrasonics to Engineering Researrh **3 (3-0)**
Prerequisites: MA 511 and EE 332
The technique and theory of propagation of ultrasonics in liquids, gases and solids. Develo ment of ultrasonic transducers, the elastic piezoelectric, and dielectric relationships. Ultr sonic applications of asdic or sonor, cavitation, emulsification, soldering, welding, and acous properties of gases, liquids and solids.

ME 641 Mechanical Engineering Seminar **1 or**
Faculty and graduate student discussions centered around current research problems and a vanced engineering theories.

ME 642 Advanced Topics in Mechanical Engineering **1 to 6 credits f or**
Prerequisite: Graduate standing
Faculty and graduate student discussions of advanced topics in contemporary Mechanic Engineering.

ME 645 Mechanical Engineering Research **Credits by arrangeme**
Prerequisites: Graduate standing in Mechanical Engineering and approval of adviser
Individual research in the field of Mechanical Engineering.

ME 651 Principles of Fluid Motion **3 (3-0)**
Prerequisite: ME 352 or equivalent; Corequisite: MA 511
Fundamental principles of fluid dynamics. Mathematical methods of analysis are emphasiz Potential flow theory development with introduction to the effects of viscosity and compr sibility. Two dimensional and three dimensional pheonomena are considered.

ME 652 Dynamics of Compressible Flow **3 (3-0)**
Prerequisite: ME 521 or equivalent; Corequisite: MA 511
Properties of compressible fluids, equation of motion of one-dimensional motion, chanr flows, shock wave theory, methods of observation, and flows at transonic speeds.

ME 653 Supersonic Aerodynamics **3 (3-0**
Prerequisite: ME 652
Equations of motion in supersonic flow, Prandtl-Meyer turns, method characteristics, hod graph plane, supersonic wind tunnels, supersonic airfoil theory, and boundary layer shc interaction.

654 Dynamics of Viscous Fluids **3 (3-0) s**
requisite: ME 555 or equivalent; Corequisite: MA 511
elopment of the Navier-Stokes equations and the boundary layer theory. Laminar and bulent boundary layers in theory and experiment, flow separation, and transition.

660 Aero-Mechanical Engineering Problems **3 (3-0) s**
requisites: ME 502, MA 514, 543 or equivalent
ivation of governing equations and set-up of representative problems in heat transfer, gas amics and magneto hydrodynamics; review of techniques for solving these problems. oduction of other techniques such as method of steepest descent, method of Weiner-Hopf. ational methods and others. Phase-space and function space concepts will be introduced . Purpose of the course in the graduate program to strengthen the analytical techniques the students in dealing with aero-mechanical engineering problems so that in their later lies more emphasis may be put on formulation of new problems and physical interpre- on of new results.

661, 662 Aerospace Energy Systems **3 (3-0) f s**
requisites: MA 512, ME 521, PY 407 or equivalent
tudy of energy systems appropriate to the varied requirements of space operations. In- des analysis of chemical, nuclear and solar energy sources and the theory of their adapta- to operational requirements for propulsion and auxiliary power, cooling requirements, dants and materials.

671, 672 Advanced Air Conditioning Design I, II **3 (3-0) f s**
requisites: ME 571 and ME 572
design of heating and air conditioning systems; the preparation of specifications and per- nance tests on heating and air conditioning equipment.

691, 692 Advanced Spacecraft Design **3 (3-0) f s**
requisites: ME 542, ME 582 and MA 512
lysis and design of spacecraft including system design criteria, acceleration tolerance, y environment, thermal requirements, criteria for configuration design, aerodynamic de- , heating rates, thermostructural design, boost phase, de-orbit, entry corridor, lift modula- , rolling entry, glide phase, maneuvering and landing, stability and control, thermal tection system, materials, instrumentation, and life support systems.

Metallurgical Engineering

urses for Undergraduates

A 201, 202 Structure and Properties of Engineering Materials I, II **3 (2-3) f s**
requisite: CH 103
n introduction to the fundamental physical principles governing the structure and con- ition of metallic and non-metallic materials of construction, and the relation of these ciples to the control of properties.
mporant applications of engineering materials and criteria for selection of materials.

A 321 Metallurgy **3 (2-3) s**
requisite: CH 103
general course in physical metallurgy including laboratory work.
constitution, structure, and properties of metals and alloys.

A 331, 332 Physical Metallurgy I, II **3 (3-0) f s**
requisites: CH 103, MIM 201
quired of juniors in MTE
fundamental principles of physical metallurgy with emphasis on correlation between cture, constitution, and properties of metals and alloys. A systematic development of metallurgical aspects of atomic and crystalline structure, solid solution, diffusion, preci- tion hardening, elastic and plastic behavior, and recrystallization.

MIM 401, 402 Metallurgical Operations I, II **4 (3-3) f·**
Prerequisite: MIM 332
A systematized treatment of the fundamental operations involved in the production an fabrication of metals and alloys. Part I deals primarily with procedures and operations em ployed in chemical or extractive metallurgy. Part II covers the operations of physical an mechanical metallurgy.

MIM 421, 422 Metallurgy I, II **2 (2-0) f·**
Prerequisite: CH 103
Required of seniors in ME and MEA
The constitution, structure and properties of engineering ferrous and non-ferrous metals an alloys; influences of mechanical working and heat treatment; physical testing, corrosion an its prevention. Laboratory work included in second semester.

MIM 423 Metallurgical Laboratory **1 (0-3) f**
Corequisite: MIM 421 or MIM 422
Laboratory work to accompany Metallurgy I, II

MIM 431, 432 Metallography I, II **3 (2-3) f·**
Prerequisite: MIM 332
An intensive study of the principles and techniques for examination and correlation of t structure, constitution, and properties of metals and alloys.

MIM 445, 446 Experimental Engineering I, II **3 (1-6) f**
Prerequisite: MIM 422 or approval of instructor
Advanced engineering principles applied to a specific project dealing with metallurgy, meta lography, or general experimental work. A seminar period provided and a written repo required.

MIM 451, 452 Metallurgical Engineering Seminar **1 (1-0) f**
Prerequisite: Senior standing in MTE
Reports and discussion of special topics in metallurgical engineering and related subjects.

Courses for Graduates and Advanced Undergraduates

MIM 521, 522 Advanced Physical Metallurgy I, II **3 (3-0) f**
Prerequisite: MIM 422 or MIM 432
Theories concerning behavior and control of engineering alloys, reaction rates in the sol state and alloy influences; current heat treating practices, surface treatments; behavior metals at high and low temperatures; special purpose alloys; powder metallurgy; review modern equipment and methods for the study of metals.

MIM 523, 524 Metallurgical Factors in Design **3 (3-0) f**
Prerequisite: MIM 422
A study of the metallurgical factors that must be considered in using metals in design.

MIM 541, 542 Principles of Corrosion I, II **3 (2-3) f**
Prerequisite: MIM 422
The fundamentals of metalic corrosion and passivity. The electrochemical nature of corrosi attack, basic forms of corrosion, corrosion rate factors, methods of corrosion protectic Laboratory work included.

MIM 545, 546 Advanced Metallurgical Experiments I, II **3 (1-6) f**
Prerequisite: MIM 422 or approval of instructor
Advanced engineering principles applied to a specific experimental metallurgical project. seminar period is provided and a written report is required.

IM 561 Advanced Structure and Properties of Materials **3 (2-3) f**
erequisite: MIM 422
systematic treatment of the fundamental physico-chemical principles governing the con-itution of both metallic and ceramic materials. Correlation of these principles with physical, echanical and chemical properties of materials. Particular emphasis is placed upon ma-rials of construction for nuclear reactors. Lecture and laboratory.

IM 562 Materials Problems in Nuclear Engineering **3 (2-3) s**
erequisite: MIM 561
gineering aspects of problems involved in the selection and application of reactor materials. ecific attention is given to elevated temperature behavior, fatigue, corrosion, irradiation mage, and the fabrication and processing of these materials. Lecture and laboratory.

ourses for Graduates Only

IM 651, 652 Theory and Structure of Metals **3 (3-0) f s**
erequisite: MIM 522
n advanced interpretation of the development of theories of the metallic state with em-asis on modern physical concepts. Topics include theory of crystallinity, bonding forces, ability of metallic structures, diffusion, and dislocation theory.

IM 695 Metallurgical Engineering Research **Credits by arrangement**
dependent investigation of an appropriate problem in Metallurgical Engineering. A report this investigation is required as a graduate thesis.

Military Science

ne Basic Course

S 101 Military Science I **1 (1-1) f**
lassroom instruction is given in individual weapons and marksmanship, and organization of e Army. On the drill field, emphasis is placed on development of teamwork, esprit de corps, id essential characteristics of leadership.

S 102 Military Science I **1 (1-1) s**
rerequisite: MS 101 or equivalent credit
lassroom instruction is given in the role of United States Army and National Security. On e drill field, emphasis is placed on development of teamwork, esprit de corps, essential aracteristics of leadership.

S 201 Military Science II **1 (0-3) f**
rerequisites: MS 101, MS 102, or equivalent credit
lassroom instruction in American Military History. On the drill field emphasis is placed on velopment of teamwork, esprit de corps, essential characteristics of leadership, and accept-nce of responsibility.

S 202 Military Science II **1 (0-3) s**
rerequisites: MS I and MS 201 or equivalent credit
lassroom instruction in map and aerial photograph reading and introduction to operations id basic tactics. On the drill field emphasis is placed on development of teamwork, esprit e corps, essential characteristics of leadership, and acceptance of responsibility.

The Advanced Course

MS 301 Military Science III **1 (2-1**
Prerequisites: MS I and MS II or equivalent credit
Classroom instruction is given in military leadership, emphasizing the factors controlling soldier's behavior and the problems of command; branches of the Army, emphasizing mission of each in order to acquaint students with all branches prior to their ROTC Summ Camp and selection of branch in their senior year; principles of military planning and c duct of offensive and defensive tactics. Practical leadership instruction is provided on drill field where emphasis is placed on acceptance of responsibility, exercise of command, a development of self-confidence, initiative and dignity in appearance and demeanor.

MS 302 Military Science III **2 (2-1**
Prerequisite: MS 301
Classroom instruction is given in methods of military teaching with special reference to leader's responsibility for soldier's learning; continuation of offensive and defensive tac including communications in support of military operations; and a pre-camp orientation pr to ROTC Summer Camp. Practical leadership instruction is provided on the drill field wh emphasis is placed on acceptance of responsibility, exercise of command and developm of self-confidence.

MS 401 Military Science IV **1 (2-1**
Prerequisites: MS III, and satisfactory completion of six weeks' summer camp training
Classroom instruction is given in military justice, troop movement, logistics, intelligence, a operations. On the drill field, emphasis is placed on the exercise of command, planning a executing all phases of training (instruction in basic fundamentals, inspections, ceremon and competitions) and maximum development of teamwork, esprit de corps, and leaders characteristics.

MS 402 Military Science IV **2 (2-1**
Prerequisite: MS 401
Classroom instruction is given in supply and evacuation, Army administration, role of United States in world affairs, and service orientation. On the drill field, emphasis is pla on the exercise of command, planning and executing all phases of training (instruction basic fundamentals, inspections, ceremonies, and competitions) and maximum developm of teamwork, esprit de corps, and leadership characteristics.

Mineral Industries

See Ceramic Engineering

See Geological Engineering

See Metallurgical Engineering

Modern Languages

Courses numbered 200 and above need not be followed as a sequence in their respec gamut. Two years of high school language will normally be considered the equivalent one year of college instruction in that language. All students registering for a language cot will be examined on proficiency and scheduled for the course for which they are fitted.

English (Foreign Students)

MLE 101 Elementary English: Pronunciation **3 (3-0)**
Emphasis in this course is laid upon the pronunciation and comprehension of Ameri English. Through oral reports students are encouraged to improve their diction and p nunciation. Comprehension is approached through dictation and lectures. Attention to gr mar and spelling is given as individual problems arise.

ALE 102 Elementary English: Composition **3 (3-0) f s**
Emphasis in this course is laid upon the writing of English, special attention being given to compositions, grammatical exercises, sentence structure, spelling and diction.

French

ALF 101 Elementary French **3 (3-0) f s**
Structure, diction, pronunciation and other matters of technique of the language, supplemented by readings and translations. No previous training in the language necessary.

ALF 102 French Grammar and Prose Reading **3 (3-0) f s**
Prerequisite: MLF 101 or equivalent
A survey of the basic elements of grammar accompanied and illustrated by intermediate readings progressing to the reading of standard texts.

ALF 201 French Prose: Selections From Modern French Literature **3 (3-0) f s**
Prerequisites: MLF 101, MLF 102 or equivalent
Selected readings from literary French. Attention given to the attainment of skill in reading and comprehension.

ALF 202 French Civilization **3 (3-0) f s**
Prerequisites: MLF 101, MLF 102 or equivalent
Special emphasis given to translating from French. After a preliminary survey of the land and people of France, such topics as language, arts, science, literature, philosophy, etc., are given consideration. Parallel readings and reports.

ALF 203 Review Grammar and Composition **3 (3-0) f s**
Prerequisites: MLF 101, MLF 102 or equivalent
This course will bridge the gap between basic grammar courses and the more advanced literary courses preparing the student for the more advanced type of composition and conversation expected of him in the latter. It will also offer an opportunity for students with previous knowledge of a language from secondary schools to review grammar and obtain experience in an area not normally covered in their high school work.

ALF 301 Survey of French Literature **3 (3-0) f s**
Prerequisite: Junior or senior standing
Lectures illustrated by selected readings in translation covering the development of the novel, the drama, the short story and the poetry of France from the 12th century to the present. Parallel readings and reports. No language prerequisites.

ALF 401 Introductory Scientific French **3 (3-0) f s**
This course is designed to present the grammar of scientific French as rapidly as possible in preparation for the reading course which follows.

ALF 402 Introductory Scientific French **3 (3-0) f s**
Prerequisite: MLF 401 or equivalent
Reading and translation of technical French, supplemented by discussions on terminology, word order, vocabulary analysis and other linguistic techniques. Subject material adjusted to individual needs; conferences.

German

ALG 101 Elementary German **3 (3-0) f s**
Study of the structure and technique of the language, supplemented by easy reading and translations. No previous training in the language necessary.

ALG 102 German Grammar and Prose Reading **3 (3-0) f s**
Prerequisite: MLG 101 or equivalent
A course designed primarily for students who wish to attain proficiency in reading German. Attention given to basic grammar and vocabulary with practice in the translation and interpretation of German prose.

MLG 201 German Prose: Selections from Modern German Literature **3 (3-0) f**
Prerequisites: MLG 101, MLG 102 or equivalent
Readings in German literature, a study of representative authors and their contribution the development of the German language and culture. Parallel readings and reports.

