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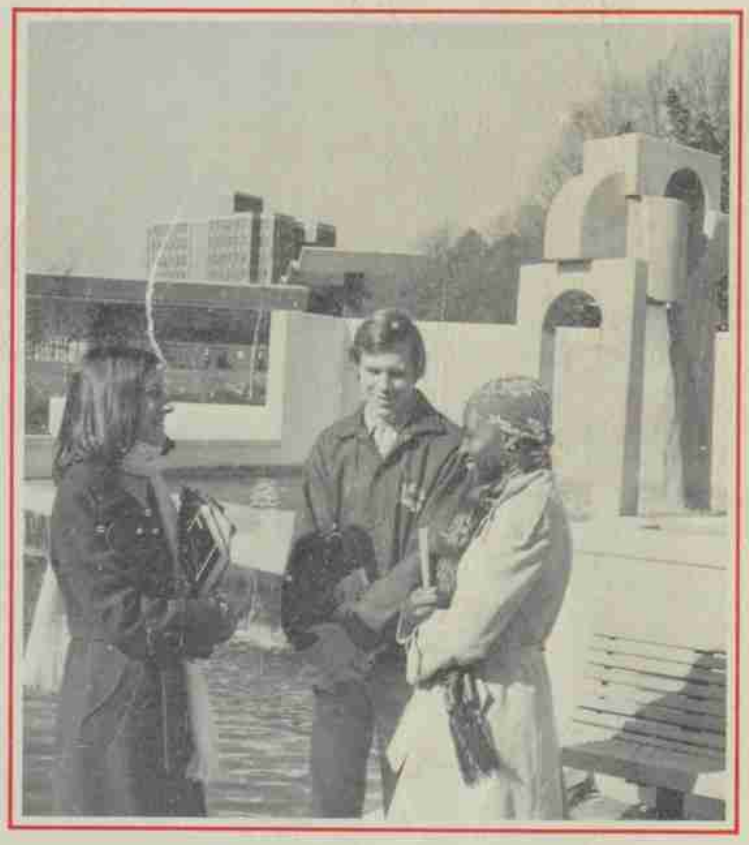
North Carolina State University

Bulletin



Undergraduate Catalog
1977-1979

December, 1976

This catalog is intended for informational purposes only. Requirements, rules, procedures, courses and informational statements set forth herein are subject to change. Notice of changes will be conveyed to duly enrolled students and other appropriate persons at the time such changes are effected.

NORTH CAROLINA STATE UNIVERSITY BULLETIN

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North Carolina State University

Raleigh, North Carolina

Undergraduate Catalog
1977-79

North Carolina State University

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Professor Richard Myers, president, Faculty Senate, and Lu Anne Rogers, president, Student Government with Chancellor Thomas.

North Carolina State University

North Carolina State University is one of the nation's major public universities—large, complex, national and international in scope, and a leader in scientific research.

It ranks among the top universities in the nation, and shares the distinctive character of Land-Grant state universities nationally—broad academic offerings, extensive public service, national and international activities, and large-scale extension and research programs.

Academic excellence is well represented in more than 90 bachelors of arts and science programs, 68 masters degree fields and 46 doctoral degrees.

Research activities span a broad spectrum of about 700 scientific, technological and scholarly endeavors, with a budget of approximately $20 million annually.

Extension work on a statewide basis in each of the 100 counties underscores the idea that the University's campus extends to the state's boundaries. Diverse extension programs include urban affairs, marine sciences, environmental protection, engineering, industrial, business and textiles, agricultural and many others.

The annual University budget is more than $100 million. The University has 4,600-plus employees. There are 1,621 faculty and professional staff and 174 adjunct and federal agency faculty, including 1,075 graduate faculty.

There are 120 campus buildings with an estimated value of about $150 million.

The central campus is 596 acres, though the University has 88,000 acres on a statewide basis, including one research and endowment forest of 78,000 acres. Near the main campus are research farms; biology and ecology sites; genetics, horticulture, and floriculture nurseries; forests, and areas such as Carter Stadium which comprise about 2,500 acres.

The University's Wolfpack athletics teams are well-known nationally. The basketball team was national champion in 1974-75. The football team has been the Atlantic Coast Conference champion four times and co-champion twice and has won three bowl games in the last decade. The Wolfpack is now fielding women's inter-collegiate athletics teams.

North Carolina State University is one of the three Research Triangle Universities along with Duke University and the University of North Carolina at Chapel Hill. In the 30-mile triangle formed by the three universities is the 5,000-acre Research Triangle Park, the Research Triangle Institute, a Universities's subsidiary, and the Triangle Universities Computation Center, a central facility for the extensive computing centers of the institutions.

N. C. State's enrollment is about 17,000. There are 13,600 undergraduates, and 3,300 graduate students. Students at State come from 50 states and more than 60 other countries. The international enrollment is a distinctive feature of the institution since its 500 international students give it a decidedly cosmopolitan aura.

State is one of 118 members of the National Association of State Universities and Land-Grant Colleges. Even though these institutions constitute less than 5 percent of the 2,500 colleges and universities in the nation, they are truly the nation's major institutions. They enroll about 30 percent of all U.S. college students —2.9 million out of 9.7 million, and award 38 percent of all degrees awarded in the United States, including 64 percent of all doctoral degrees.

Chancellor Thomas has described NCSU as a "magnet of progress," noting that its faculty have been attracted from more than 150 of the top universities of the nation and the world. Some 30 nations are represented. A recent study showed that the Research Triangle area has more Ph.D's proportionate to population than any area of the nation. The Triangle universities—State, Duke and UNC-Chapel Hill—plus the Research Triangle Park, constitute a notable concentration of knowledge.

NCSU is dedicated to advancing knowledge, providing superior education and serving the people. It looks to the future with optimism and confidence.

PROGRAMS OF STUDY

About 2,300 different courses are taught at North Carolina State University. These range from basic courses for freshmen to high level courses available only to graduate students working on Ph.D. degrees. The importance of this number of courses to students is that they constitute a wide range of curricula, that is, "fields of study" or majors, such as history, chemical engineering, business or conservation. Equally important, the courses can be combined in special cases to form entirely "new" majors or specializations of the student's particular interest. This is the case with a program in Liberal Arts called Multidisciplinary Studies.

N. C. State offers about 90 rather clearly defined undergraduate programs of study. In addition it offers options in many fields, such as the science, business or technology options in a number of agricultural fields.

The following is a listing of the majors offered at N. C. State as undergraduate degree programs, specialized curricula, or options.