MLG 202 German Civilization **3 (3-0) f**
Prerequisites: MLG 101, MLG 102 or equivalent
Attention given to translation from German. Readings in the history and customs of Germany, supplemented by lectures on such topics as language, arts, science, philosophy, etc. Parallel readings and reports.

MLG 203 Review Grammar and Composition **3 (3-0) f**
Prerequisite: MLG 101, MLG 102 or equivalent
This course will bridge the gap between basic grammar courses and the more advanced literature courses preparing the student for the more advanced type of composition and conversation expected of him in the latter. It will also offer an opportunity for students with previous knowledge of a language from secondary schools to review grammar and obtain experience in an area not normally covered in their high school work.

MLG 301 Survey of German Literature **3 (3-0) f**
Prerequisite: Junior or senior standing
The study of various types of German literature. A brief outline of German literary development. Parallel readings in translation. No previous training in the language necessary.

MLG 401 German Grammar for Graduate Students **3 (3-0) f**
This course is open to graduate students and senior honor students and is designed to present the grammar of scientific German as rapidly as possible in preparation for the reading course which follows.

MLG 402 Scientific German **3 (3-0) f**
Prerequisite: MLG 401 or equivalent
Reading and translation of technical German, supplemented by discussions on terminology, word order, vocabulary analysis and other linguistic techniques. Subject material adjusted to individual needs; conferences.

Italian

MLI 101 Elementary Italian **3 (3-0) f**
Structure, diction, pronunciation, and other matters of technique of the language, supplemented by easy readings, individual reports and conferences. No previous training in the language required.

MLI 102 Italian Grammar and Prose Reading **3 (3-0) f**
Prerequisite: MLI 101 or equivalent
A survey of basic elements of grammar accompanied and illustrated by intermediate reading progressing to the reading of standard texts.

Russian

MLR 101 Elementary Russian **3 (3-0) f**
Basic structure of the language, supplemented by easy readings.

MLR 102 Russian Grammar and Prose Reading **3 (3-0) f**
Prerequisite: MLR 101
A course for students who wish to attain proficiency in reading Russian. Attention given basic grammar and the use of the written language.

MLR 201 Russian Prose: Selections from Russian Literature **3 (3-0) f**
Prerequisites: MLR 101, MLR 102 or equivalent
Selected readings from Russian literature. Grammar review and emphasis on vocabulary building and improvement in reading and speaking ability.

ILR 202 Russian Civilization **3 (3-0) f s**
rerequisites: MLR 101, MLR 102
eading in Russian covering the history, politics, customs, and culture of Russia. Emphasis ven to accurate translation from Russian to English. Parallel readings and reports.

Spanish

ILS 101 Elementary Spanish **3 (3-0) f s**
tructure, diction, pronunciation and other matters of technique of the language, supplemented by easy readings. No previous training in the language necessary.

ILS 102 Spanish Grammar and Prose Reading **3 (3-0) f s**
rerequisite: MLS 101 or equivalent
survey of the basic elements of grammar accompanied and illustrated by intermediate adings progressing to the reading of standard texts.

ILS 201 Spanish Civilization **3 (3-0) f s**
rerequisites: MLS 101, MLS 102 or equivalent
mphasis is placed upon translating Spanish prose and developing vocabulary. The readings ve the student a comprehensive picture of the culture, geography, history, and economy of ain.

LS 202 Hispano-American Civilization **3 (3-0) f s**
rerequisites: MLS 101, MLS 102 or equivalent
mpasis is placed upon translating Spanish prose and developing vocabulary. The readings ve the student a comprehensive picture of the culture, geography, history and economy of e Spanish American countries.

LS 203 Review Grammar and Composition **3 (3-0) f s**
rerequisites: MLS 101, MLS 102 or equivalent
his course will bridge the gap between basic grammar courses and the more advanced erary courses preparing the student for the more advanced type of composition and conrsation expected of him in the latter. It will also offer an opportunity for students with evious knowledge of a language from secondary schools to review grammar and obtain perience in an area not normally covered in their high school work.

LS 301 Survey of Spanish Literature **3 (3-0) f s**
erequisite: Junior or senior standing
cture illustrated by selected reading in translation covering the development of the novel, ama, short story, and poetry of Spain from 1300 to the present. Parallel reading and ports by students.

LS 307, 308 Technical Spanish **3 (3-0) f s**
erequisite: MLS 201 or equivalent
study of technical and industrial literature. Particular attention given to the special terminology characteristic of such literature with a view to the acquisition of a practical vocabury. Individual conferences and reports.

LS 401 Introductory Scientific Spanish **3 (3-0) f s**
his course is designed to present the grammar of scientific Spanish as rapidly as possible preparation for the reading course which follows.

LS 402 Introductory Scientific Spanish **3 (3-0) f s**
erequisite: MLS 401 or equivalent
ading and translation of technical Spanish, supplemented by discussion on terminology, rd order, vocabulary analysis and other linguistic techniques. Subject material adjusted to dividual needs; conferences.

General Courses

ML 321, 322 Romance Literature **2 (2-0)**
Prerequisite: Junior or senior standing
A course cutting across language barriers to illustrate the most outstanding literary productions of France, Spain, Italy, and Portugal and showing the cultural and social pattern these nationalities having a common language inheritance. Selected readings and reports.

ML 323, 324 Germanic Literature **2 (2-0)**
Prerequisite: Junior or senior standing
A study of the literary productions in each of the various types of Germanic literature, ar lectures on their cultural background. Designed primarily to meet the needs of students wl wish to supplement their knowledge of their own literature with that of the literature other civilizations. Attention is given to the literary monuments of Germany, Holland, Dec mark, Iceland, and the Scandinavian countries. No foreign language prerequisites.

Nuclear Engineering

Courses for Graduates and Advanced Undergraduates

NE 501 Nuclear Engineering Systems I **3 (3-0)**
An introductory course in reactor theory and engineering including the fission process; neutro energy distribution; lethargy; neutron slowing, diffusion and interactions; Fermi age theor the diffusion equation, criticality conditions; reactor instrumentation.
Graduate Stu

NE 502 Nuclear Engineering Systems II **3 (3-0)**
Continuation of reactor theory from NE 501. Topics include treatment of reactor pa meters for homogeneous and heterogeneous reactors; reflected reactors, two-group theo reactor kinetics, temperature effects, control rod theory, perturbation theory and transpo theory.
Graduate Stu

NE 503 Nuclear Reactor Theory I **3 (3-0)**
Course considers reactor as a system including aspects of reactor control, radiation protectio shielding and thermal design.
Graduate Stu

NE 531 (PY 531) Nuclear Reactor Laboratory **1 (0-1) f**
Corequisites: PY 518, PY 530
Observation and measurements of static and dynamic nuclear reactor behavior, the effecti ness of control and temperature, and correlation with theory. Experiments of the motio and detection of neutrons and gamma-rays, with emphasis on the research uses of nucle reactor radiations.

Courses for Graduates Only

NE 619 (PY 619) Reactor Theory and Analysis I **3 (3-0)**
Prerequisite: PY 530
The theory of neutron slowing, resonance capture, Doppler effect, and thermal flux dist butions in heterogeneous nuclear reactors. Analysis of reactor control by temperature, effe of localized and distributed absorbers, fission products, fuel consumption and productio One-velocity neutron transport theory.

NE 620 (PY 620) Nuclear Radiation Attenuation **3 (3-0)**
Prerequisites: PY 530, MA 512
Physical theory of the behavior of neutrons, gamma-rays and charged particles in matt Calculation of source terms, attenuation factors, heating rates, geometrical transformatio radiation streaming and radioactive decay effects required in the design of nuclear radiati shields for reactors, accelerators, and space vehicles. Transport theory of gamma-ray a neutron transmission through matter. Analysis of experimental techniques for obtain shielding data.

NE 630 (PY 630) Reactor Theory and Analysis II **3 (3-0) s**
Prerequisite: PY 530
The theory of neutron multiplication in uniform media, with several dimensions, regions, and neutron energy groups. Reactor control by absorbers, time dependent reactor behavior, matrix treatment of perturbation theory, neutron thermalization, energy dependent neutron transport theory, and multigroup machine methods.

Occupational Information and Guidance

(See Education)

Philosophy and Religion

Courses for Undergraduates

HI 201 Logic **3 (3-0) f s**
anguage as symbol system, the formal structure of reasoning, and characteristics of empirical nowledge; emphasis on the establishment of reflective habits.

HI 203 Introduction to Philosophy **2 (2-0) f s**
The course is designed (1) to acquaint the student with basic principles and problems of ogic and theory of knowledge; (2) to develop ability in effective philosophical analysis and he formulation of one's own ideas in selected areas of contemporary concern.

HI 205 Problems and Types of Philosophy **3 (3-0) f s**
The great philosophers of the western world, the socio-cultural heritage in which they vorked, their major concerns and conclusions; the relation of philosophy to vital questions f human life.

EL 301 Religious Groups and Trends in the United States **2 (2-0) f s**
ackground and characteristic beliefs of the major religious groups in the United States; urvey of the dominant trends and movements in contemporary American religion.

EL 302 The Bible and Its Background **3 (3-0) f s**
ackground of the Bible, origin, growth and development of central concepts, leading personlities, and the process by which it has come to us as viewed in the light of modern holarship.

EL 303 Christian Ethics **2 (2-0) f s**
n analysis of the major areas of modern life in the light of the ethical teachings of Christiany, with an examination of the religious faith upon which these teachings rest.

HI 305 Philosophy of Religion **3 (3-0) f s**
sychological and historical roots of religious belief; science, philosophy, and religion; the tional foundations of theism; the concept of God in Western thought.

HI 306 Philosophy of Art **3 (3-0) f s**
udy of historical and contemporary theories of art; development of coherent set of conpts for analysis and discussion of esthetic experience, critical judgments, works of art and eir relations to other aspects of culture.

HI 307 Ethics **3 (3-0) f s**
udy of major ethical theories; systematic analysis of the nature of value judgments, and the ncepts of moral obligation, right and good; personal and social aspects of human conduct.

PHI 309 Marriage and Family Living **3 (3-0) f**
Secular and religious concepts of marriage; physical, socio-psychological, and ethical aspec of premarital and marital relationships; parenthood; analysis of value judgments relative marriage and family living; formulation of philosophy of marriage.

PHI 311 Parent-Child Relationships **2 (2-0) f**
Principles of inter-personal relationships; democratic values and the attainment of growt by parent and child through freedom, responsibility, and creative activity; analysis of curren theories of husband-wife, and parent-child relationships.

PHI 395 Philosophical Analysis **3 (3-0) f**
Semantical, logical, and experiential methods of investigation; intensive application of critica inquiry to a few fundamental problems including the nature of knowledge and its validatio and value judgment; major objective to afford personal participation in and acquaintanc with philosophical analysis as intellectual tool with wide applicability.

PHI 401 Symbolic Logic **3 (3-0) f**
Modern methods in logic involving formalized expression that avoids inherent difficulties an ambiguities of ordinary language and makes possible greater effectiveness in handling comple material.

REL 403 Religions of the World **3 (3-0) f**
Background, general characteristics, and basic teachings of the major living religions of th world; consideration of contemporary secular movements that are in a sense religions.

PHI 405 Foundations of Science **3 (3-0) f**
Nature and validity of knowledge, basic concepts of modern science, scientific method, an the implications of the philosophy of modern science for ethics, social philosophy, and th nature of reality.

Courses for Graduates and Advanced Undergraduates

REL 502 Problems of Religion **3 (3-0) f**
Prerequisite: Six term credits in religion or related fields
Major trends in contemporary theology; significance of the resurgent interest in religion an the growth of the church in recent times; problem of communication between theology an science; the ecumenical movement.

Physical Education

The College requires four semesters in physical education to be taken consecutively durin the freshman and sophomore years. Each semester of physical education is divided into tw eight-week courses or activities. These courses are divided into two areas; the areas are Pre scribed Courses and Elective Sports Activities. In as much as staff, facilities, and allotment c time will permit, each student is directed into courses which will best meet his individua needs. The basis for determining the needs of the individual student are as follows:

1. *Medical Examination.* The required medical examination should give the College Healt Service an awareness of unusual physical impairments that a student may have. If th student knows of any other possible reason for limiting his physical activity, he shoul inform the college physician. The college physician will then recommend possible limita tions in activities to the Physical Education Department. Based on this recommendation a special program will be arranged for the student involved. All medical recommendation must be cleared through the College Health Service.
2. *Swimming Test.* All students who have any requirement in physical education to mee at State College, must take a swimming test. Those students who cannot pass the test ar assigned to Beginning Swimming as their first course in physical education. This cours must be passed, qualifying the student as a swimmer, before the physical education re quirement is completed. Those students who pass the swimming test are further classifie according to their ability level. This classification determines which swimming cours they select first.

3. *Athletic Ability Test.* An athletic ability test is given to all freshmen during Freshman Orientation Week. Students who score below the 15th percentile are enrolled in a course in fundamental sports for two semesters or until they gain a level of ability which indicates they are ready for the basic sports program. The students who score between the 15th and the 75th percentile are enrolled in the basic sports program. Those who score above the 75th percentile are permitted to elect their activities along with the sophomores. All sophomores, juniors, and seniors are allowed to select activities of their choice.
4. *Health Knowledge Test.* All freshmen are required to take a health knowledge test during Freshman Orientation Week. Those who do not pass this test must take a course in hygiene for eight weeks (½ semester) in lieu of one physical education activity.

Requirements for Veterans and Transfer Students

1. All servicemen who have taken as much as six-months military service will receive one year of credit, PE 101, PE 102.
2. All servicemen will be required to take one year of Physical Education (PE 201, PE 202.)
3. A former student or transfer student with one earned semester credit in Physical Education, plus military service must earn one more semester credit. (PE 202)
4. A student who has earned one year (2 semester credits) here or elsewhere, plus his credit of one year for military service, will have completed his requirements.
5. Veterans or transfer students who have received credit for two full years of Physical Education, may elect to take additional courses which would be in the 300 series—PE 301, PE 302, PE 303, PE 304.
6. All students who have received one year of credit in Physical Education, from military service or as a transfer student, will be exempt from the hygiene requirement.
7. All students who take even one semester of physical education as a required course at North Carolina State College must pass the swimming requirement.

Courses

PE 101, 102 **1 (0-2) f s**

PE 201, 202 **1 (0-2) f s**

PE 301, 302, 303, 304 Junior and Senior electives **1 (0-2) f s**

Note: Juniors and seniors may elect any activity from the controlled elective sports area in which they have not previously received credit. Transfer students and veterans who cannot swim will be urged to elect beginning swimming.