Agriculture
- Agricultural Economics
- Agronomy
- Animal Science
- Biological and Agricultural Engineering
- Crop Science
- Food Science
- Horticultural Science
- Nutrition
- Pest Management for Crop Protection
- Poultry Science
- Soil Science

Business and Economics
- Accounting
- Business Management
- Economics

Biological Sciences
- Biological Sciences (General)
- Biochemistry
- Botany
- Entomology
- Fisheries and Marine Biology
- Microbiology
- Wildlife Biology
- Zoology

Design
- Architecture
- Landscape Architecture
- Product Design
- Visual Design

Education (incl. teacher certification)
- Agricultural
- English
- French Language and Literature
- Industrial Arts
- Mathematics
- Science (biology, chemistry, earth science, & physics)
- Secondary Education
- Social Studies (economics, history, political science, & sociology)
- Spanish Language and Literature
- Technical
- Vocational Industrial

Engineering
- Aerospace
- Chemical
- Civil
- Construction
- Electrical
- Engineering Science and Mechanics
- Engineering Operations
- Furniture Manufacturing and Management
- Industrial
- Materials
- Mechanical
- Nuclear

Forestry and Wood Sciences
- Forestry
- Pulp and Paper Science and Technology
- Wood Science and Technology

Humanities
- English and American Literature
- French Language and Literature
- History
- Philosophy

Spanish Language and Literature
Speech-Communication
Writing-Editing

Individualized Programs
Individualized Study Program (Agriculture and Life Sciences)
Multidisciplinary Studies (Liberal Arts)

Mathematics and Related Sciences
Computer Science
Mathematics
Statistics

Physical Sciences
Chemistry
Geology
Meteorology
Physics

Medical and Veterinary Sciences
Medical Technology
Pre-dental
Pre-medical
Pre-veterinary

Psychology
Experimental Psychology
Human Resource Development
Psychology

Recreation and Natural Resources
Conservation
Recreation Resources Administration

Social Sciences
Criminal Justice
Political Science
Rural Sociology
Social Work
Sociology

Textiles
Textile Chemistry
Textile Technology

Agricultural Institute

This two-year program requires high school graduation and a letter of recommendation. The program does not carry college credit. An Associate of Applied Science degree is awarded. Fields of study are:

Agricultural Equipment Technology
Agricultural Pest Control (Agricultural, Urban and Industrial Options)
Field Crops Technology
Flower and Nursery Crops Technology
Food Processing, Distribution and Service
General Agriculture
Livestock Management and Technology (Dairy and Animal Husbandry Options)
Soil Technology
Turfgrass Management

UNDERGRADUATE DEGREES AND OPTIONS LEADING TO DEGREES

Bachelor's degrees of:

Design	environmental design in architecture; environmental design in landscape architecture; and environmental design in product design (including option in visual design).
Liberal Arts	social work.

Bachelor of Science degrees in:

Agriculture and Life Sciences

(Business)	agricultural economics; animal science; horticultural science; and poultry science.

(Science) agricultural economics; animal science; biological and agricultural engineering; biological sciences (including options in biochemistry, microbiology, and nutrition); botany; conservation; crop science; entomology; food science; horticultural science; medical technology; pest management for crop protection; poultry science; pre-veterinary option; rural sociology (including option in criminal justice); soil science; wildlife biology; and zoology (including options in pre-dental and pre-medical; fisheries and marine biology).

(Technology) agronomy; animal science; biological and agricultural engineering; food science; horticultural science; and poultry science.

Individualized Study Program in Agriculture and Life Sciences.

Education agricultural education; industrial arts education; mathematics education; science education (including biology, chemistry, earth science, and physics); secondary education; technical education; and vocational industrial education.

Engineering aerospace engineering; biological and agricultural engineering; chemical engineering; civil engineering; construction option; electrical engineering; engineering operations; engineering science and mechanics; furniture manufacturing and management; industrial engineering; materials engineering; mechanical engineering; and nuclear engineering.

Forest Resources conservation; forestry; pulp and paper science and technology; recreation resources administration; and wood science and technology.

Liberal Arts economics English; history; philosophy; and political science.

Physical and Mathematical Sciences
chemistry; computer science; geology; mathematics; meteorology; physics; and statistics.

Textiles textile chemistry; and textile technology.

Bachelor of Arts degrees in:

Education psychology (including options in experimental; human resource development).

Liberal Arts accounting; business management; economics; English (including options in teacher education; writing-editing); French (including option in teacher education); history; multi-disciplinary major in liberal arts; philosophy; political science (in-

cluding option in criminal justice); social studies education option (in economics, history, politics, or sociology); sociology (including option in criminal justice); Spanish (including option in teacher education); and speech-communication (including option in teacher education.

Physical and Mathematical Sciences
geology.

Professional degrees (fifth year) in:

chemical engineering; civil engineering; electrical engineering; industrial engineering; materials engineering; mechanical engineering; and nuclear engineering.

GRADUATE DEGREES

Master's degrees of:

adult and community college education, agricultural education, agriculture, architecture, biological and agricultural engineering, biomathematics, chemical engineering, civil engineering, curriculum and instruction, economics, educational administration and supervision, electrical engineering, engineering (off-campus program), engineering science and mechanics, forestry, guidance and personnel services, industrial arts education, industrial engineering, landscape architecture, life sciences, mathematics education, mechanical engineering, occupational education, product design, public affairs, recreation resources, sociology, science education, special education, statistics, technology for international development, textile technology, urban design, vocational industrial education, wildlife biology, wood and paper science.

Master of Arts programs in:

economics, English, history, and political science.

Master of Science programs in:

adult and community college education, agricultural economics, agricultural education, animal science, applied mathematics, biochemistry, biological and agricultural engineering, biomathematics, botany, chemical engineering, chemistry, civil engineering, crop science, curriculum and instruction, ecology, educational administration and supervision, electrical engineering, engineering science and mechanics, entomology, food science, forestry, genetics, geology, guidance and personnel services,

horticultural science, industrial arts education, industrial engineering, management, marine sciences, materials engineering, mathematics, mathematics education, mechanical engineering, microbiology, nuclear engineering, nutrition, occupational education, operations research, physics, physiology, plant pathology, poultry science, psychology, recreation resources administration, rural sociology, science education, soil science, special education, statistics, textile chemistry, textile technology, vocacational industrial education, wildlife biology, wood and paper science, and zoology.

Doctor of Philosophy programs in:

animal science, applied mathematics, biochemistry, biological and agricultural engineering, biomathematics, botany, chemical engineering, chemistry, civil engineering, crop science, economics, electrical engineering, engineering science and mechanics, entomology, fiber and polymer science, food science, forestry, genetics, horticultural science, industrial engineering, marine sciences, materials engineering, mathematics, mathematics education, mechanical engineering, microbiology, nuclear engineering, nutrition, operations research, physics, physiology, plant pathology, psychology, science education, sociology, soil science, statistics, wood and paper science, and zoology.

Doctor of Education programs in:

adult and community college education, curriculum and instruction, educational administration and supervision, guidance and personnel services, industrial arts education, and occupational education.

Consult the Graduate Catalog for further information on graduate programs and admissions procedures.

Admissions

Freshman applications to the University for the fall semester or summer sessions should be submitted during the fall of the senior year in high school. Based on past experience, applications and credentials received in the fall and early winter have received full consideration while those applications received later have been (and may be again) subject to a waiting list, depending upon space availability. Those students whose applications are placed on a waiting list will be notified of their final status by June 1.

Applicants for the School of Design should submit applications by January 1. Applications for the spring semester should be submitted prior to November 1; however, all acceptances for the spring semester are subject to space availability.

Each applicant must complete an application form which may be obtained from high school counselors or by writing to:

Director of Admissions
P. O. Box 5126
North Carolina State University
Raleigh, North Carolina 27607

A nonrefundable $10 fee must accompany the completed application.

FRESHMAN ADMISSION

Applicants normally should be graduates of an accredited high school and have the recommendation of the principal or counselor. Non-graduates should usually have a high school equivalency certificate, the minimum high school mathematics preparation, and present other evidence of maturity and ability to deal effectively with college work.

Prospective students should have the following high school credits (courses):

English—4 years

History—2 years

Mathematics—2 years of algebra; 1 year of geometry; advanced algebra and trigonometry is recommended for some programs

Science—2 years, preferably biology, chemistry or physics

Foreign Languages—2 years required for Liberal Arts School only

Information the University needs for admissions purposes includes: the high school record showing grades through the junior year, a listing of courses in progress in the senior year, an overall grade point average based on at least three years of high school study, scores on the Scholastic Aptitude Test (SAT) or ACT, and the field of study or curriculum preferred.

In addition to adequate high school preparation, each freshman must meet a minimum Predicted Grade Average computed on the basis of the high school grade point average and scores on the SAT or ACT. The grade point average carries greater weight in the prediction than the test scores.

Applicants are accepted on either junior or senior test scores, although senior scores are recommended, especially if the applicant is also applying for financial aid. An interview is not required and does not weigh in the admissions decision; however, a prospective student is always welcome to visit the Admissions Office, 112 Peele Hall, from 8:00 a.m. until 5:00 p.m. Monday through Friday.

Two-Year Agricultural Institute

Requirements for admission to the Agricultural Institute, a two-year terminal program, include graduation from an accredited high school or successful completion of the high school equivalency examination administered by the State Department of Public Instruction. The application should include a copy of the high school record or a letter indicating the applicant has passed the equivalency examination, and a letter of recommendation. Each application is reviewed and evaluated by the Institute Director. SAT scores are not required.

Freshman Class Profile

Who makes up the student body at North Carolina State University? Fifty-five percent of the freshmen who entered in August 1975 were in the top fifth of their high school graduating class; eighty-two percent, in the top two-fifths. High school performance is usually considered the best predictor of success in college; however, applicants who do well on the SAT or ACT exams and have "low" high school averages should not be discouraged from applying for admission. In 1975-76, the freshman class at N. C. State had average SAT scores of 475 Verbal and 534 Mathematics.

Scholastic Aptitude Test (SAT), American College Testing Program Achievement Tests, Advanced Placement

Scholastic Aptitude Test and American College Test—Applicants for admission as freshmen must take the College Entrance Examination Board Scholastic Aptitude Test (SAT) or the American College Test (ACT) and request that their scores be sent directly from the Board to North Carolina State University (Code No.—R5496). Information booklets and application forms may be obtained from school counselors or by writing:

College Entrance Examination Board
Box 592
Princeton, New Jersey 08540

or

American College Testing Program
P. O. Box 414
Iowa City, Iowa 52240

Achievement Tests—Achievement Test scores are not used in the admissions decision; however, freshmen who take the English and Math Level I Achievement Tests will receive more accurate placement in the beginning English and math courses. The fall and winter test dates are considered the best time for taking these tests.

Advanced Placement—A student may qualify for advanced placement by one or more of the following means: 1) by passing a proficiency examination administered by a teaching department; 2) by attaining a sufficient predicted grade in English (PGE) which is based on the SAT Verbal score and either the high school record or the CEEB English Achievement score; 3) by attaining a sufficient predicted grade in mathematics (PGM) which is based on the SAT Mathematics score and either the high school record or the CEEB Mathematics Achievement score; 4) by meeting a specific minimum score on certain of the CEEB Advanced Placement Program (APP) examinations; and 5) by attaining at least a minimum score on certain of the College Level Examination Program (CLEP) tests.

OUT-OF-STATE STUDENTS

Undergraduate applicants from outside North Carolina must meet higher standards than required of N. C. residents in some fields of study before admission

will be granted. North Carolina State University is limited to accepting not more than 15 percent of total undergraduate admissions from outside the State.

TRANSFER STUDENTS

North Carolina State University welcomes transfer applicants, and in recent years, more than 25 percent of our graduates started their college programs at other institutions.

All transfer applicants must have an overall 2.5 average on all college-level work taken at accredited institutions and must be eligible to return to the last institution regularly attended. At least 28 semester hours of "C" work are required, or the applicant must meet freshman admissions requirements. Applications of students from non-accredited institutions are reviewed by the Admissions Committee.

Work completed at technical institutes is generally not considered college level; however, after enrolling at North Carolina State University, students from such institutes may take comprehensive examinations in courses in which they feel previous training qualifies them for advanced placement.

If admitted, the prospective transfer student's record will be further evaluated to determine the amount of credit that can be transferred and applied toward degree requirements at N. C. State. This evaluation will be approved by the dean of the school in which the student wishes to enroll. *Transcripts are not evaluated however until the applicant has been admitted.* A nonrefundable $2 transcript evaluation fee, payable to North Carolina State University, is charged for this service.

ADDITIONAL CLASSIFICATIONS

Unclassified Students—An unclassified student is one who has been approved for admission to a specific school and is earning college credit but has not chosen a specific curriculum. He or she must meet the same admissions requirements as regular students. If, at a later date, an unclassified student wishes to change to regular status, credits must be evaluated for his or her chosen curriculum.

Special Students—The special student classification is primarily designed for students 18 years of age or older who are employed in the Raleigh area, including homemakers and other mature individuals interested in college courses for special reasons, but who do not desire to work toward a degree at North Carolina State University. The usual college admissions requirements may be waived for qualified special students, but regular rules of scholarship apply after admission. A maximum of 2 courses per semester may be taken by "special" students.

Special student applications should be made through the Division of Continuing Education, McKimmon Extension Education Center, corner of Western Boulevard and Gorman Street. If special students wish to change to regular status at a later date, they must make regular application through the Admissions Department and meet the same admissions requirements as other degree candidates.

Auditors—New students desiring admission as auditors should also apply through the Division of Continuing Education. Auditors receive no college credit; however, they are expected to attend classes regularly. Auditor participation in class discussion and in examinations is optional with the instructor.

SERVICEMEN'S OPPORTUNITY COLLEGES, COLLEGE LEVEL EXAMINATION PROGRAM

Servicemen's Opportunity Colleges (SOC)—College level courses offered by accredited institutions and made available to military personnel through SOC will be considered for transfer credit if a grade of "C" or better has been earned and if the courses are applicable to the student's curriculum. A transcript must be sent to the Director of Admissions directly from the institution offering the course.

College Level Examination Program—CLEP primarily serves non-traditional students who have acquired knowledge through University extension courses, educational television, non-credit adult education programs, on-the-job training, and independent study by enabling them to demonstrate their knowledge and receive college credit on the basis of examinations.

There are two types of examinations, General Examinations and the Subject Examinations. Although only a limited amount of credit is given for the General Examinations, most Subject Examinations are accepted for credit. The examinations are given at N. C. State during the third week of each month, and candidates should register three weeks before the test date.

For further information write or telephone the Counseling Center, North Carolina State University, Box 5072, 200 Harris Hall, Raleigh, N. C. 27607; (919) 737-2423.