Courses in Prescribed Sports Area

Beginning Swimming: Offered in the fall semester. A course designed for meeting the swimming requirement and for preparing the student for intermediate swimming.

Fundamental Sports: Offered in the fall and spring. A course designed for the low skilled student where a particular type of activity can be given to meet his special needs.

Basic Sports: Offered in the fall and spring semesters. A course designed to acquaint the medium skilled student with appropriate activities to prepare him for elective sports.

Hygiene: Offered in the second half of the fall semester, and in the first half of the spring semester. A course designed to meet the health knowledge requirement and to guide the student to a more healthful way of life.

Courses in Elective Sports Area

All courses offered as elective sports are classified as Team Sports, Aquatics, Recreational Sports, Developmental Activities, or Varsity Sports. A student cannot repeat any course for credit. The courses are listed under their proper classification as follows.

Team Sports:

Basketball: Offered in the second half of the fall semester and in the first half of the spring semester. A course designed to cover the fundamentals of shooting, offensive and defensive strategy, history and rules.

Football (touch): Offered in the first half of the fall semester. A course designed to cover the fundamentals of offensive and defensive play.

Soccer: Offered in the first half of the fall semester. A course designed to acquaint the student with the fundamental skills and to provide out-of-door activity in a team sport.

Softball: Offered in the second half of the spring semester. A course designed to include the fundamentals, history, and rules of the game.

Speedball: Offered in the fall and spring semesters. A course designed to teach the fundamentals, together with history and rules of squash.

Volleyball: Offered in the first half of the fall semester, and in the entire spring semester. A course designed to include the fundamentals, history, and rules of the game.

Aquatics:

Swimming (Intermediate): Offered in both fall and spring semesters. A course designed to give the student competence in four basic strokes and two dives, preparatory to the Life Saving Program.

Water Sports: Offered in fall and spring semesters. A course to teach the skills of water-polo and water basketball, plus improvement in stamina and skill necessary to improving ability. This course may not be taken by those students who have progressed beyond Senior Life Saving.

Swimming (Senior Red Cross Life Saving): Offered in the fall and spring semesters. Prerequisite: Intermediate Swimming or the equivalent. A course designed to qualify students for a Senior Red Cross Life Saving certificate and the possibility of a Water Safety Instructor's rating.

Swimming (Red Cross Instructors): Offered in the fall and spring semesters. Prerequisite: A certificate for Senior Red Cross Life Saving. A course designed to qualify students for a Water Safety Instructor's rating.

Recreational Sports:

Angling: Offered in the first half of the fall semester, and the second half of the spring semester. A course designed to teach the fundamentals of spin, fly and bait casting, and an understanding of the game of skish.

Badminton: Offered in the second half of the spring semester. A course designed to give the beginner a thorough knowledge of the basic strokes and a general knowledge of the history, rules and strategy of the game.

Bowling (Ten Pins): Offered in the first and second half of the fall semester, and in the first half of the spring semester. Fundamentals of ball selection, grip, stance, and delivery are taught, together with rules, history, scoring and general theory of spare coverage. Students take turns setting pins. (Fee $2.50).

Golf: Offered in the first half of the fall semester and in the second half of the spring semester. A course designed for the beginner; grip, stance, swing, and use of the various clubs, together with the history and etiquette of play.

Handball (Four Wall): Offered in both fall and spring semesters. A course designed to include the fundamentals, together with history and rules of handball.

Roller Skating: Offered during the second half of the fall semester and the first half of the spring semester. A course designed to teach the fundamentals of roller skating. Emphasis will be on body balance and control.

Squash: Offered in both fall and spring semesters. A course designed to include the fundamental skills, history, and rules of the game.

Tennis (Beginning): Offered in the first half of the fall semester and in the second half of the spring semester. A course designed to give the beginner a thorough knowledge of the history, rules and basic strategy of the game.
Tennis (Advanced): Offered in the first half of the fall semester and in the second half of the spring semester. Prerequisite: Beginning Tennis or its equivalent. Basic strokes are reviewed and the more difficult strokes taught. Emphasis is placed upon strategy during play and upon a more factual knowledge of the game and court etiquete.

Developmental Activities:

Boxing: Offered in the second half of the fall semester. A course designed to acquaint the student with the fundamentals, history, and rules, with special emphasis on defensive techniques.
Cross Country: Offered both fall and spring semesters. A course designed to develop knowledge, skill, and interest in cross-country.
Gymnastics: Offered in the second half of the fall semester and first half of the spring semester. A course designed to include the fundamentals of gymnastics on the parallel bars, side horse, trampoline, and mats.
Advanced Gymnastics: Offered in the fall semester. A course designed for those students who wish to progress beyond the beginning course in gymnastics.
Track and Field: Offered during the first half of the fall semester and second half of the spring semester. A course designed to develop knowledge, skill and interest in track and field events.
Wrestling: Offered in the first half of the fall semester and the first half of the spring semester. A course designed to give the fundamentals, history and rules of wrestling.

Varsity Sports:

Note: students may elect, with the approval of the coach, the following varsity sports: baseball, basketball, cross-country track, football, golf, soccer, swimming, track, and wrestling.

Physical Sciences and Applied Mathematics

PSM 100 Orientation **0 (1-0) f**
Introduction to the fields of the physical sciences and mathematics. Required of all new freshmen in the school. Staff

Physics

Courses for Undergraduates

PY 201, 202 General Physics **5 (3-4) f s; f s**
Corequisite: MA 201
Required of sophomores in sciences, mathematics, and engineering. A study of classical and modern physics in which the analytical approach is employed. Emphasis is placed on the understanding of fundamental facts and principles, and on the solution of problems. The MKS system of units is used, and calculus is applied as needed. Demonstration lectures, recitations, problem drill and laboratory work are coordinated to give a working knowledge of basic principles. PY 201, mechanics, sound, and heat; PY 202, electricity, light, and modern physics. Staff

PY 205, 206, 207 General Physics **4 (2-4) s; f; s**
Corequisite: MA 201
Intended primarily for majors in departments of the School of Physical Sciences and Applied Mathematics. A study of classical and modern physics in which fundamental principles are emphasized. Calculus is used throughout as needed. Demonstrations and laboratory work tend to emphasize the modern aspects for a firm foundation for further study in the physical sciences.

PY 211, 212 General Physics **4 (3-3) f s;**
Prerequisite: MA 111
A survey of general physics designed to provide a practical understanding of the fundamentals on which technology is based. Recitations, demonstrations, and laboratory work. PY 211 mechanics and heat; PY 212, sound, light, and electricity. Staff

PY 221 College Physics **5 (5-0) f**
Prerequisite: MA 111
Required in certain curricula of the School of Agriculture. An introduction to the origins of physical science, the fundamental principals of physics, and the many applications to modern technology. The important concepts in the classical areas of mechanics, heat, sound, electricity and magnetism, and light are presented, along with a brief survey of modern atomic physics. Lectures and demonstrations with class participation. Staff

PY 223 Astronomy and Astrophysics **3 (3-0)**
Prerequisite: PY 212 or PY 202
An introduction to descriptive and physical astronomy, with attention to the solar system, constellations, and star groups. The physical aspects of stars, such as brightness, temperature, energy and composition, are reviewed, along with the development of theories of galaxies and the universe. The nature of fusion sources of energies in stars is discussed. Mr. Snyder

PY 300 Evaluation of Radiation Hazards **3 (2-2) f s**
Prerequisites: PY 202 and CH 102
An introductory course on radiation and protection from the hazards of radiation designed principally for non-physics students. Fundamentals of radiation, radioactivity, and dosimetry. Biological effects. Maximum permissible exposure limits and MPC in air and water. Shielding, handling methods, decontamination, waste disposal, and monitoring techniques. Mr. Story

PY 401 Mechanics **4 (3-3) f**
Prerequisite: PY 202; Corequisite: MA 301
An intermediate course in theoretical mechanics. Dynamics of particles and rigid bodies with an introduction to advanced dynamics. Lagrange's equations and simple applications, Lorentz transformations and an introduction to the theory of special relativity. Mr. Moss

PY 402 Heat and Sound **4 (3-3) s**
Prerequisite: PY 302; Corequisite: MA 301
An intermediate course in the principles of thermodynamics, kinetic theory, heat transfer, and vibrations. Mr. Moss

PY 403 Electricity and Magnetism **4 (3-3) f**
Prerequisite: PY 202; Corequisite: MA 301
An intermediate course in the fundamentals of static and dynamic electricity, and electromagnetic theory. Mr. Doggett

PY 404 Optics **4 (3-3) s**
Prerequisite: PY 202; Corequisite: MA 301
An intermediate course in physical and geometrical optics. Mr. Doggett

PY 407 Introduction to Modern Physics **3 (3-0) f s**
Prerequisites: PY 202, MA 202
A survey of the important developments in atomic and nuclear physics of this century. Among topics covered are: atomic and molecular structure, determination of properties of ions and fundamental particles, the origin of spectra, ion accelerators, and nuclear reactions. Staff

PY 410 Nuclear Physics I **4 (3-3) f s**
Prerequisite: PY 407
An introduction to the properties of the nucleus, and the interaction of radiation with matter. A quantitative description is given of natural and artificial radioactivity, nuclear reactions, fission, fusion, and the structure of simple nuclei. Mr. Waltner

PY 491 Senior Research **3-3**
Prerequisite: Senior Honors program standing, except with special permission
Investigations in physics under the guidance of staff members. Literature reviews, experimental measurements, or theoretical studies. A project report will be prepared. Staff

Courses for Graduates and Advanced Undergraduates

PY 501 Wave Mechanics **3 (3-0) s**
Prerequisites: PY 407, MA 511, and either PY 401 or PY 403
An introduction to the foundations of quantum and wave mechanics, with solutions of the problem of the free particle, harmonic oscillator, rigid rotating molecule, and the hydrogen atom. Approximation methods are developed for more complex atomic systems.
Mr. Cobb

PY 503 Introduction to Theoretical Physics **3 (3-0) f**
Prerequisites: PY 401 or PY 403, MA 511
An introductory course which offers preparation necessary for advanced graduate study, presented from the viewpoint of vector and tensor calculus. Particle dynamics, Lagrange's equations of motion, Hamilton's principle, mechanics of rigid bodies, topics in electromagnetic theory and relativity, with an elementary treatment of the motion of charged particles.
Mr. Freyre

PY 507 Advanced Atomic Physics **3 (3-0) f**
Prerequisites: PY 401 or PY 403, MA 511
A study of atomic structure and spectra, with emphasis on the analysis of spectra. Topics include the alkali spectra, multiplet structure, electron spin, hyperfine structure, moments, etc.
Mr. Cobb

PY 508 Ionization in Gases **3 (3-0) f**
Prerequisites: PY 401, PY 403, MA 301
Statistical theory of matter; excitation and ionization in gases; mobilities and conductivities; processes at solid surfaces in ionized gases; characteristic forms of electrical discharges in gases.
Mr. Bennett

PY 509 Plasma Physics **3 (3-0) s**
Prerequisite: PY 508
Individual and collective motion or charged particles in electric and magnetic fields and through ionized gases. Pinch effect, relativistic streams, conductivities, and runaway electrons. Astrophysical concepts and approximations. Properties of plasmas, including waves, confinement, instabilities and shocks, with applications.
Mr. Bennett

PY 510 Nuclear Physics II **4 (3-3) s**
Prerequisite: PY 410
The description and analysis of nuclear energy levels, meson theory, nuclear resonance, atomic and molecular magnetism, and cosmic radiation. Principles and experiments in neutron physics are discussed. In the laboratory work, emphasis is placed on gaining experience in independent research.
Mr. Waltner

PY 518 Radiation Hazard and Protection **3 (3-0) f s**
Prerequisite: PY 410
The hazards from external exposure to ionizing radiation are evaluated, and the factors influencing dosage due to internal exposure are investigated. Methods of providing protection are analyzed.
Mr. Underwood

PY 520 Physical Measurements in Radioactivity **3 (2-3) f s**
Prerequisite: PY 410
The principles of experimental measurements on radioactive materials are presented and demonstrated through laboratory work. Emphasis is placed on preparation of samples for precise quantitative study, detection of radiations, and analytical interpretation of experimental data.
Mr. Lynn

PY 530 (NE 530) Introduction to Nuclear Reactor Theory **3 (3-0) s**
Prerequisites: PY 410, MA 401 or MA 511
The principles of neutron motion in matter, with emphasis on the analysis of the nuclear chain reactor. Slowing of neutrons, diffusion, space distributions of flux, conditions for criticality, group theories, and the time dependent behavior of fissionable assemblies. Staff.

PY 531 (NE 531) Nuclear Reactor Laboratory **1 (0-3) f s**
Corequisites: PY 518, PY 530
Observation and measurements of static and dynamic nuclear reactor behavior, the effectiveness of control and temperature, and correlation with theory. Experiments on the motion and detection of neutrons and gamma rays, with emphasis on the research uses of nuclear reactor radiations. Staff

PY 541 Special Problems in Physics **1-3 credits by arrangement**
Prerequisite: Permission of department
Study and research in special topics of classical and modern physics. Experimental measurements with emphasis on the treatment and interpretation of data, literature surveys, or theoretical investigations. Graduate Staff

PY 552 Introduction to the Structure of Solids **3 (3-0) s**
Prerequisites: PY 202, MA 202; PY 403 and PY 407 are recommended
Basic considerations of amorphous and crystalline solids, metals, conductors, and semi-conductors. Mr. Doggett

PY 555 (MA 555) Principles of Astrodynamics **3 (3-0)**
Prerequisites: MA 511, either PY 401 or EM 312
The differential equations of motion in two-body problems and their integrals; orbit theory; integrals of the n-body problem; differential equations of motion of natural and artificial satellites and their approximate solutions. Mr. Musen

PY 601, 602 Advanced General Physics **3 (3-0) f s**
Prerequisite: PY 503; Corequisite: MA 661
Mathematical and theoretical approach to relationships between the various branches of physics, with applications to mechanical, electrical, optical, thermal, and vibratory problems. The restricted theory of relativity, electrodynamics, the theory of electrons, classical field theory, and the general theory of relativity. Mr. Davis

PY 610 Advanced Nuclear Physics **3 (3-0) s**
Prerequisites: PY 501, PY 510
Current hypotheses of nuclear structure and reactions including deuteron binding, neutron-proton scattering, the compound nucleus, stripping reactions, shell structure, beta decay, neutron resonances, and mesons. The use of neutrons in present-day nuclear research is emphasized. Staff

PY 611 Quantum Mechanics **3 (3-0) f**
Prerequisites: PY 501, MA 512
Theory of quantum mechanics with applications to atomic and molecular structure, scattering phenomena, and a semi-classical treatment of the interaction of radiation with matter. Mr. Davis

PY 612 Advanced Quantum Mechanics **3 (3-0) s**
Prerequisites: PY 601, PY 611
Dirac's relativistic electron theory, elementary scalar and vector meson field theory. Introduction to quantum electrodynamics and the general theory of quantized fields. Mr. Davis

PY 617, 618 Principles of Health Physics Measurements **2 (1-3) f s**
Prerequisite: PY 510; Corequisites: PY 518, PY 520 recommended
The physical principles underlying health physics measurements are studied both theoretically and experimentally. The purpose of the course is to develop in the student an insight into the principles and problems involved in measuring radiation and determining dose. Mr. Underwood

PY 619 (NE 619) Reactor Theory and Analysis I **3 (3-0) f**
Prerequisite: PY 530
The theory of neutron slowing, resonance capture, Doppler effect, and thermal flux distributions in heterogeneous nuclear reactors. Analysis of reactor control by temperature, effects of localized and distributed absorbers, fission products, fuel consumption and production. One-velocity neutron transport theory. Mr. Murray

PY 620 (NE 620) Nuclear Radiation Attenuation **3 (3-0) f**
Prerequisites: PY 530, MA 512
Physical theory of the behavior of neutrons, gamma-rays and charged particles in matter. Calculation of source terms, attenuation factors, heating rates, geometrical transformations, radiation streaming and radioactive decay effects required in the design of nuclear radiation shields for reactors, accelerators, and space vehicles. Transport theory of gamma-ray and neutron transmission through matter. Analysis of experimental techniques for obtaining shielding data. Mr. Doggett

PY 621 Kinetic Theory of Gases **3 (3-0) f**
Prerequisites: PY 501, PY 503, and MA 512
The theory of molecular motion, including velocity and density distribution functions; the phenomena of viscosity, heat conduction, and diffusion; equations of state; fluctuations.
Mr. Freyre

PY 622 Statistical Mechanics **3 (3-0) s**
Prerequisites: PY 501, PY 503, MA 512, and PY 612
A treatment of statistical mechanics from both the classical and quantum points of view. Development of thermodynamic theories and application to atomic systems. Mr. Freyre

PY 630 (NE 630) Reactor Theory and Analysis II **3 (3-0) s**
Prerequisite: PY 530
The theory of neutron multiplication in uniform media, with several dimensions, regions, and neutron energy groups. Reactor control by absorbers, time dependent reactor behavior, matrix treatment and perturbation theory, neutron thermalization, energy dependent neutron transport theory, and multigroup machine methods. Mr. Murray

PY 631, 632 Atomic and Molecular Spectra **3 (3-0) f s**
Prerequisite: PY 501
Atomic models and coupling schemes; multiplet series, Zeemen, Paschen-Back and Stark effects; hyperfine structure and complex spectra; spectra of polyatomic molecules; infrared and Ramen spectra. Applications adopted to the interest of the students in the course.
Staff

PY 670 Seminar **1 (0-3) f s**
Literature surveys and written and oral presentation of papers on current topics in (a) general physics, (b) nuclear physics, (c) ionic phenomena of space physics, (d) plasma physics, (e) non-inertial space mechanics. Staff

PY 690 Research **Credits by arrangement**
Graduate students sufficiently prepared may undertake research in some selected field of Physics. Staff

Plant Pathology

Courses for Undergraduates

PP 315 Plant Diseases **3 (2-3) f**
Prerequisite: BO 103
The nature and symptoms of disease in plants and the characteristics of important plant pathogenic nematodes, viruses, bacteria, and fungi are studied. An understanding of the important concepts and methods of disease control is developed, based on a knowledge of major types of plant diseases. Mr. Powell

PP 318 Diseases of Forest Trees **3 (2-3) s**
Prerequisite: BO 103
The nature and symptoms of major types of tree diseases and the important characteristics of their casual agents are studied. Emphasis is placed on the influence of environmental factors on disease development as well as the basic principles and methods of control.
Mr. Kelman

Courses for Graduates and Advanced Undergraduates

PP 500 Advanced Plant Pathology **2 (2-0) s**
Prerequisite: PP 315 or equivalent
An advanced study of the economic importance, symptoms, disease cycles, epiphytology, and control of major groups of plant diseases. Students who register for this course are also required to register for either PP 501 or PP 502, or they may register for both.
Mr. Winstead

PP 501 Advanced Plant Pathology Laboratory-Field Crops Diseases **1 (0-3) s**
Prerequisite: PP 315 or equivalent
Laboratory course for students whose major interest is diseases of field crops to accompany lecture course in advanced plant pathology (PP 500). Diseases will be selected for study which are important on field crops. Either this course or PP 502 must be taken concurrently with PP 500.
Mr. Kline

PP 502 Advanced Plant Pathology Laboratory-Horticulture Crops Diseases **1 (0-3) s**
Prerequisite: PP 315 or equivalent
Laboratory course for students whose major interest is diseases of horticulture crops to accompany lecture course in advanced plant pathology (PP 500). Diseases will be selected for study which are important on fruit, ornamental and vegetable crops. Either this course or PP 501 must be taken concurrently with PP 500.
Mr. Winstead

PP 503 Diagnosis of Plant Diseases **Summer Session 3 (1-4)**
Prerequisites: One advanced course in Plant Pathology, permission of instructor
A study of techniques used in plant disease diagnosis with emphasis on diagnostic value of signs and symptoms for certain types of diseases. Consideration will be given to major sources of descriptive information on plant pathogens and the use of keys for the identification of fungi.
(Offered in 1962 and alternate years)
Mr. Hebert

Courses for Graduates Only

PP 601 Phytopathology I **4 (1-6)**
Prerequisites: PP 315, permission of the instructor
A study of the principles of phytopathological research. The course is designed to apply the classical scientific method to disease investigation. Exercises will include appraising disease problems, reviewing literature, laboratory and greenhouse experiments, and the evaluation and presentation of data.
Mr. Apple

PP 602 Phytopathology II **4 (2-6)**
Prerequisites: PP 315, permission of the instructor
The basic concepts of the etiology, pathology, epiphytology, and control of plant diseases.
Mr. Nusbaum

PP 604 Plant Parasitic Nematodes **2 (1-3)**
Prerequisite: PP 315
A study of morphology, anatomy, physiology, and taxonomy of plant parasitic nematodes. Methods of isolating nematodes from soil and plant parts and other laboratory techniques used in the study and identification of nematodes will be considered.
Mrs. Triantaphyllo

PP 605 Plant Virology **3 (1-6) f**
Prerequisites: PP 315, GN 411, and a course in organic chemistry
A study of plant viruses including effects of host plants, transmission, classification, methods of purification, determination of properties, chemical nature, structure, and multiplication.
(Offered in 1963-64 and alternate years) Mr. Hebert

PP 607 (GN 607) Genetics of Fungi **3 (3-0) f**
Prerequisites: GN 512 or equivalent, permission of instructor
Review of major contributions in fungus genetics with emphasis on principles and theories that have evolved in recent developments.
(Offered in 1962-63 and alternate years) Mr. Nelson

PP 608 History of Phytopathology **1 (1-0) f**
Prerequisites: PP 315, permission of instructor
Development of the science of phytopathology from its early beginning to the early part of the 20th century.
(Offered in 1963-64 and alternate years) Mr. Ellis

PP 609 Current Phytopathological Research under Field Conditions **2 (1-3) s**
Prerequisite: Graduate standing
Study of concepts involved, procedures used, and evaluation made in current phytopathological research by Plant Pathology staff. Visits to various Research Stations will be made by the class. Mr. Clayton

PP 611 Nematode Diseases of Plants **3 (1-4) s**
Prerequisite: PP 604
A study of plant diseases caused by nematodes. Special consideration will be given to host-parasite relationships, host ranges, and life cycles of the more important economic species. Principles and methods of control will be considered. Mr. Sasser

PP 612 Plant Pathogenesis **3 (2-3) f**
Prerequisite: PP 500
A study of interactions of pathogens and suscept plants. The following major topics will be considered: hydrolytic enzyme systems involved in tissue disintegration; role of enzymes, polysaccharides, and toxins in wilting phenomena; mode of action of toxins in altering plant metabolism; role of growth regulators in hypertrophic responses; alterations in respiration and other physiological processes during pathogenesis; and nature and biochemical basis for disease resistance.
(Offered in 1962-63 and alternate years) Mr. Kelman

PP 615 Research in Plant Pathology **Credits by arrangement**
Prerequisites: Graduate standing and consent of instructor
Original research in plant pathology. Graduate Staff

PP 625 Seminar in Plant Pathology **1 (1-0) f s**
Prerequisite: Consent of seminar chairman
Discussion of phytopathological topics selected and assigned by seminar chairman.
Graduate Staff

Political Science

(See History and Political Science)

Poultry Science

Courses for Undergraduates

PO 201 Poultry Production **4 (3-3) f s**
Principles of broiler, market eggs, hatching egg and turkey productions. Classes, breeds and varieties identification of chickens and turkeys. Breeding, incubation, raising, housing, feeding, and parasite control, marketing of chickens, eggs and turkeys. Messrs. Brown, Martin

PO 301 Poultry Quality Evaluations **2 (1-3) f**
Prerequisite: PO 201
Elective for others with permission of instructor.
Evaluation of poultry for production and standard qualities; determining market, poultry and eggs. Mr. Brown

PO 351 Poultry Grading **1 (0-3) f**
Prerequisite: PO 301
Laboratory experience in determining federal grades of poultry and eggs. Mr. Brown

PO 401 Poultry Diseases **4 (3-3) s**
The major infectious, non-infectious and parasitic diseases of poultry are studied with respect to economic importance, etiology, susceptibility, dissemination, symptoms and lesions. Emphasis is placed upon practices necessary for the prevention, control and treatment of each disease. Mr. Craig.

PO 402 Commercial Poultry Enterprises **4 (3-2) s**
Required of majors in Poultry Science
Elective for others with permission of instructor.
Principles of incubation of chicken and turkey eggs; hatchery management; organization and development of plans for the operation and maintenance of a commercial poultry farm for meat and egg production; study of the types of buildings, equipment and methods of management currently employed by successful poultrymen in North Carolina. Problem.
Mr. Brown

PO 403 Poultry Seminar **1 (1-0) f s**
Current topics and problems relating to Poultry Science and to the poultry industry are assigned for oral report and discussion. Two semesters. Staff

PO 404 (FS 404) Poultry Products **3 (2-3) f**
Prerequisites: ZO 103, CH 101
Required of majors in Poultry Science.
Elective for others with permission of instructor.
Selection, processing, grading, and packaging poultry meat and eggs. Factors involved in preservation of poultry meat and eggs. Mr. Fromm

Courses for Graduates and Advanced Undergraduates

PO 520 Poultry Breeding **3 (2-3) f**
Prerequisite: GN 411
Required of Poultry Science majors.
Application of genetic principles to poultry breeding, considering physical traits and physiological characteristics—feather patterns, egg production, hatchability, growth, body conformation and utility. Mr. Martin

PO 521 Poultry Nutrition **3 (2-3) f**
Prerequisite: CH 220 or 221
Required of majors in Poultry Science; elective for others.
Elective for others with permission of instructor.
A study of proteins, carbohydrates, fats, minerals and vitamins required for growth, egg production and reproduction in the chicken and turkey. Symptoms and lesions induced by nutritional deficiencies. Compounding different types of poultry mashes and methods of feeding these mashes. The production of certain vitamin and mineral deficiencies in chicks for observation and examination. Mr. Kelly

PO 522 Endocrinology of the Fowl **3 (2-3) s**
Prerequisite: ZO 301 or equivalent
The endocrine system is studied with respect to its physiological importance in such intricate processes as metabolism, growth and reproduction. Emphasis is placed upon this system for the fowl, but mammalian examples are also used to illustrate basic concepts of the science. The interests of the students will be considered in the selection of illustrative material.
Mr. Garren

Courses for Graduates Only

Graduate courses may not be offered if registration for the course is too low or if the faculty or facilities become unavailable.

PO 602 Advanced Poultry Nutrition **3 (0-6) arrange**
Prerequisites: PO 521, CH 551 or equivalent
Students taking this course will conduct a research problem in poultry nutrition. This problem will involve the designing and carrying out of microbiological and chick experiments. The students will obtain practice in correlating results obtained in microbiological and chick assays. Mr. Hill

PO 611 Poultry Research **1-6 (arrange) f s**
Prerequisite: Graduate standing
Appraisal of present research, critical study of some particular problem involving original investigation. Problems in poultry breeding, nutrition, disease endocrinology, hematology or microbiology. Credits: A maximum of six is allowed toward a master's degree.
Graduate Staff

PO 613 Special Problems in Poultry Science **1-6 (arrange) f s**
Prerequisite: Graduate standing
Specific problems of study are assigned in various phases of poultry science. Graduate Staff

Product Design

PD 201, 202 Product Design and Orientation **4 (3-6) f s**
Prerequisite: DN 102
Required of second year students in Product Design
Elementary problems in form and function. Transitional implications of handcrafted and mass-produced objects, in various materials. Demonstrations by specialists in graphics, photography, rendering, modeling, typography, and technical illustration. Visits to design departments of local industries. Mr. Baron

PD 301, 302 Product Design **6 (3-12) f s**
Prerequisites: PD 202, PY 212
Required of third year students in Product Design
Manufacturing and structural considerations in the design of a wide range of products.
Mr. Papanek

PD 331,332 Materials and Processes **3 (3-0) f s**
Required of third year students in Product Design
Study of the basic materials of industry, from raw materials and their properties to fabrication techniques, design criteria and potential.

PD 401, 402 Advanced Product Design **6 (3-12) f s**
Prerequisites: PD 302, PD 332
Continuation of product design into more complex systems. Emphasis is placed on functional innovation and integration of form and structure. Thorough analysis of fabrication by models and sketches. Mr. Macomber

PD 422 Office and Industrial Practice **2 (2-0) s**
Prerequisite: PD 302
Required for graduation in Product Design
Study of the ethics, organization, and procedures of professional product design practice; patent law.

PD 441, 442 Design Analysis **2 (2-0) f s**
Prerequisite: PSY 200
Required of fourth year students in Product Design
Seminar on imaginative problem solving. Individual and group operational techniques in the spectrum of creative thought. Mr. Papanek

PD 501 Advanced Product Design **8 (3-12) f**
Prerequisite: PD 402
Required of fifth year students in Product Design
Continuation of emphasis on new product design and development, with reference to current developments in automatic fabrication and assembly. Mr. Papanek

PD 502 Product Design Thesis **9 (3-18) s**
Prerequisites: PD 501, PD 442, IE series
A one semester project chosen by the student in his area of major interest, with faculty guidance. Independent research and development of functional contribution, including complete programming of manufacture and distribution systems appropriate to the design.
Mr. Papanek

Psychology

(See Education)

Recreation and Park Administration

(See Education)

Rural Sociology

*Courses for Undergraduates

RS 204 North Carolina Rural Life **2 (2-0) f s**
Introduction to the specific patterns of rural living in North Carolina; structure and function of the groups in which North Carolina rural people participate; major social institutions and their related problems; and organized efforts to improve community life in the State. Staff

* Additional courses, suitable for rural sociology majors and graduate students, are listed in the offerings of the Department of Sociology and Anthropology. Other sociology courses especially suitable for advanced students and graduates are offered by the Department of Sociology and Anthropology of the University at Chapel Hill.