GRADUATE STUDENTS

Procedures and policies governing graduate admission are outlined in a special catalog issued by the Graduate School. For a copy of the Graduate School catalog contact:

Dean of the Graduate School
104 Peele Hall
North Carolina State University
Raleigh, North Carolina 27607

READMISSIONS

See readmissions procedures, page 29.

Registration

Preregistration: To preregister a student meets with his or her adviser to discuss an academic program and to select courses for the next semester. The courses selected by each student are processed through the computer which assigns a day and an hour for each course requested. During the registration period at the beginning of each semester, the student obtains a completed class schedule. Schedule of Courses listings are available for every semester and they contain all necessary instructions for completing preregistration. To be preregistered, a student must submit a Preregistration Schedule Request form to Registration and Records during the specified preregistration period.

Registration: Registration consists of three steps: 1) paying tuition and fees—preferably by mail, 2) completing registration forms, and 3) obtaining class schedules. Students who register late must follow late registration instructions and pay the required late fees. Instructions for completing registration and late regis-

tration are issued each semester and summer session. Each student is expected to complete registration in person. Under no circumstances is a preregistered student considered officially registered until such time as the student has picked up a class schedule and completed the registration forms.

INTERINSTITUTIONAL REGISTRATION

A regularly enrolled undergraduate degree student who is enrolled in at least eight credit hours at North Carolina State University may take course work at one of the Raleigh colleges, at the University of North Carolina at Chapel Hill, at the University of North Carolina at Greensboro or at Duke University. Interinstitutional registration forms and all registration procedures are available from Registration and Records.

SCHEDULE CHANGES—DROPS AND ADDS

Courses may be freely added during the first week of a regular semester and with the permission of instructor, courses may be added through the second week. Courses may be freely dropped until the end of the fourth week of the semester without grades for these courses appearing on the student's permanent academic record. After that time no courses may be dropped without approval by the dean of the student's school. If a student is enrolled for only one course and wishes to drop it, the procedure is that of withdrawal from the University.

Tuition and Fees

North Carolina Resident—$262.15 per semester ($165 tuition plus $97.15 fees)
Nonresident—$1,085.15 per semester ($988 tuition plus $97.15 fees)

A statement of tuition and fees is mailed to each preregistered student around 30-40 days before the beginning of any semester. The statement must be returned with full payment or complete financial assistance information by the due date appearing on the statement. Normally the due date is approximately one week before classes begin. Fees are the same for both residents and nonresidents and are required of all regularly enrolled students. Nonresident students are required to pay an additional $823.00 per semester for tuition. A few non-preregistered students pay their tuition and fees at registration.

ESTIMATED ANNUAL UNDERGRADUATE EXPENSES

Tuition and Fees	*Fall Semester*	*Spring Semester*	*Year*
N. C. Residents	$ 262.15	$ 262.15	$ 524.30
Out-of-State Residents	(1,085.15)	(1,085.15)	(2,170.30)
Room Rent	180.00	180.00	360.00
Board (estimated)	495.00	495.00	990.00
Books and Supplies (estimated)	87.50	87.50	175,00
Other personal expenses and incidentals (estimated)	200.00	200.00	400.00
Total—N. C. Resident	$1,224.65	$1,224.65	$2,449.30
(Non resident)	($2.047.65)	($2,047.65)	($4,095.30)

NOTE: All charges are subject to change without notice.

Expenses Other Than Tuition and Fees

Application Fee—A nonrefundable fee of $10 must accompany each application for admission. Transfer students must pay an additional $2 ($12 total) as a transcript evaluation fee.

Room Rent—New incoming students receive a room application card with payment instructions in the letter of acceptance. Continuing students are provided a card with instructions at their residence hall rooms.

Board—Meals are paid for individually at the various dining facilities available both on and near the campus.

Books and Supplies—Books and supplies are usually purchased during the first week of classes often directly from the Students Supply Stores.

Personal Expenses—Personal expenses vary widely among students but the yearly estimate of $400 is based on what students have told us they spend on these items.

REFUND POLICY

A student who officially withdraws from school during the first two weeks of classes will receive a tuition and fees refund of the full amount paid less a registration fee. The withheld registration fee amounts to $15 the first week and $25 the second week. After the two week period, no refunds will be made.

In some instances, circumstances justify the waiving of rules regarding refunds. An example might be withdrawal from the University because of sickness. Students have the privilege of appeal to the Refund and Fees Committee when they feel special consideration is merited. Applications for such appeals may be obtained from the Office of Business Affairs or the Division of Student Affairs.

An itemization of required fees and other detailed information concerning expenses or related data can be obtained by contacting the Office of Business Affairs, P. O. Box 5067, Raleigh, N. C. 27607, (919) 737-2986.

RESIDENCE STATUS

Until May of 1973, determination of a student's residence status for tuition purposes rested upon the easily administered statutory requirement that "a legal resident must have maintained his domicile in North Carolina for at least 12 months *next preceding the date of enrollment or re-enrollment* in an institution of higher education in this State," with the express proviso that "student status in an institution of higher learning in this State shall not constitute eligibility for residence to qualify said student for in-state tuition" (G.S. 116-143.1, 1971) (emphasis added). The administrative consequence of this law was to make necessary, in most cases, only one inquiry concerning residence status for each student, at the outset of the higher education experience, since time spent enrolled as a student could not be counted in satisfaction of the 12-month eligibility requirement.

The 1973 Session of the General Assembly amended the applicable law, so as to read in pertinent part as follows:

"(b) To qualify for in-state tuition a legal resident must have maintained his domicile in North Carolina for at least the 12 months immediately prior to his classification as a resident for tuition purposes. In order to be eligible for such classification, the individual must establish that his or her presence in the State during such 12-month period was for purposes of maintaining a bona fide domicile

rather than for purposes of merely temporary residence incident to enrollment in an institution of higher education; further, (1) if the parents (or court-appointed legal guardian) of the individual seeking resident classification are (is) bona fide domiciliaries of this State, this fact shall be prima facie evidence of domiciliary status of the individual applicant and, (2) if such parents or guardian are not bona fide domiciliaries of this State, this fact shall be prima facie evidence of non-domiciliary status of the individual." (University regulations concerning the classification of students by residence, for purposes of applicable tuition differentials, are set forth in detail in *A Manual to Assist The Public Higher Education Institutions of North Carolina in the Matter of Student Residence Classification for Tuition Purposes*. Each enrolled student is responsible for knowing the contents of that *Manual*, which is the controlling administrative statement of policy on this subject. Copies of the *Manual* are available for review on request at the Admissions Office, 112 Peele Hall, North Carolina State University.)

The essential change effected by the 1973 amendment to this statute is that a person who is an enrolled student is no longer necessarily precluded from demonstrating during the period of one's enrollment that he or she in fact has become a legal resident of North Carolina entitled to the in-state tuition rate. The administrative consequences of this modification of the law are substantial. Two inquiries are mandated by the statute. First, has the applicant for classification as a legal resident in fact resided in North Carolina for a minimum period of 12 months immediately prior to the proposed effective date of his or her classification as a resident for tuition purposes? Second, during the 12-month period in question, did the applicant's presence in the State constitute legal residence? Thus, a carefully detailed inquiry must be made in each such case concerning the residential status of the applicant, as measured by established legal principles which control the disposition of questions about the place of legal residence of an individual.