RS 301 Sociology of Rural Life **3 (3-0) f s**
Prerequisite: Completion of the freshman year
A systematic sociological analysis of the characteristics, institutions and problems of rural life. Part I is a brief description of the basic concepts, the theoretical framework and the method of analysis of institutions and problems. Part II consists of systematic analyses of the major social institutions and their respective problems. Part III portrays the role of the community as an area of institutional functioning and societal integration. Staff

RS 321 Introduction to Social Research **3 (3-0) f s**
Prerequisite: RS 301
Designed to give the student a basic understanding of the methods of sociological research. Reviews the scientific method and its application to the design of social research including the collection, analysis, and interpretation of social data. Appropriate ways of presenting the findings and of making the greatest use of the data are presented. Critical and objective thinking are stressed throughout the course. Messrs. Young and Mayo

RS 322 Introduction to Rural Social Work **3 (3-0) s**
Prerequisite: RS 301 or permission of the instructor
Constructed to acquaint the preprofessional student with the subject matter of social work as well as its related professional fields. Attention is given to three major areas: (1) case work in various settings. (2) group work, and (3) community organization. Public and private agencies which employ persons trained in social work are studied. Mr. Mayo

RS 441 Rural Social Pathology **3 (3-0) f**
Prerequisite: RS 301 or permission of the instructor
A study of major social problems in modern society: physical and mental health, family instability, crime and penology, and minority group problems. A framework for analysis and understanding is presented and stressed throughout including a positive approach for prevention.
Mr. Mayo

RS 442 Rural Social Structure **3 (3-0) s**
Prerequisite: RS 301 or permission of the instructor
Social structure is viewed in its two major dimensions: (1) vertically through the concepts of social stratification; and (2) horizontally as a set of basic social institutions interacting by means of a system of concrete social organizations. Particular attention is given to the place of the rural segment in the total social system. The bases of social cohesion which permit diversity within a functioning whole are examined. Mr. McCann

Courses for Graduates and Advanced Undergraduates

RS 511 Rural Population Problems **3 (3-0) f**
Prerequisite: RS 301
A study of population growth, rates of change and distribution. Considerable attention is given to the functional roles of population, i. e., age, sex, race, residence, occupation, marital status and education. The dynamic aspects of population are stressed: fertility, mortality and migration. Population policy is analyzed in relation to national and international goals. A world view is stressed throughout. Mr. Mayo

RS 512 Rural Family Living **3 (3-0) s**
Prerequisite: RS 301
Values, patterns and levels of rural family living. Differentials and factors related thereto in the world, the nation and North Carolina. Analysis of selection problems, programs, policies and methods of study. Mr. Hamilton

RS 513 Community Organization **3 (3-0) f**
Prerequisite: RS 301
Community organization is viewed as a process of bringing about desirable changes in community life. Community needs and resources available to meet these needs are studied. Democratic processes in community action and principles of community organization are stressed along with techniques and procedures. The roles of leaders, both lay and professional, in community development are analyzed. Mr. Mayo

* See footnote on page 370

RS 523 Sociological Analysis of Agricultural Land Tenure Systems **3 (3-0) f**
Prerequisite: Permission of the instructor
A systematic sociological analysis of the major agricultural land tenure systems of the world with major emphasis on the problems of family farm ownership and tenancy in the United States. Mr. Hamilton

RS 534 (HI 534) Farmers' Movements **3 (3-0) s**
Prerequisite: Three hours of Sociology
A history of agricultural organizations and movements in the United States and Canada principally since 1865, emphasizing the Grange, the Farmers' Alliance, the Populist Revolt, the Farmers' Union, the Farm Bureau, the Equity societies, the Non-partisan League, cooperative marketing, government programs and present problems. Mr. Noblin

RS 541 Social Agencies and Programs **3 (3-0) s**
Prerequisite: Three hours of Sociology
Study of social agencies and programs and their implementation through specific organizations in dynamic relation with the people whom they serve. Consideration is given to the relation of these agencies and programs to community structure and forces in rural society; coordination of the several types of agencies and programs; professional leadership in the local community; and problems of stimulating local leadership and participation. Mr. Mayo

Courses for Graduates Only

RS 611 Research Methods in Sociology **3 (3-0) f**
Prerequisite: Permission of the instructor
Designed to give the student a mature insight into the nature of scientific research in sociology. Assesses the nature and purpose of research designs, the interrelationship of theory and research, the use of selected techniques and their relation to research designs, and the use of modern tabulation equipment in research. Mr. McCann

RS 621 Rural Social Psychology **3 (3-0) f**
Prerequisite: Permission of the instructor
Treats the genetic development of the rural personality and the interrelationship of the individual and the rural society. Studies the social psychological factors related to rural leadership, morale, social organization and social change, and examines the attitudes and opinions of rural people on current local and national issues. Mr. McCann

RS 631 Population Analysis **3 (3-0) s**
Prerequisite: Permission of the instructor
Methods of describing, analyzing and presenting data on human populations: distribution, characteristics, natural increase, migration and trends in relation to resources. Mr. Hamilton

RS 632 Rural Family **3 (3-0) f**
Prerequisite: Permission of the instructor
Emphasis is placed on the development of an adequate sociological frame of reference for family analysis; on discovering both the uniquely-cultural and common-human aspects of the family by means of cross-cultural comparisons; on historical explanations for variability in American families with especial concern for the rural family; and on analyzing patterns of family stability and effectiveness. Mr. Hamilton

RS 633 The Rural Community **3 (3-0) s**
Prerequisite: Permission of the instructor
The rural community is viewed in sociological perspective as a functional entity. A method of analysis is presented and applied to eight "dimensions," with emphasis on the unique types of understanding to be derived from measuring each dimension. Finally, the effect of change on community integration and development is analyzed. Mr. Mayo

RS 641 Statistics in Sociology **3 (3-0) f**
Prerequisite: ST 513
The application of statistical methods in sociological research. Emphasis on selecting appropriate models, instruments and techniques for the more frequently encountered problems and forms of data. Mr. Hamilton

SS 642 Research in Rural Sociology **Credits by arrangement (Maximum of six credits)**

rerequisite: Permission of chairman of graduate study committee.
lanning and execution of research, and preparation of manuscript under supervision of raduate committee.

SS 653 Theory and Development of Rural Sociology **3 (3-0) s**

rerequisite: Permission of the instructor
equired of all master's and doctoral candidates in Rural Sociology and recommended for all raduate minors. Designed to meet two objectives: (1) to introduce the student to the sudy f current sociological theory and (2) to survey events and trends in the historical development f rural sociology. Mr. Hamilton

SS 671 Seminar **Credits by arrangement**

ppraisal of current literature; presentation of research papers by students; progress reports on epartmental research; review of developing research methods and plans; reports from scienti- meetings and conferences; other professional matters. (A maximum of three credits is al- wed toward the master's degree, and six credits toward the doctorate.) Graduate Staff

Social Studies

SS 301, 302 Science and Civilization **3 (3-0) f s**

rerequisites: For engineering students, ENG 205, HI 205, EC 205; for others, permission of the department
n examination of the major concepts, methods and values that characterize modern thought the fields of physical science, the humanities and the social sciences. The course utilizes the udent's previous training, plus materials from the history and philosophy of science and the istory of technology to demonstrate the essential interrelatedness of scientific, social, and esthetic activity.

SS 491, 492 Contemporary Issues **3 (3-0) f s**

rerequisites: For engineering students, SS 301, 302; for others, permission of the department his course deals with concrete problems as they arise from day to day in the world of public fairs. These problems are studied and discussed in the context of a search for a more realistic efinition of the limits of freedom and authority. Text materials are books, magazines and ewspapers.

Sociology

(Also see Anthropology)

courses for Undergraduates

OC 202 Principles of Sociology **3 (3-0) f s**

troduction to the scientific study of man's behavior in relation to other men, the general laws fecting the organization of such relationships and the effects of social life on human personali- and behavior.

OC 301 Human Behavior **3 (3-0) f s**

study of the effects of social interaction upon individual behavior and personality; collective titudes and behavior as products of group experience; analysis of fashions and fads, crowds, obs, publics, social movements.

OC 302 Public Relations and Modern Society **3 (3-0) f s**

he development and composition of social groups and the processes involved in group or- nization. These are analyzed in terms of the expanding functions of mass communication in ntemporary society.

SOC 303 Current Social Problems **3 (3-0) f**
Study of the social and cultural aspects of specific problems such as crime, divorce, race conflict, illness, poverty, housing, recreation and personality adjustment to demonstrate the basis integration of society and community life.

SOC 304 Contemporary Family Life **3 (3-0) f**
The social organization of the family with special attention to socialization, marital choice kinship relations, and the social changes affecting family structure and functions.

SOC 305 Race Relations **3 (3-0) f**
Analysis of race relationships both in the United States and throughout the world with particular emphasis on factors producing the changes taking place at the present time.

SOC 306 Criminology **3 (3-0) f**
The study of causation, treatment, prevention, and control of criminality and juvenile delinquency. Special emphasis is placed on socio cultural theories of causation and on the examination of court and correctional systems for adults and juveniles. Arranged field trips.

SOC 401 Human Relations in Industrial Society **3 (3-0) f**
Prerequisite: Senior standing or permission of instructor
Studies in the sociology of occupations, professions and work, with special attention to human relations in industrial plants and other work situations.

SOC 402 Urban Sociology **3 (3-0) f**
Prerequisites: SOC 202 and permission of instructor
A study of the factors in the growth of cities; the relationship between the design of cities and their social organization; detailed analysis of new developments in the serving of human needs. City and regional planning.

SOC 411 Community Relationships **3 (3-0) f**
Prerequisites: SOC 202 and permission of instructor
A survey of the institutions, organizations, and agencies found in modern communities; social problems and conditions with which they deal; their interrelationship and the trend toward over-all planning.

SOC 412 Introduction to Social Work **3 (3-0) f**
Prerequisites: SOC 202 and permission of instructor
A course designed to acquaint students with the various types of public and private social work and with remedial and preventive programs in applied sociology, social psychiatry, health public welfare, and recreation.

SOC 414 Social Structure **3 (3-0) f**
Prerequisites: Six hours in Sociology and permission of instructor
Studies of the major social institutions and systems of stratification; the organization of social systems as, for example, religion, education, and government; the functions of such structural components as age and sex groups, vocational and professional groups, and social classes.

SOC 416 Research Methods **3 (3-0) f**
Prerequisites: Nine hours in Sociology and permission of instructor
An analysis of the principle methods of social research; the development of experimental schedules and questionnaires; the measurement of behavior.

Courses for Graduates and Advanced Undergraduates

SOC 501 Leadership **3 (3-0) f**
Prerequisites: SOC 202, SOC 301 or equivalent
A study of leadership in various fields of American life; analysis of the various factors associated with leadership, with particular attention given to recreational, scientific and executive leadership problems.

SOC 502 Society, Culture, and Personality **3 (3-0) f s**
Prerequisites: SOC 202, SOC 301 or equivalent
Human personality from its origins in primary groups through its development in secondary contacts and its ultimate integration with social norms. Emphasis is placed upon the normal personality and the adjustment of the individual to our society and our culture. Dynamics of personality and character structure are analyzed in terms of the general culture patterns and social institutions of society.

SOC 505 The Sociology of Rehabilitation **3 (3-0) f s**
Prerequisites: SOC 202, SOC 301 or equivalent
The course stresses the social and cultural implications of the rehabilitation approach. Emphasis is placed upon the social and personal problems of physically and mentally handicapped persons. The interrelationships of the major social environments are considered at length in this regard. Objectives of the rehabilitation processes are analyzed in terms of the sociology of work. A major portion of the course is devoted to rehabilitation as a profession, particular attention being given to the diverse roles of specialists in this field.

SOC 510 Industrial Sociology **3 (3-0) f s**
Prerequisites: SOC 202, SOC 301 or equivalent
Industrial relations analyzed as group behavior with a complex and dynamic network of rights, obligations and rules; the social system as an interdependent part of total community life; background and functioning of industrialization studied as social and cultural phenomena; analysis of specific problems of industry.

SOC 511 Social Theory **3 (3-0) f s**
Prerequisites: Nine semester hours in Sociology, or equivalent work in related fields, and permission of instructor.
The study of social theories from the earliest recorded thinkers to those of modern times; the evolution of theories of the individual, groups, culture, community, and society; the modern development of sociology and anthropology, and interpretive systems accompanying these developments.

SOC 515 Research in Applied Sociology **3 (3-0) f s**
Prerequisites: SOC 202, SOC 301 or equivalent
Individual research problems in applied fields of sociology, such as problems of the family, population and social work; rural-urban relations; student success; American leadership.