CLASSIFICATION PROCEDURES

A. *Initial Classification*—A student admitted to initial enrollment in an institution (or permitted to re-enroll following an absence from the institutional program which involved a formal withdrawal from enrollment) shall be classified by the admitting institution either as a resident or as a nonresident, for tuition purposes, prior to actual matriculation. Particular officials or offices of the institution shall be designated to evaluate all such initial classification cases and to assign an appropriate classification consistent with the requirements of State law and the provisions of this manual. Basic data on which such assignment shall be based shall be collected in accordance with the common informational form prescribed herein (see Appendix B of Residence *Manual*, 1973, as revised 7/74 and 7/75, NCSU); additional data or documentation deemed essential to a reliable determination may be elicited from the student, as deemed appropriate by the responsible official or office.

B. *Subsequent Classification Inquiries: Reclassification*—A residential classification once assigned (and confirmed pursuant to any appellate process invoked) may be changed thereafter only at intervals corresponding with the established primary divisions of the academic calendar of the institution, viz., at the beginning of a semester, quarter, or otherwise denominated basic interval of the academic calendar. No change in residential status for tuition purposes (and thus no change in applicable billing rates) shall be effected during such a semester, quarter, or term, with resulting increases or decreases in the tuition obligation on a pro rata basis for a portion of such semester, quarter, or term.

The institution shall provide to each student at the time of and in connection with the transmission to him or her of each periodic bill for tuition charges a

notice of the circumstances under which and the time at which a change in classification may occur. The notice shall be of the type prescribed in Appendix C of the Residence *Manual*, July 1973, as revised 7/74 and 7/75, NCSU.

Financial Aid

To gain consideration for all forms of aid administered by the Financial Aid Office, a student needs to obtain *both* a Parents' Confidential Statement (PCS) and a Basic Educational Opportunity Grant (BEOG) application (a new freshman may get these forms from his or her high school; a continuing student may obtain them from the Financial Aid Office). The parents should complete each form and then submit them to the appropriate offices, preferably before February 1 of the year of expected fall enrollment and by November 15 for spring consideration. New freshmen should also inquire about the North Carolina Student Incentive Grant. Information on this grant should be available from the high school counselor or may be obtained from the Financial Aid Office.

Awards are made to applicants on the basis of financial need and admission to the University. Determination of a student's need is based on estimated educational costs and a consideration of the family's financial strength—family income, student's summer savings, family asset holdings and debts, and other resources that may be available for use such as G.I. Bill benefits, Social Security, Vocational Rehabilitation assistance, etc.

Aid is available on a non-discriminatory basis to all qualifying students. These awards are usually offered in combinations of scholarship or grant, loan, and/or a work-study job, depending upon the degree of need. Continuing students must have a satisfactory record of academic achievement in order to have their aid renewed, and a new application must be submitted *each year* for continued aid.

SCHOLARSHIPS

Each financial aid applicant who submits the PCS and BEOG is automatically considered for any scholarship for which he or she qualifies. Some special "name" scholarships have curricular, geographic, or other special restrictions involved.

GRANTS

Basic Educational Opportunity Grant (for which all students who have never received a bachelor's degree *must* apply) will provide awards ranging from $200 to $1,400 to qualified students.

N. C. Student Incentive Grant is a grant program for legal residents of North Carolina. Entering freshmen and students who have received the grant before have priority for future grants. Grants range up to $1,500 per academic year.

Supplemental Educational Opportunity Grants are made from federal funds to undergraduate students from low-income families in amounts of $200 to $1,500 per year and limited to no more than half the total amount of aid given the student. They are especially useful in encouraging promising new students to attempt college.

ATHLETIC AWARDS

Athletic awards are made upon the recommendation of the Department of Athletics to students who meet the established qualifications for such awards. A full award provides tuition, fees, room, meals and books.

LOANS

National Direct Student Loans—Both undergraduate and graduate students carrying at least halftime academic loads may be awarded these loans. Loans, like other forms of financial aid, are need-based. Nine months after ceasing to be enrolled at least half time, a student must begin paying interest on his or her loan at 3% per year as well as assuming a $30 per month minimum repayment obligation. In order to establish a repayment schedule, borrowers are expected to have exit interviews at the loan office in the Office of Business Affairs just prior to graduation or other termination of studies.

Institutional Loans—A limited amount of other long-term loan money is available in several funds, and loans made therefrom are on essentially the same liberal terms as the National Direct Student Loans.

Guaranteed Student Loans—These are federal loans provided through banks and private lenders in the various states. Interest is at 7% per year with the Federal Government paying the interest during the in-school period for students who qualify for the interest benefit. In North Carolina, College Foundation, Inc. administers the program. Information and forms are available in the Financial Aid Office.

Emergency Short-Term Loans—These are available in small amounts, usually not exceeding $100, to enable qualified students to meet unexpected expenses. These loans are usually to be repaid within 30 days and are not extended beyond the end of a term or graduation.

COLLEGE WORK-STUDY

The federally supported Work-Study Program provides jobs on campus for students who qualify with need in the same manner as is required for scholarship or long-term loan assistance. Pay rates vary with the job. Similar off-campus programs, mainly in the summer, supplement the campus program as a part of the total Work-Study plan.

OTHER STUDENT EMPLOYMENT

The Financial Aid Office operates an employment service to assist any student who wants possibilities for part-time or summer work. No particular academic or economic qualifications are required to obtain jobs on- or off-campus outside the College Work-Study Program. A list of current job openings is available at the Financial Aid Office in Peele Hall.

Student Housing

North Carolina State University furnishes housing for approximately 6,395 students. The University operates residence halls which house 3,813 men and

1,722 women students. In addition, 300 apartments are available for married students and 14 University-owned fraternity and sorority houses accommodate 560 students.

RESIDENCE HALLS

The residence halls are operated to provide opportunities through a variety of group living experiences which will complement and expand the residents' educational experiences. Each hall is staffed with selected students, both graduate and undergraduate, who are responsible directly to professionally trained people in their area and to the Director of Residence Life. Staff members are available to help students initiate programs and activities and to advise and assist residents in any way possible.

Living arrangements in buildings vary. Six high-rise buildings are arranged in suites of four or five rooms sharing a bath; the other buildings have a center corridor with rooms opening on to it. Rooms are furnished but residents must provide bed linen, pillows and towels. (See page 34 for linen and blanket rental.)

To be eligible for University housing one must enroll as a regular full-time student (an undergraduate must carry a minimum of 12 credit hours per semester).

Room Rentals and Reservations—All rooms rent for $180 per semester; this rate is subject to change on a year to year basis. Reservation cards are mailed with the letter of acceptance for admission to the University. These reservation cards and the check for the rent must be returned to the Office of Business Affairs in accordance with the dates established by the Department of Residence Life before room assignments can be made.

Refund of Room Rent—If a room reservation is cancelled at the Office of Residence Life, Harris Hall, in person or in writing on or before the first day of classes (the date of cancellation is the date notification is received by that office), the rent paid will be refunded less a $25 processing fee. After the first day of classes, a refund will be given only if there is a waiting list of room applicants from which the vacated space can be filled. A refund given after the first day of classes will be the rental fee paid less the $25 processing fee and a prorated daily charge from the first day of classes until the room is vacated. Students who fail to notify the Residence Life Office and who fail to check in and secure their keys on or before 5 p.m. the first day of classes will have their reservation cancelled without refund.

HOUSING FOR MARRIED STUDENTS

The University operates 300 apartments in E. S. King Village for married students. The rental is $60 for an efficiency, $71 for a one-bedroom, and $82 for a two-bedroom including water only (gas is included in efficiency units). This rate is subject to change on a year to year basis. Information on availability and applications should be requested from the Department of Residence Life, Box 5072, Raleigh, N. C. 27607.

OFF-CAMPUS HOUSING

Raleigh has numerous privately owned apartments and houses available for rent to University students. A partial listing is located in the Residence Life Office in Harris Hall. No listing is published because of the rapid turnover.

The University does not operate a trailer parking area; however, privately owned parks are available within a reasonable distance of the campus.

FRATERNITIES AND SORORITIES

Seventeen of the 20 fraternities and all five social sororities chartered by the University maintain chapter houses. Twelve of the fraternities and two of the sororities are housed on Fraternity Row, a University-owned project; the remaining eight fraternities and three sororities are located throughout the immediate community.

Rental fees vary in fraternity houses depending on the individual chapter, but are approximately the same as the residence hall rates.

Academic Regulations

CLASSIFICATION OF STUDENTS

Regular degree students are classified at the beginning of each semester and summer session. The required number of hours of each classification is:

Classification	*Semester Hours of Earned Credit*
Freshman(FR)	Less than 28
Sophomore (SO)	28 or more, but less than 60
Junior (JR)	60 or more, but less than 92
Senior (SR)	92 or more

Agricultural Institute students are designated as first (01) year if they have earned less than 28 semester credits and second (02) year if they have earned 28 or more semester credits.

Unclassified students (UN) are those working for college credit, but not enrolled in a degree-granting program. Admission as an unclassified student requires the dean's recommendation in the school in which the student wishes to enroll. Unclassified students must meet the same entrance requirements as regular degree students and must meet the same academic requirements to continue.

Special (non-degree) students in the various schools are non-degree candidates carrying seven hours (two courses) or less in a semester. Special students must meet the same academic requirements as regular degree students in order to continue during a semester. Individuals in this category are called UGS if they have not obtained a baccalaureate degree, and PBS if they have obtained at least a baccalaureate degree.

SEMESTER COURSE LOAD AND SPECIAL REQUIREMENTS

The University considers a minimum full-time semester load as 12 credit hours for undergraduates and nine credit hours for graduate students. The maximum load for a semester is 21 credit hours for undergraduates and 15 credit hours for graduate students. To carry more than the maximum, a student must consult his or her adviser and obtain the approval of the dean of his or her school.

Permission is granted only under extenuating circumstances. Also, undergradu-

ate degree students who plan to register for 19 or more credit hours must obtain approval from their advisers.

For a regular summer session, a student must have the same approval if he or she carries more than seven credit hours.

NOTE: The number of hours for which a student is officially enrolled is that number in which the student is enrolled at the end of the second week of classes (i.e. the last day to withdraw or drop a course with a refund).

ACADEMIC ACHIEVEMENT MEASURES

Grading System

(Definition of Letter Grades and Quality Points)

Grade	*Definition*	*Quality Points Per Credit Hour*
A	Excellent	4
B	Good	3
C	Satisfactory	2
D	Marginal	1
NC	No Credit	0

(The following grades do not have quality points and are not calculated in the determination of quality point averages.)

S Satisfactory (Credit-only and certain other courses)
U Unsatisfactory (Credit-only and certain other courses)
CR Credit by Examination or Advanced Placement
IN Incomplete
LA Temporarily Late
AU Audit
NR No Recognition Given for Audit

Explanation of Letter Grades

D—Marginal. This grade will be used to recognize that a student's performance was marginal but clearly better than that of students who receive *NC.* (See section on GRADUATION REQUIREMENTS for policy on limiting the number of *D* credits which may be used to fulfill graduation requirements.)

NC—No Credit. This grade will be used to indicate that the student is not to receive course credit.

S—Satisfactory. This is a passing grade to be awarded only when the quality of the student's work is judged to be *C* or higher level. It is used as the passing grade for students who are taking free elective courses under the credit-only option. It may also be used for certain courses approved by the Provost, such as orientation courses, seminars, and research problems, in which *A, B,* and *C* grades are not appropriate.

U—Unsatisfactory. This is used to indicate that the student is not to receive credit for a credit-only or other course for which the passing grade would be *S* (*Satisfactory*).

CR—Credit. This is used by the Registrar to indicate course credit received by examination or advanced placement as certified by appropriate departments or schools. This grade shall be awarded only when the advanced placement testing indicates that the quality of the student's work in the course would have been expected to be of *C* or higher level.

IN—Incomplete. This is a temporary grade. At the discretion of the instructor, a student may be given an *IN* grade for work not completed because of a serious interruption in his work not caused by his own negligence. An *IN* grade must be made up by the end of the next regular semester (not including summer sessions) the student is in residence unless the instructor or teaching department involved is not able to allow the makeup. In the latter case, the instructor or teaching department will notify the student and the Department of Registration and Records when the *IN* grade must be made up.

The student must not register again for the course while the *IN* grade stands. Any *IN* grade not removed by the end of the next regular semester in residence or during the period specified by the instructor or teaching department will automatically become a *No Credit (NC)* grade and will count as a course attempted.

NOTE: In the case of a graduating student who has received an *IN*, the following procedures will apply:

If the course *is* needed for graduation, the student will not be allowed to graduate until the work has been made up.

If the course is *not* needed for graduation, the school dean or director of instruction must either (1) notify in writing the Department of Registration and Records that the *IN* grade is to be changed to a *W* or (2) notify in writing the Department of Registration and Records that permission has been given for the *IN* to remain and that a deadline has been established for the completion of the course. In the event that the course is subsequently not completed satisfactorily, the school dean or director of instruction shall notify in writing the Department of Registration and Records that the *IN* grade is to be changed to a *W*.

LA—Temporarily Late. The *LA* is an emergency symbol to be used *only* when grades cannot be reported by the teaching department or the professor on time. The *LA* differs from the *IN* grade in that the student receiving the *LA* has completed the work of the course including the examination. The *LA* should not be used by a teaching department or the instructor unless it is absolutely necessary; when it is used the following procedure should be used:

a. Return the Grade Report Rolls at the regularly scheduled time with the *LA* clearly marked.
b. Secure a Late Grade Report Form (pink) from Registration and Records or departmental office.
c. Return late grades on the Late Grade Report Form (pink) at the earliest possible time and not later than 15 days after the examination.

NOTE: It should be kept in mind that the semester grade reports of those students who receive an *LA* will not be complete. This

situation often causes students to be uninformed as to their academic eligibility and as to the correctness of their schedules for the following semester.