Soil Science

Courses for Undergraduates

SSC 200 Soils **4 (3-3) f s**
Prerequisite: CH 103 or CH 107. MIG 120 is recommended but not required
The fundamental properties of soils and their relation to proper soil management. Geological information important to an understanding of soils and agriculture is presented for a better understanding of the interrelationship which exists between soils and management.
Mr. Younts

SSC 302 Soils and Plant Growth **4 (3-3) s**
Prerequisites: SSC 200, BO 103, PY 211
An examination of the fundamental chemical, physical and microbiological characteristics of soils, as related to crop production. The chemical and mineralogical composition of soils; ion exchange, soil reaction and the solubilities of plant nutrients; transformations between organic and inorganic forms of plant nutrients; water and air relations in soils; lecture–demonstrations will be used to illustrate fundamental soil properties and to acquaint students with methods used in the study of soils. Mr. McCollum

SSC 341 Soil Fertility and Fertilizers **3 (3-0)**
Prerequisites: SSC 200, BO 103
History of plant nutrition and soil fertility. Plant nutrition and growth as related to crop fertilization. Fertilizer materials, their manufacture, properties and usage. Fertilizer practice as related to a sound soil management program. Mr. Yount

SSC 452 Soil Classification **3 (2-3)**
Prerequisite: SSC 200
The processes involved in the origin of soil and its properties are explained. Logical schemes o soil classification and soil management are developed based upon soil profile properties a operational criteria. The laboratories and field trips are designed to teach the student ho to recognize certain soil profile properties and inferences which may be drawn from them. Mr. Cook

SSC 461 Soil Conservation and Management **3 (3-0)**
Prerequisite: SSC 200 or permission of instructor
The history and status of erosion and fertility conditions; the economic and social aspects o soil conservation; the effects of climatic factors, vegetation (forest, sod crops, cover crops an rotations), soil properties, and other management practices on soil conservation and fertilit maintenance. Mr. Lut

SSC 480 Senior Seminar **1 (1-0) f**
Prerequisite: Senior standing in the School of Agriculture
A student participation course in which the student will prepare and present thorough an documented discussions of important soil topics. Staf

Courses for Graduates and Advanced Undergraduates

SSC 511 Soil Physics **4 (3-3) f**
Prerequisites: SSC 200 and PY 212
Physical constitution and analyses; soil structure, soil water, soil air and soil temperature in relation to plant growth. Mr. Lutz

SSC 522 Soil Chemistry **4 (3-3) s**
Prerequisites: SSC 200, SSC 553 and CH 433 or permission of instructor.
A consideration of the chemical and colloidal properties of clay and soil systems, including ion exchange and retention, soil solution reactions, solvation of clays, and electrokinetic properties of clay-water systems.
(Offered in 1964 and alternate years thereafter) Mr. Weed

SSC 524 Mass Spectrometry **2 (1-3) s**
Prerequisites: SSC 302 and CH 433 or permission of instructor
An examination of theoretical and analytical aspects of mass spectrometry and stable isotopic techniques; application of these methods to biochemical research.
(Offered in 1963 and alternate years thereafter) Mr. Volk

SSC 532 Soil Microbiology **3 (3-0) s**
Prerequisites: SSC 302, BO 312 and CH 220
The more important microbiological processes that occur in soils; decomposition of organic materials, ammonification, nitrification, and nitrogen fixation.
(Offered in 1963 and alternate years thereafter) Mr. Bartholomew

SSC 541 Soil Fertility **3 (3-0)**
Prerequisites: SSC 302 and SSC 341
Soil conditions affecting plant growth and the chemistry of soil and fertilizer interrelationships. Factors affecting the availability of nutrients. Methods for measuring nutrient availability. Mr. Kamprath

SSC 551 Soil Morphology, Genesis and Classification **(3-0)**
Prerequisites: SSC 200, SSC 302, or SSC 341 and MIG 120
Morphology: study of concepts of soil horizons and soil profiles and chemical, physical and mineralogical parameters useful in characterizing them. Genesis: critical study of soil forming factors and processess. Classification: critical evaluation of historical development and present concepts of soil taxonomy with particular reference to great soil groups as well as discussion of logical basis of soil classification.
(Offered in 1962 and alternate years thereafter) Mr. McCracken

SSC 553 Soil Mineralogy **3 (2-3) f**
Prerequisites: SSC 200, SSC 341 and MIG 330 or permission of instructor
Composition, structure, classification, identification, origin, occurrence, and significance of soil minerals with emphasis on primary weatherable silicates, layer silicate clays, and sesquioxides.
Messrs. McCracken and Weed

SSC 560 North Carolina Soils and Their Management **3 (Summer)**
Prerequisites: SSC 200, SSC 302 or SSC 341
Field studies of selected soil series in the Coastal Plain, Piedmont and Mountain areas of North Carolina. Discussion of management practices that should be associated with the various soils under different types of farming.
(Offered in Summer 1963 and alternate years thereafter). Messrs. McCracken, Fitts and Spain

SSC 570 Special Problems **Credits by arrangement.**
Prerequisites: SSC 200 and SSC 302
Special problems in various phases of soils. Problems may be selected or will be assigned. Emphasis will be placed on review of recent and current research. Staff

Courses for Graduate Students Only

SSC 622 Physical and Chemical Properties of Soils **0-4**
Prerequisites: SSC 511, SSC 522, CH 433, MA 301 or permission of instructor
An examination in depth of current ideas concerning the physics and chemistry of soil and clay systems. Topics will include ion exchange, molecular adsorption, electrokinetics, relations between mineral structures and their physical and chemical properties, and the properties of adsorbed water. Emphasis will be determined by student interest and by current literature.
(Offered in 1963 and alternate years thereafter). Messrs. Miller and Weed

SSC 651 Pedology **2 or 3-0 (By arrangement)**
Prerequisites: SSC 522 and SSC 511
A critical study of current theories and concepts in soil genesis and morphology; detailed study of soil taxonomy. Topics include weathering and clay mineral genesis as related to soil morphology and genesis, functional analyses of soil genesis, properties of and processes responsible for soil profiles formed under various sets of soil forming factors, classification theory and logic as applied to soil classification, structure of soil classification schemes. Any of these topics may be emphasized at the expense of the others according to interests of students.
(Offered in 1964 and alternate years thereafter). Mr. McCracken

SSC 672 Soil Properties and Plant Development **0-4**
Prerequisites: CH 551, SSC 522 or equivalents
A detailed examination of the effects of soil factors in the development of crop plants. Segments of the course will treat (1) soil transformation processes of both organic and inorganic constituents, (2) concepts of nutrient availability and (3) the relation of plant development indices to specific soil properties.
(Offered in 1964 and alternate years thereafter). Messrs. Jackson, Bartholomew and Davey

SSC 680 Seminar **1 (1-0) f s**
Prerequisite: Graduate standing in Soil Science
Scientific articles, progress reports in research and special problems of interest to agronomists reviewed and discussed.
A maximum of two credits is allowed toward the master's degree, but any number toward the doctorate. Graduate Staff

SSC 690 Research **Credits by arrangemer**
Prerequisite: Graduate standing in Soil Science
A maximum of six credits is allowed toward the master's degree, but any number towar the doctorate. Graduate Sta :

Statistics

(See Experimental Statistics)

Textiles

Courses for Undergraduates

Textile Technology

TX 221 Fundamentals of Textiles **3 (2-2) f**
Prerequisite: MA 101 or MA 111, or equivalent
Required of students in all Textile curricula
Nomenclature, flow of processes through weaving, yarn numbering systems, basic calculation of machinery constants, textile production, and yarn and fabric structures. Two 1-hour lecture: and one 2-hour laboratory period per week. Messrs. Lassiter, Mose:

TX 261 Fabric Structure **3 (2-2) f**
Prerequisite: TX 221
Required of students in all Textile curricula
A study of the fundamental principles of fabric construction and weave formation of selectec staple fabrics. Laboratory instruction is given in physical analysis and design techniques es- sential to the development of technical specifications for the production of woven fabrics. Twc 1-hour lectures and one 2-hour laboratory period per week. Messrs. Berry, Klibbe

TX 271 Upholstery Fabrics **2 (2-0) :**
Required of students in Furniture Manufacturing
Textile students may not take this course for degree credit.
A study of the basic principles of textile manufacturing and structure of woven fabrics. identification of classic decorative fabrics used for upholstered furniture coverings, with em- phasis on nomenclature and physical properties and textile trade customs. Two 1-hour lecture periods per week Mr. Moser

TX 281 Fiber Quality **3 (2-2) f :**
Prerequisite: TX 221
Required of students in all Textile curricula
A study of the physical, chemical and aesthetic properties of the major textile fibers. Included are methods of measuring fiber properties and interpretation of test results, complete analysis of typical stress-strain curves, influence of moisture on physical properties, and fiber identifi- cation. Two 1-hour lectures and one 2-hour laboratory period per week.
Messrs. Hamby, Wiggins

TX 303 Fiber and Yarn Technology **4 (3-2) f s**
Prerequisite: TX 281
Required of all students in the Textile Technology curriculum.
Technological and scientific concepts of fiber and yarn structures and modifications resulting from processing. For all systems, the opening, cleaning and carding actions; blending of fibers stressing intimacy, methods, effectiveness, and influence on product; yarn structure as a factor of blend, fiber distribution, twist in its many ramifications, spinning limits; composite yarn structures; bulk and yarn coverage; drafting methods, types, and limits. Three 1-hour lectures and one 2-hour laboratory period per week. Messrs. Hamby, Pardue, Lassiter:

TX 304 Fiber and Yarn Technology **4 (3-2) f s**
Prerequisite: TX 303
Required of students in Fiber and Yarn Technology and General Textiles
Elective for others.
Technological and economic aspects of fiber and yarn processing including; packaging, production and efficiency levels; specialized yarn processes such as combing with economic justifications; design and use of specialty novelty yarns; economical and mechanical limitations of textile equipment. Three 1-hour lectures and one 2-hour laboratory period per week.
Messrs. Stuckey, Pardue, Hamby

TX 327 Textile Testing **4 (3-2) f s**
Prerequisites: TX 303, TX 365, ST 361
Required of students in all Textile curricula
Quality control methods for textile processing, with emphasis on the measurement by laboratory instruments and techniques, and including a study of the mechanical and natural influences involved. Three 1-hour lectures and one 2-hour laboratory period per week.
Messrs. Hamby, Stuckey

TX 365 Fabric Technology **4 (3-2) f s**
Prerequisites: TX 261, TX 281
Required of students in the Textile Technology curriculum
Geometry of fabrics; properties of fabrics dependent on the weave, geometrical configurations and yarn properties, such as compressional resilience, air and water permeability, water repellency, creasing tendencies, abrasion properties, hand, and drape. Mechanical properties of fabrics; transmission of heat, moisture, and air. Yarn additives and treatments; slashing and warp preparation, materials, and techniques. Non-woven structures. Three 1-hour lectures and one 2-hour laboratory period per week. Messrs. Berry, Porter

TX 366 Fabric Technology **4 (3-2) f s**
Prerequisite: TX 365
Required of students in Fabric Technology and General Textiles
Elective for others
Technology and economic aspects of fabric construction, design, and production. The classical weaves, their design, inherent uses, production techniques, and types of looms required. Marketing methods, with Worth Street and other trade rules and regulations. The loom as a production unit: types, nomenclature, basic and special mechanisms. Mill balance. Fabric defects. Three 1-hour lectures and one 2-hour laboratory period per week. Messrs. Moser, Berry

TX 430 Continuous Filament Yarns **3 (2-2) f s**
Prerequisite: TX 303
Required of Students in Fiber and Yarn Technology and Knitting Technology.
Elective for others
A study of properties and processes applicable only to filament yarns such as texturizing and bulking. Detailed studies of throwing systems, engineering requirements of equipment, and yarn property changes resulting from processing. Two 1-hour lectures and one 2-hour laboratory period per week. Mr. Wiggins

TX 436 Staple Fiber Processing **3 (2-2) f s**
Prerequisite: TX 303
Required of students in Fiber and Yarn Technology.
Elective for others
A study of special systems of processing long staple, natural and man-made fibers, including woolen, worsted, direct spinning, Turbo Stapler, or Pacific Converter, and silver to yarn methods. New concepts and research findings as applied to all yarn processes. Two 1 hour lectures and one 2-hour laboratory period per week. Mr. Pardue

TX 478 Design and Weaving **3 (2-2) f s**
Prerequisite: TX 366
Required of students in Fabric Technology
Elective for others
Advanced study of special weave formations and the techniques and equipment necessary to form these fabrics. Studies in depth of new developments and research findings in the areas of warp preparation, design, weaving, and fabric formation. Two 1-hour lectures and one 2-hour laboratory period per week. Messrs. Porter, Berry

TX 485 Mill Design and Organization **3 (2-2)**
Prerequisites: TX 303, TX 365
Required of students in the Textile Technology curriculum. Beginning in the 1963 fall semester, for seniors in final semester only
Application of economic principles of textile factoring, hedging, and other buying and sellin problems. Inventory control, organization, and departmental functions of textile companie Technical problems of plant site selection, plant design and layout, and selection of equipment Layout of a mill by each student. Two 1-hour lectures and one 2-hour laboratory period pe week. Messrs. Grover, Pardu

TX 490 Development Project I **1 (0-2) f**
Prerequisites: Senior standing and permission of instructor
Elective
A problem of independent study assigned to seniors in the major field of study serving als. as the laboratory period for senior level courses. One 2-hour laboratory period per week.
Staf

Knitting Technology

TX 342 Knitting Principles **2 (2-0) f**
Prerequisites: TX 281 and TX 221
Required of juniors in Textile Technology and Knitting Technology. A basic course in knitte fabric construction with emphasis on the many types of stitch structures found in knitte textiles. Attention is also devoted to the equipment and mechanisms necessary to produce thes structures. Two 1-hour lecture periods per week. Messrs. Li, Middleto

TX 441 Flat Knitting **3 (2-2)**
Prerequisite: TX 342
Required of seniors in Knitting Technology
Elective for others
A study of the leading types of flat knitting machines including warp knitting machines, desig possibilities and fabric adaptability. Two 1-hour lectures and one 2-hour laboratory perio per week. Mr. Shin

TX 442 Knitted Fabrics **3 (2-2) f**
Prerequisite: TX 342
Required of seniors in Textile Technology and Knitting Technology
Design, analysis, and production of knitted fabrics, including flat, circular, and warp type The economic aspects of the knitting process as a method of clothing production. Introductio to garment design, production and marketing. Two 1-hour lectures and one 2-hour laborator period per week. Messrs. Shinn, Middleto

TX 444 Garment Manufacture **3 (2-2)**
Prerequisite: TX 342
Required of seniors in Knitting Technology
Elective for others
A study of circular latch needle and spring needle machines for knitted fabric productio Styling, cutting and seaming of the basic garment types for underwear and outerwear; standar seam types; high speed sewing machines. Two 1-hour lectures and one 2-hour laboratory perio per week. Mr. Shin

TX 447, 448 Advanced Knitting Laboratory **2 (0-4) f**
Prerequisite: TX 342
Required of seniors in Knitting Technology
Elective for others
Systematic study of circular hosiery mechanisms; hosiery types and constructions. Seamle hosiery production methods utilizing the newer synthetic yarns, toe closing methods, finishin processes, and marketing are emphasized. Messrs. Li, Shin

TX 449 Tricot Knitting **3 (2-2) s**
Prerequisite: TX 342
Elective for juniors and seniors
A study of basic types of tricot knitting machines with emphasis on mechanisms and fabrics. Attention is given to warp preparation methods applicable to the tricot machine, the characteristics of yarn made from natural and synthetic fibers as they affect processing into warp knitted fabrics, machine settings for proper qualities and ratios; economics of warp knitting, and end uses. Attention is given to fabric design and analysis. Two 1-hour lectures and one 2-hour laboratory period per week. Mr. Shinn

TX 483 Textile Cost Methods **2 (2-0) f s**
Prerequisites: TX 303, TX 365
Required of seniors in Textile Technology except those in Management.
A study of cost methods applicable to textile mills with emphasis on calculations, the preparation of cost reports, and their use in cost control. Two 1-hour lectures per week.
Messrs. Lynch, Middleton, Shinn

Textile Chemistry

TC 201 Textile Chemistry I **2 (2-0) f s**
Prerequisites: CH 103, TX 281
Required of juniors in Textile Technology
A comprehensive course designed to familiarize the student with the chemical properties of all natural and man-made fibers; some emphasis is placed upon the relationship between molecular structure and physical properties; the principles and methods for producing man-made fibers are discussed; a brief survey of organic chemistry is included, particularly those parts that relate to polymer chemistry. Two one-hour lectures per week. Mr. Rutherford

TC 303, 304 Textile Chemistry III **3 (2-3) f s**
Prerequisites: CH 221, CH 223
Required of juniors in Textile Chemistry
A study of the action of chemicals on fibers; methods and chemistry of scouring, bleaching and mercerization; preparation of typical dyestuffs and their application to fibers. Two 1-hour lectures and one 3-hour laboratory period per week. Mr. Hayes

TC 307 Textile Chemistry II **4 (3-2) f s**
Prerequisite: TC 201
Required of seniors in Textile Technology
A comprehensive course covering scouring, bleaching, and dyeing of textile materials. Also fabric finishing, effects of heat and chemicals on fibers, and the economic aspects of different dyes and chemical treatments on fibers and fabrics. Three 1-hour lectures and one 2 hour laboratory period per week. Mr. Hayes

TC 403, 404 Textile Chemical Technology **3 (3-0) f s**
Prerequisites: TC 304, CH 223
Required of seniors in Textile Chemistry
Basic principles are applied to the study of three important areas of textile processing: dyeing, printing, and finishing. These areas are concerned with the chemical nature of dyes and other chemical agents applied to fibrous systems; with the chemical and physical properties of the various fibers; and with the mechanical aspects of the application of chemical materials to fibers and fabrics. The course includes an extensive review of the various classes of dyes and their application to all important textile fibers and blends of fibers; a comparative analysis of dyeing machinery and processes involving special machinery and equipment; a survey of modern preparatory and bleaching for all important fibers; a study of the roller printing machine, and the principles involved in print formulations for the major classes of dyes and their application to the various fibers; a study of important mechanical, additive, and chemical modification type finishes for fabric. Three 1-hour lectures per week. Mr. Campbell

TC 405, 406 Textile Chemical Technology Laboratory **2 (0-6) f s**
Required of seniors in Textile Chemistry
To be taken concurrently with TC 403, 404. Two 3-hour laboratories per week.

TC 411 Textile Chemical Analysis I **3 (1-6) ff**
Prerequisite: CH 215
Elective for students in Textile Chemistry
Analysis and evaluation of textile chemicals and related materials such as water, soap, wettin agents, synthetic detergents, bleaching and stripping agents and finishing compounds. Identi fication and quantitative determination of materials employed in several categories of textil wet processing such as sizes, surface-active agents, dyestuffs and finishes. One 1-hour lectur and two 3-hour laboratory periods per week. Messrs. Campbell, Cates, Rutherfor

TC 412 Textile Chemical Analysis II **3 (1-6) ff**
Prerequisites: CH 215, TC 304
Required of students in Textile Chemistry
Analysis of textile materials involving specialized instruments and techniques such as spectro photometry, pH measurements, electrometric titration, viscometry, etc. One 1-hour lectur and two 3-hour laboratory periods per week. Messrs. Campbell, Cates, Rutherfor

TC 421 Fabric Finishing I **2 (2-0) ff**
Prerequisite: TC 201
Elective for students in Textile Technology
Students in Textile Chemistry may not take this course for degree credit
A general course in fabric finishing designed for students not majoring in Textile Chemistr Emphasis placed on finishes used on garment-type fabrics, including stabilization finishes, wate repellency, crease resistance, moth and mildew proofing, fire-proofing, etc. Emphasis on chem istry of finishes varied to fit requirements of students. Two 1-hour lectures per week.
Mr. Hayc

Courses for Advanced Undergraduates and Graduates

Textile Technology

TX 501 Textile Technology Seminar **2 (2-0) ff**
Prerequisites: Senior standing and permission of instructor
Elective
Lecture and discussion periods are designed for students who are particularly interested i yarn manufacturing aspects of the textile industry. Subject matter will include such aspects as training methods, safety programs, modern mill design, specialized techniques in settin rates, employee relations and developments that arise from technical meetings. Two 1-hour lectures per week. Messrs. Grover, Hamb

TX 521 Textile Testing II **3 (2-3) I**
Prerequisite: TX 327
Elective
Advanced techniques for measuring properties of natural and man-made fibers, yarns, and fabrics. Interrelations of raw material, quality, processing characteristics, and end product properties. The application of the laws of physical sciences to evaluation of textile materials Two 1-hour lectures and one 3-hour laboratory per week. Messrs. Hamby, Stucker

TX 522 Textile Quality Control **3 (2-3) I**
Prerequisite: TX 521
Elective
Quality control systems for textile operations. Defect prevention methods, isolation of pro cesses contributing to substandard quality, relationship between quality control departmen and operating divisions. Laboratory design, equipment and personnel selection, installation of quality control systems. Two 1-hour lectures and one 3-hour laboratory period per week
Messrs. Hamby, Stucker

TX 524 Special Projects in Textiles **1 to 3 f**
Prerequisites: TX 327, senior standing, permission of instructors
Elective
Special studies in either the major or minor field of the advanced undergraduate or graduate student. These special studies will take the form of current problems of the industry, inde pendent investigations in the areas of textile testing and quality control, seminars and technical presentations, both oral and written. Staf

X 525 Advanced Textile Microscopy **2 (arranged) f s**
rerequisite: TX 327
lective
xperiments, lectures and demonstrations in more advanced techniques of textile microscopy. etailed studies of structures of fibers covered in lecture series, supplemented by experiments n lecture topics. Detailed study of all types of microscopes and their uses in textiles. Prearation of slides for photography. Uses of photomicrographic equipment. Lectures and boratory arranged. Mr. Stuckey

X 551 Complex Woven Structures **4 (3-2) s**
rerequisites: TX 303, TX 478
lective
he development of design specifications for complex fabrics as related to fabric geometry, nctional and aesthetic properties and manufacturing limitations. Three 1 hour lectures and ne 2-hour laboratory per week. Mr. Berry

X 575 Fabric Analytics and Characteristics **3 (3-0) f s**
rerequisite: TX 365 or TX 366 or TC 511
equired of students in Fabric Technology
lective for others
orrelation of fiber and yarn properties with those of the fabric. Fabric design features lated to utilitarian as well as aesthetic values, with case studies of successful fabrics. spection and classification of defects with economic aspects. Engineering design of fabrics ilizing blends of fibers and yarns. Three 1-hour lectures per week. Mr. Porter

General Textile Course

C 581 Instrumentation and Control **3 (2-2) f s**
erequisite: PY 212
equired of all seniors in all Textile curricula
lecture series with coordinated laboratory exercises designed to familiarize the student th the theory and application of instruments and control apparatus found in the modern xtile plant. The studies cover the measurement and control of temperature, humidity, essure, flow and liquid level, the application of control apparatus to chemical processes d physical finishing of textile products. Two 1-hour lectures and one 2-hour laboratory riod per week. Mr. Asbill

Textile Chemistry

C 501 Seminar in Textile Chemistry **2 (arranged) s**
erequisite: TC 403
equired of seniors in Textile Chemistry
ie course is designed to familiarize the student with the principal sources of textile emical literature and to emphasize the importance of keeping abreast of developments in e field of textile chemistry. Particular attention is paid to the fundamentals of technical iting. Reports. Lectures arranged. Mr. Campbell, Staff

C 511 Chemistry of Fibers **3 (3-0) f**
erequisite: CH 223
equired of seniors in Textile Chemistry
lecture course emphasizing the theory of fiber structure; the relationship between the emical structure and physical properties of natural and man made fibers; the nature of chemical reactions which produce degradation of fibers; the production of man-made ers. Three 1-hour lectures per week. Mr. Rutherford

C 512 (CH 512) Chemistry of High Polymers **3 (3-0) f s**
erequisite: CH 431
ective for Textile Chemistry students
chanisms and kinetics of polymerization; molecular weight description; theory of polymer utions. Three 1-hour lectures per week. Mr. Cates

TC 521 Textile Chemical Analysis III **3 (arranged) f**
Prerequisite: TC 421 or permission of instructor
Elective for students in Textile Technology.
No credit allowed for students majoring in Textile Chemistry.
The work includes a survey of organic chemistry, with emphasis on organic surfactants, wax sizes, and fabric finishes of all types; the identification of fibers by chemical means; the qualitative and quantitative analysis of fiber blends by chemical means; the identification of finishes; the evaluation techniques for dyed and finished materials. Two one-hour lectures and one three-hour laboratory period per week. Graduate Staff

Courses for Graduates Only

TX 601, 602 Yarn Technology **3 (arranged) f**
Prerequisite: Graduate standing
This course provides the student with an opportunity for intensive study of advanced topics in the field of yarn technology. Messrs. Grover, Hamby

TX 621 Textile Testing III **2 (1-2) f**
Prerequisite: TX 522 or equivalent
Design of textile laboratories, including conditioning equipment and instruments required for specific needs; performance of tests and analysis of data on industrial problems; specialized physical tests; inter-laboratory tests and analysis; study of A.S.T.M. specifications and work on task groups for the A.S.T.M. Society. One 1-hour lecture and one 2-hour laboratory period per week. Mr. Hamby

TX 631 Synthetic Fibers **2 (arranged)**
Prerequisite: TX 430 or TX 436 or equivalent
Lectures and projects on advanced problems relative to the properties and processing of man-made continuous filament and staple fiber yarns. Messrs. Grover, Hamby

TX 641, 642 Advanced Knitting Systems and Mechanisms **3 (arranged) f**
Prerequisite: TX 441 or equivalent
A critical study of inventions which have contributed to the development of the modern knitting industry; knitting needles and their adaption for specific uses; means for mounting them for individual and en masse operation; construction and functioning of cooperating elements including sliders, jacks, sinkers, dividers, pressing elements, narrowing and tensioning and draw off motions, regulating mechanisms, timing and control chains and cams. Use will be made of patent literature which covers important developments in the hosiery industry. Three 1-hour lectures per week. Mr. Shin

TX 643, 644 Knitting Technology **3 (2-2) f**
Prerequisites: Graduate standing and 8 credits in Knitting Technology
Problems of specific interest to the knitting industry will be assigned for study and investigation. The use of experimental methods will be emphasized. Attention will be given to the preparation of reports for publication. Graduate Staff

TX 651, 652 Fabric Development and Construction **3 (arranged) f**
Prerequisite: Graduate standing
Application of advanced technology to the development and construction of woven fabric
Mr. Porter

TX 681 Textile Research **Credits by arrangement**
Problems of specific interest to the textile industry will be assigned for study and investigation. The use of experimental methods will be emphasized. Attention will be given to the preparation of reports for publication. The master's thesis may be based upon the data obtained. Graduate Staff

TX 683 Seminar **1 (1-0) f**
Discussion of current scientific publications of interest to the textile industry; review and discussion of student papers and research problems. Graduate Staff

TC 605 Physical Chemistry of Dyeing **3 (arranged) f s**
Prerequisite: CH 433
Development of principles of thermodynamics, emphasizing applications in dye and fiber chemistry. Mr. Cates

TC 606 Chemistry of Fiber-Forming High Polymers **3 (arranged) f s**
Prerequisite: CH 433
Composition and structure of high polymers; properties of linear polymers with particular emphasis on mechanical behavior; chemistry of high polymer degradation. Three 1-hour lectures per week. Mr. Cates

Zoology

Courses for Undergraduates

ZO 103 General Zoology **4 (3-2) f s**
The study of animals with special reference to the morphology, physiology, and ecology of those forms that illustrate zoological principles. Staff

ZO 205 Invertebrate Zoology **4 (3-3) f**
Prerequisite: ZO 103
The biology and classification of the invertebrate animals with special reference to the forms commonly encountered and those which illustrated zoological principles.
Mr. Miller

ZO 206 Vertebrate Zoology **4 (3-3) s**
Prerequisite: ZO 103 or equivalent
The biology, classification, behavior, and natural history of fishes, amphibians, reptiles, birds, and mammals, including laboratory identification of representative forms, local field trips, and student projects and reports. Mr. Quay

ZO 212 Human Anatomy **3 (2-2) f**
Prerequisite: ZO 103
A study of human anatomy with major emphasis on the structure and function of the muscular, skeletal, circulatory and nervous systems. Required of majors in recreation.
Staff

ZO 213 Human Physiology **3 (3-0) s**
Prerequisite: ZO 103
An elementary survey of human physiology. The central theme is the changes in the human body accompanying increased physical activity. The nature and mechanisms of these changes.
Staff

ZO 223 Comparative Anatomy **4 (2-4) f s**
Prerequisite: ZO 103
A comparative morphology of vertebrates demonstrating the interrelationships of the organ systems of the various groups. Mr. Harkema

ZO 301 Animal Physiology **4 (3-3) f s**
Prerequisites: ZO 103, PY 215 and CH 221
Physiology of vertebrates with particular reference to man and the lower animals.
Mr. Santolucito

ZO 312 Principles of Game Management **3 (3-0) s**
Prerequisites: ZO 103, Elective for juniors and seniors not majoring in Wildlife
This course is intended to provide the student with a basic understanding of the major principles of wildlife management. It is designed especially for those individuals who anticipate entering the fields of agriculture, forestry, agricultural extension or rural and industrial recreation. Mr. Barkalow

ZO 315 Animal Parasitology **3 (2-3)**
Prerequisite: ZO 103
This course is designed to give students a knowledge and appreciation of the parasitic hab The biology, life history, pathology and control of the common parasites of domestic anim and poultry are covered. Mr. Harker

ZO 321 Wildlife and Natural Resources Conservation **3 (3-0)**
Prerequisite: Sophomore standing in any school
The importance of natural resources to man and the part they play in national and inte national affairs; the principles which under-lie their conservation and the impact of ove exploitation on primitive and civilized societies. Emphasis is placed on the renewable r sources, particularly wildlife. Mr. Barkalo

Courses for Graduates and Advanced Undergraduates

ZO 501 Ornithology **3 (2-3)**
Prerequisite: ZO 103
The biology and classification of birds. Field trips for the study and identification of loc forms, including trips to Lake Mattamuskeet in February and the coast in May. Individu research projects on nesting populations. Mr. Qu