Correction of Error in Grading—When submitted to Registration and Records, end of course grades are final and not subject to change by reason of a revision of the instructor's judgement; nor are submitted grades to be revised on the basis of a second trial (e.g., a new examination or additional work undertaken or completed). Changes may be made only within one calendar year after the date final grades were submitted in order to correct an error in computation or transcribing, or where part of the student's work has been unintentionally overlooked.

QUALITY POINT AVERAGE

The number of credit hours officially attempted in a semester or summer session (for which a report of *A,B,C,D,NC* is received) is divided into the total number of quality points earned (see chart, page) to arrive at the Quality Point Average (QPA). The Quality Point Average of work attempted will be computed to three decimal points and used solely for class ranking and academic recognition.

For example, if a student takes 17 credit hours, earning an *A* in two 3-credit courses, a *B* in one 3-credit course, and one 2-credit course, a *C* in a 3-credit course and a *NC* in a 2-credit course, the quality point average would be:

6 (credits of *A*)	x 4 (quality points per credit hour)	= 24
5 (credits of *B*)	x 3 (quality points per credit hour)	= 15
3 (credits of *C*)	x 2 (quality points per credit hour)	= 6
2 (credits of *NC*)	x 0 (quality points per credit hour)	= 0
		45

The total number of quality points earned (45) divided by the number of credit hours attempted (17) equals the grade point average, in this case 2.647.

Semester Dean's List—Any full-time undergraduate student who earns a semester average of 3.5 or better on 12 to 14 hours of course work for which quality points are earned or 3.25 or better on 15 or more hours of course work for which quality points are earned is placed on the semester Dean's List. Students with *NC* or *IN* grades are not eligible for the Dean's List. Dean's List achievement is noted on the student's grade report and permanent academic record.

Class Rank—A student's ranking in his or her class will be determined on the basis of the Quality Point Average and will be indicated on his or her permanent academic record upon graduation.

GRADE REPORTS

At the end of each semester or summer session, Registration and Records issues a grade report showing all grades earned during that grading period.

At registration students will be asked to complete an address form giving a mailing address to which grade reports and other University correspondence will be mailed. Students have the choice of having their grade reports sent to their parents or guardians. However, students may elect to have their grade reports sent directly to themselves.

Change of Name or Address—It is the student's responsibility to inform Registration and Records of any changes in name or address. Failure to do this may

prevent prompt delivery of important University correspondence. Also, news stories about Dean's List students are sent to N. C. newspapers based on hometown information furnished Registration and Records.

ACADEMIC RETENTION-SUSPENSION RULES

An undergraduate student shall be suspended at the end of any academic year or summer session if that student fails to pass at least 50 percent of the cumulative hours attempted with satisfactory grades or better (*A, B, C, S,* and *CR*). Total credit hours passed with grades of *A, B, C, S,* and *CR* are divided by total credit hours attempted to determine this percentage. Grades of *D, NC, U* (plus *F, FD, FA,* and *FI* which were used prior to the 1974 fall semester) are less than satisfactory. (Note: *NC* grades made prior to the 1974 fall semester are not calculated in the cumulative hours attempted.)

The exceptions to the above suspension policy are that no student will be suspended (a) at the end of the fall semester, (b) at the end of the spring semester if that is the student's first semester, or (c) at the end of any semester in which that student has passed nine or more credit hours with satisfactory or better grades (*A, B, C, S,* and *CR*), or 50 percent of the hours completed in the case of a student officially enrolled that semester for less than 12 credit hours at the end of the second week of classes.

Suspended students are eligible to attend the summer session at NCSU and/or take independent study by extension (formerly correspondence) courses offered by NCSU to improve their academic standing and will be eligible for readmission when they have raised their cumulative percentage of total hours passed with grades of *C,* its equivalent or better, to at least 50 percent of the total hours attempted at NCSU.

Students who were suspended prior to the 1974 fall semester under the quality-point- deficit system will be eligible for readmission if they have passed with grades of *A, B, C, S,* and *CR* at least 50 percent of the total hours attempted at NCSU. Suspended students who have had a break in residency must file an Application for Readmission.

Appeal of Suspension—The Admissions Committee will consider petitions from a suspended student when there are extenuating circumstances. A letter of petition should be written by the student to the Admissions Committee stating:

a. The reason for his or her academic difficulty; and
b. The reasons why the student believes he or she can now be successful in meeting the University's academic standards and complete all degree requirements within a reasonable length of time; and
c. The address and telephone number to be used for notification of the Admissions Committee's decision.

A student who has been denied readmission on his or her petition letter may subsequently request a personal appearance before the Admissions Committee.

WITHDRAWAL FROM THE UNIVERSITY

If a regularly enrolled degree student wishes to withdraw from the University (dropping all courses) during a semester or summer session, the student initiates the official withdrawal process at the Counseling Center.

Determination of grades and the entry on the permanent academic record for a student withdrawing during a semester depend upon his or her reasons for withdrawal and the time of withdrawal in the semester. A student who discontinues attendance in all classes without officially withdrawing will receive all *NC* grades.

A student who withdraws after the first two weeks of classes of a semester will receive no refund of tuition and fees, except in unusual cases approved by the Refund Committee. All courses dropped prior to the fourth week of classes in a semester will not appear on the permanent academic record.

Withdrawal from a regular semester constitutes a break in the student's residence, and, if the student plans to return, he or she must file a readmission form even though preregistration for the next academic period may have been completed.

READMISSION OF FORMER AND SUSPENDED STUDENTS

A *former student returning* is one who a) was not in attendance during the fall or spring semester prior to applying for readmission or b) withdrew from the University during a fall or spring semester. All former students returning, both graduates and undergraduates, must apply for readmission to the Department of Registration and Records, N.C.S.U., P.O. Box 5745, Raleigh, N.C. 27607 at least 30 days prior to the date of desired enrollment.

A student who receives a bachelor's degree must apply for admission to the Graduate School or for readmission as an unclassified or professional student. An undergraduate working toward a second degree must reapply only if there has been a break in residence. Otherwise, only a curriculum change form indicating the desired second major must be submitted to Registration and Records.

Preregistration alone is not sufficient to enable the student to be readmitted.

Regulations

1. A *student who was eligible to continue* at N.C. State at the time of his or her leaving is eligible to return (except as indicated immediately below). Students in this categoy need only complete a readmission form.
   a. A student who was eligible to continue at the time of his or her leaving but who has subsequently taken work at another institution and earned less than a *C* average on such work must complete a readmission form *and* write a letter of petition to the Admissions Committee.
   b. A student eligible to continue at the time of his or her leaving who has subsequently taken correspondence and/or extension work at N.C. State and earned grades which resulted in suspension must complete a readmission form *and* write a letter of petition to the Admissions Committee.
2. *Suspended Students.* For condition of suspension, see Academic Retention-Suspension Rules, page 28. For readmission, follow procedures outlined under "Appeal of Suspension."

REPEATING COURSES

A student who repeats a course, regardless of the grade previously made, will have both grades counted in his or her cumulative Quality Point Average. An

undergraduate student is allowed as many semester hours as are appropriate in one's curriculum for courses: 1) titled seminar, special problems, special topics, independent study or research (usually numbered 490-499 or 590-599); 2) covering topics different from those studied when the courses were taken previously. However, for any courses other than one that satisfies these conditions, if a student repeats and passes the course both times, the semester hours will be counted only once toward the number of hours required for graduation.