ZO 513 Comparative Animal Physiology **3 (3-0)**
Prerequisite: ZO 301
The comparative physiology of selected systems. Topics will be chosen for detailed consider tion in lectures, collateral reading, and class discussion. Each student will, in addition, pr pare a term report. A few topics for study may be determined by the interests of th students and by their needs as may be expressed by the supervisor of their major work. Mr. Santoluci

ZO 520 Fishery Science **3 (1-6)**
Prerequisites: ZO 103 and approval of the instructor
This course is intended as an introduction to the principles and methods of fishery scienc Current theories and practices of fish management will be studied. Life history and biolog of important game and commercial species. Survey of fishery resources. Mr. Hassl

ZO 521 Fishery Science **3 (1-6)**
Prerequisite: ZO 520
An analysis of fishery research methods and objectives. Detailed studies of the procedures fo estimating fish populations, annual reproduction, mortality rates, growth rates, and explo tation rates. The relationship between natural fluctuations in fisheries and environment factors. Mr. Hassl

ZO 522 Animal Ecology **3 (2-3)**
Prerequisites: ZO 103 and BO 103
The general principles of the inter-relations among animals and between animals and the environments—land, freshwater, marine. Mr. Qua

ZO 541 Cold-blooded Vertebrates (Ichthyology) **3 (1-4)**
Prerequisite: ZO 103
The classification and ecology of selected groups of fishes. Lectures, laboratories, and fiel trips dealing with the systematic positions, life histories, interrelationships, and distributio of the particular groups of fishes selected in accordance with the needs and interests of th class. Mr. Hassl

ZO 542 Cold-blooded Vertebrates (Herpetology) **3 (1-4)**
Prerequisite: ZO 103
The classification and ecology of selected groups of amphibians and reptiles. Lectures, labora tories, and field trips dealing with the systematic positions, life histories, interrelationship and distribution of the particular groups of amphibians and reptiles selected in accordanc with the needs and interests of the class. Mr. Hassl

ZO 544 Mammalogy **3 (1-4) f**
Prerequisites: ZO 103, ZO 206, and approval of instructor
The classification, identification, and ecology of the major mammalian groups.
Mr. Barkalow

ZO 545 Histology **4 (2-4) f**
Prerequisite: ZO 103
The microscopic anatomy of animal tissues. Mr. Roberts

ZO 551, 552 Wildlife Science **3 (2-3) f s**
Prerequisite: ZO 206
The principles of wildlife management and their application are studied in the laboratory and in the field. Mr. Hester

ZO 561 Animal Embryology **4 (2-4) f**
Prerequisite: ZO 103
The study of fundamental principles which apply in the achievement of complex animal structure, including both invertebrate and vertebrate materials. Correlative laboratory study to provide training in the basic disciplines and techniques. This course is intended for advanced students in entomology, animal science, poultry science, and zoology.
Mr. Alliston

ZO 571 Special Studies **Credits by Arrangement**
Prerequisites: ZO 103 and approval of the instructor
A directed individual investigation of a particular problem in zoology, accompanied by a review of the pertinent literature. A maximum of three credits allowed toward the bachelor's degree, six toward the master's degree and nine toward the doctorate. Graduate Staff

ZO 581 Parasitology I **4 (2-4) s**
Prerequisites: ZO 103 and 223
The study of the morphology, biology, and control of the parasitic protozoa and helminths of man, domestic and wild animals.
(Offered in fall semester 1963) Mr. Harkema

ZO 582 (ENT 582) Medical Entomology **3 (2-3) s**
Prerequisite: ENT 301 or 312
A study of the morphology, biology and control of the parasitic arthropods of man, domestic and wild animals.
(Offered in spring semester 1962) Messrs. Harkema and Farrier

Courses for Graduates Only

ZO 603 Advanced Parasitology **3 (2-3) s**
Prerequisites: ZO 591 and 592
The study of the theoretical and practical aspects of parasitism; taxonomy, physiology, and immunology of animal parasites. Mr. Harkema

ZO 614 Cell Physiology **3 (3-0) s**
Prerequisites: ZO 103, and approval of the instructor
A study of those fundamental physiological properties at the cellular level which are common to nearly all organisms. Lectures, discussions, and critical reports (oral and written) to promote aquaintance with general literature and recent advances. Mr. Santolucito

ZO 622 Seminar **1 (1-0) f**
The presentation and defense of current literature papers dealing with the findings o
original research or with fundamental biological concepts. Graduate Sta

ZO 627 Zoogeography **3 (3-0)**
Prerequisites: ZO 522, and approval of instructor.
The geographic distribution of animals, with primary emphasis on land and freshwate
vertebrates. Mr. Quz

ZO 641 Research in Zoology **Credits by arrangemen**
Prerequisites: Twelve semester credits in Zoology, and approval of the instructor
Problems in development, life history, morphology, physiology, ecology, game managemen
taxonomy, or parasitology. A maximum of six credits is allowed toward the master's degre
but any number toward the doctorate. Graduate Sta:

ADMINISTRATION AND FACULTY

The Alumni Association

. W. TAYLOR, Director of Alumni Affairs

'he purposes of the Alumni Association are to promote the growth, prog ess, and general welfare of State College; to foster among its former udents a sentiment of regard for one another and continuing attachment) their Alma Mater; and to interest prospective students in attending tate College.

Membership Activities

Active membership is available to all former students, regardless of ength of stay at the College; members of the faculty, administrative staff, agricultural Extension Service, Agricultural Experiment Station, teachers f agriculture in North Carolina high schools; and other persons who have uccessfully completed a short course at North Carolina State College and eceived a certificate therefor.

Honorary membership consists of such distinguished persons as are duly lected to honorary membership in the association. The association meets nnually during Alumni Week. Class reunions (scheduled in order that ach class has a reunion every five years after graduation) are also held each ear in connection with Alumni Week. Officers of the association are lected by the active members each year through the medium of a mail allot. Local State College clubs are organized in most of the counties in North Carolina and in a number of cities in other states.

Alumni Fund

The Alumni Fund was established by the Alumni Association at State College in 1952 to replace the old dues paying program and provide a neans through which the alumni may contribute to the advancement of he College. Each alumnus is invited to make an annual contribution.

State College News

State College News is published every month in the year by the Alumni Association and sent to contributors to the Alumni Fund. The purpose of the magazine is to keep association members in touch with the College and with each other. It carries news and pictures of students and former students and of the College.

The Alumni Office

Records of both graduates and nongraduates are kept by the Alumni Office. The master file includes information on all former students; other files are arranged geographically and by classes. Biographical files are also kept.

Serving as a medium of communication between alumni and the College, the Alumni Office, located in the Alumni Memorial Building (formerly the Old Infirmary Building), is official headquarters for alumni when they visit the campus.

College Foundations

L. L. RAY, Director

Nine foundations, organized and incorporated under the laws of North Carolina, promote and support various State College programs.

The foundations include the North Carolina State College Foundation, Inc., the North Carolina Agricultural Foundation, Inc., the North Carolina Dairy Foundation, Inc., the North Carolina Engineering Foundation, Inc. the North Carolina Textile Foundation, Inc., the North Carolina Design Foundation, Inc., the North Carolina Forestry Foundation, the Pulp and Paper Foundation, Inc., and the 4-H Development Fund, Inc.

State College Foundation

The North Carolina State College Foundation, Inc., was organized December 11, 1942, to foster and promote the general welfare of North Carolina State College and to receive and administer gifts and donations for such purposes. The Board of Directors is composed of alumni of State College and members of the Board of Trustees of the University of North Carolina.

Agricultural Foundation

The North Carolina Agricultural Foundation, Inc., renders financial assistance through supplements in the development of strong teaching programs in agriculture and assist the Extension Service and Agricultural Experiment Station of the School of Agriculture at North Carolina State College.

Dairy Foundation

The North Carolina Dairy Foundation, Inc., aims to promote and improve all phases of dairying in North Carolina through education, research, and extension. A Board of Directors of 60 persons handles the affairs of the Foundation; these directors represent distributors, producers, and jobbers.

Engineering Foundation

The North Carolina Engineering Foundation, Inc., gives financial assistance to teaching, research, and extension in and through the School of Engineering.

Textile Foundation

The North Carolina Textile Foundation, Inc., was formed to promote the development of the School of Textiles, and was incorporated December 31, 1942. Funds for this foundation have been raised largely from textile manufacturing plants and other corporations and industries closely allied to textiles.

Design Foundation

The North Carolina Design Foundation, Inc., was organized January, 1949. Foundation funds are used for the promotion and advancement of architectural education at North Carolina State College.

Forestry Foundation

The North Carolina Forestry Foundation was incorporated April 15, 1929. The foundation has acquired a tract of land known as the Hofmann Forest, consisting of about 80,000 acres in Jones and Onslow counties, which is used as a demonstration and research laboratory for forestry students.

Pulp and Paper Foundation

The Pulp and Paper Foundation, Inc., was incorporated December 19, 1954, by the southern pulp and paper mills, for the purpose of supporting the program of pulp and paper technology in the School of Forestry.

4-H Development Fund

The 4-H Development Fund, Inc., was organized in 1959. 4-H Development Fund monies are used to promote and advance all areas of 4-H Club work in North Carolina.

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By action of the Trustees, the General Faculty includes all members of the College's teaching force above the rank of Instructor and all general administrative offices of the institution. Under the President of the Consolidated University, the Chancellor of the College, and the General Faculty is vested final authority (under the Trustees) over all matters of College policy and activity. Under the General Faculty and Administrative Council, the Schools have separate Faculties and Administrative Boards (composed of all Department Heads) which have final authority over matters pertaining solely to their respective Schools, when not in conflict with Consolidated University and College regulations.

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Accrediting Agencies:[1]	North Carolina College Conference Southern Association of Colleges and Schools	
Major Memberships:	American Council on Education	1924
	Association of State Universities and Land-Grant Colleges	1889
	College Entrance Examination Board	1958
	National Commission on Accrediting	1950
	North Carolina College Conference	1920
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[1] Individual schools and departments are accredited by the various associations in their respective fields.

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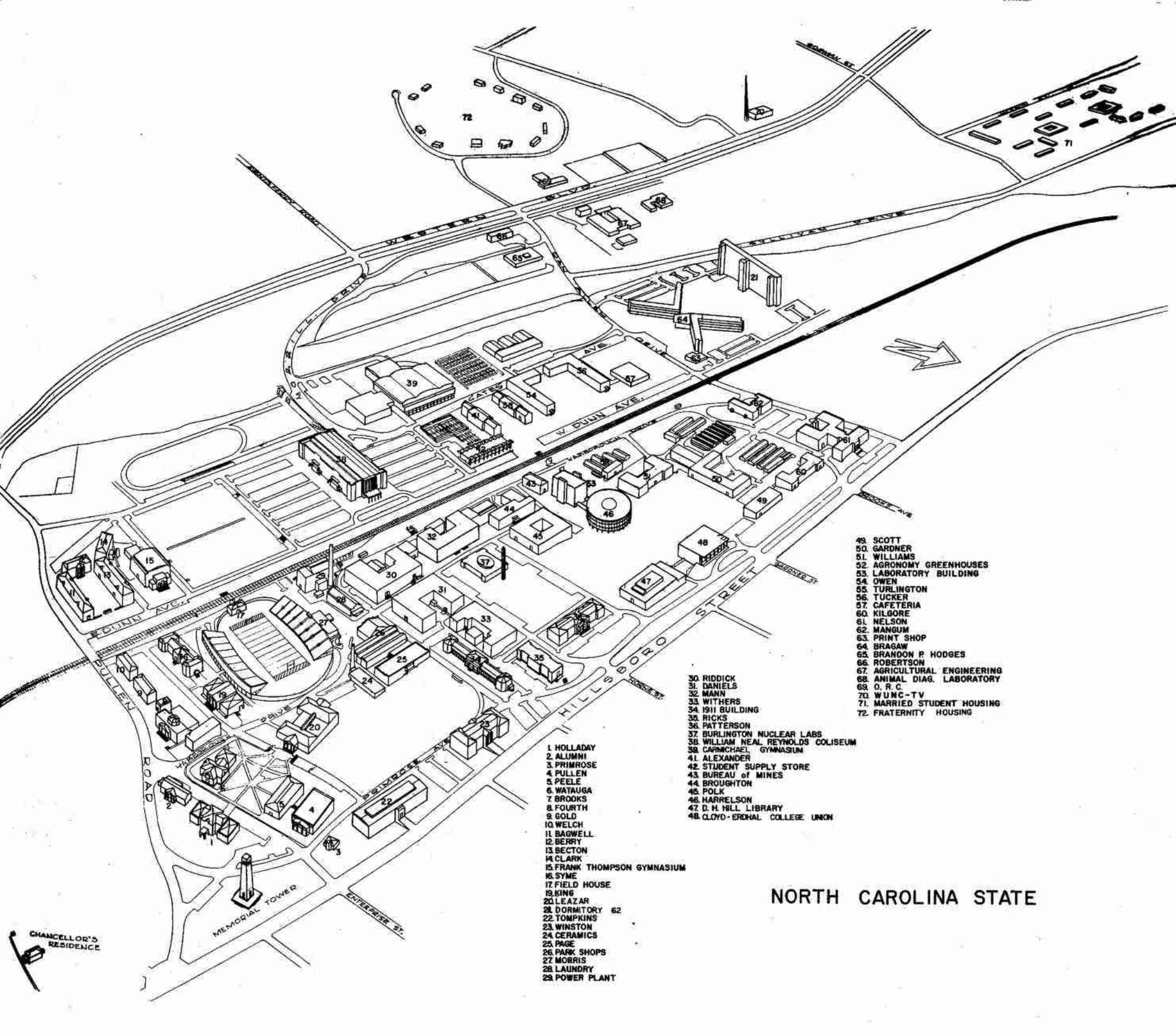
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55. TURLINGTON
56. TUCKER
57. CAFETERIA
60. KILGORE
61. NELSON
62. MANGUM
63. PRINT SHOP
64. BRAGAW
65. BRANDON P. HODGES
66. ROBERTSON
67. AGRICULTURAL ENGINEERING
68. ANIMAL DIAG. LABORATORY
69. O. R. C.
70. WUNC-TV
71. MARRIED STUDENT HOUSING
72. FRATERNITY HOUSING
NORTH CAROLINA STATE
CHANCELLOR'S RESIDENCE
MEMORIAL TOWER
BOULEVARD
DUNN AVE.
HILLSBORO STREET
PULLEN ROAD
ENTERPRISE ST.
PRIMROSE AVE.
BROOKS AVE.
GORMAN ST.
DAN ALLEN DRIVE
WESTERN BLVD.
AVENT FERRY ROAD
GARDNER DRIVE
TURLINGTON DRIVE
CATES AVE.
W. DUNN AVE.
VARSITY DRIVE
HARRELSON
PARK SHOPS