The adviser's approval is required for a student to repeat any course previously passed. Approval should not be given when a student wishes to repeat a course already passed with a grade of *A* or *B*. Nor should it be given when: 1) a student wishes to repeat a lower division course that he or she has passed with a grade of *C* or better after successfully completed an advanced course covering the same material or 2) a student wishes to repeat a lower level course that he or she has passed with a *C* or better which is a prerequisite for an advanced course that he or she had already successfully completed.

CREDIT-ONLY COURSES

Each undergraduate student has the option to count toward graduation requirements a maximum of 12 semester hours in the category of "credit-only" courses (exclusive of courses which departments or instructors choose to grade on a Satisfactory-Unsatisfactory basis with the approval of the Provost's Office). The student may select as "credit-only" any course offered by the University except those in Military Science and Aerospace Studies. Selected courses must be included under the free elective category of the specific curriculum in which the student is enrolled. The student will be responsible for attendance, assignments and examinations.

The student's performance in a "credit-only" course will be reported as *S* (Satisfactory grade for credit-only course) or *U* (no credit grade for credit-only course) and will not affect his or her Quality Point Average. An S allows the course credit to be counted toward the student's graduation requirements. "Credit-only" work may drop a student below 12 hours of course work for which quality points are earned and thus make him or her ineligible for the semester Dean's list.

AUDITS

A student wishing to audit a course must have the approval of his or her adviser and of the department offering the course. Participation in class discussion and in examinations is optional with the instructor. Auditors receive no course credit; however, they are expected to attend classes regularly.

A student who has taken a course for audit may, with his or her adviser's approval, enroll in the course for credit during a subsequent semester or summer session.

CREDIT BY EXAMINATION

A currently registered undergraduate student (degree, unclassified, or special) desiring to take an examination for course credit in lieu of enrolling or re-enrolling for a course must initiate a request with his or her adviser (except when a teaching department initiates group testing of beginning students for placement

purposes and grants credit). If the adviser approves, the student arranges for the examination with the department offering the course. The department may administer the examination in any manner pertinent to the materials of the course. The academic standards for credit by examination will be commensurate with the academic standards for the course.

If the student performs satisfactorily on the examination, the instructor will notify Registration and Records on a late grade report form by stating "Credit by Examination." The appropriate number of credit hours is entered on the student's permanent academic record and he or she is issued a grade report. Credits earned in this manner are considered in the same way as transfer credits and are not used in the computation of the student's Quality Point Average. Registration and Records will post course credit to the permanent academic record only if the student is currently registered unless the student is a graduating senior and this is the only course required for graduation. If the student does not exhibit satisfactory performance, no action beyond notifying the student is required. However, the student is not eligible for another such examination in the same course. Once a student has failed a course or has attempted more than fifty percent of a course, he or she may not attempt credit by examination for that course. Under unusual circumstances, exceptions may be made upon the written recommendation of the adviser and the approval of the department concerned.

CURRICULUM CHANGE

To initiate a curriculum change, a student secures a Curriculum Change Form from the office of his or her dean or director of instruction, obtains the required signatures, and files the completed form with Registration and Records, preferably by the end of the preregistration period.

From the standpoint of advising, preregistration, and dropping courses, the student is considered to be in the new curriculum as soon as the Curriculum Change Form is completed and filed with Registration and Records, and his or her records are transferred to the new department.

GRADUATION REQUIREMENTS

Students are eligible for graduation when they have satisfied all the academic requirements of their degree program as specified by their major department, their school, and NCSU.

Limited D Grades—A grade of *C*, its equivalent or better, is required for each course in a student's degree program. A student's major department, however, (a) may accept up to 12 credit hours of *D's* for graduation and (b) may designate courses or categories of courses in which *D's* will not be accepted for graduation. A statement of departmental policy in this matter shall accompany all curricula material distributed to students. All *D* grades earned prior to 1974 fall semester may be used to satisfy course requirements insofar as they are allowed at that time by the department granting the degree. No more than 12 additional credits of *D* earned in the 1976 fall semester, or thereafter, may be used to satisfy course requirements for courses in which the *D* grade is acceptable to the department granting the degree.

Quality Point Average—Since the 1974 fall semester, the Quality Point Average has not been a part of the graduation requirements.

Previous Quality Point Deficits—Students who have quality point deficits incurred prior to the 1974 fall semester may select one of two options to achieve eligibility for graduation:

a. making up those quality point deficits which were incurred prior to the 1974 fall semester by earning a sufficient number of *A* or *B* grades. (*D* grades may be repeated for this purpose.) *NC* grades received during the 1974 fall semester or thereafter, and *D* grades earned during the 1976 fall semester or thereafter shall have no effect on quality point deficits incurred by students prior to the 1974 fall semester; or

b. repeating with a *C* grade or better all courses required for graduation in which the previous grade was a *D* and for which *D* grades have been determined to be unacceptable by the student's major department.
Under this option the courses repeated may not be counted as free electives and the make-up of any pre-existing quality point deficit shall not be required.

Transfer and Independent Study Credits—Individual departments and/or schools may determine their own limits, if any, of credit hours for transfer and/or independent study by extension (formerly correspondence) courses.

Residence Requirements—A transfer student, to be eligible for a bachelor's degree, normally must earn at least 20 of his or her last 30 hours of credit in residence on this campus; however, individual departments and/or schools may waive this guideline and determine their own residency requirements for a bachelor's degree.

Students who have satisfactorily completed the requirements for more than one bachelor's degree may, upon the recommendation of their deans, be awarded two bachelor's degree at the same or at different commencement exercises. To earn two degrees the student registers in one school or department and, with the cooperation of the second school or department, works out his or her program to cover the requirements for both. The student must file an approved Curriculum Change Form labeled "Second Degree" with Registration and Records.

TRANSCRIPTS OF ACADEMIC RECORD

A transcript is an exact copy of a student's permanent academic record at the time it is issued. A fee of one dollar is charged for each transcript.

No official transcript may be issued to or for a student who is indebted to the University until such indebtedness has been paid or satisfactorily adjusted.

Official transcripts are released only upon the *written* request of the student to Registration and Records, Box 5745, Raleigh, N.C. 27607.

NONDISCRIMINATION STATEMENT

North Carolina State University is dedicated to equality of opportunity within its community. Accordingly, North Carolina State University does not practice or condone discrimination, in any form, against students, employees, or applicants on the grounds of race, color, national origin, religion, sex, age, or handicap. North

Carolina State University commits itself to positive action to secure equal opportunity regardless of those characteristics.

North Carolina State University supports the protection available to members of its community under all applicable Federal laws, including Titles VI and VII of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Sections 799A and 845 of the Public Health Service Act, the Equal Pay and Age Discrimination Acts, the Rehabilitation Act of 1973, and Executive Order 11246. For information concerning these provisions, contact:

Dr. Lawrence M. Clark
Assistant Provost & Affirmative Action Officer
208 Holladay Hall
North Carolina State University
Raleigh, North Carolina 27607

Special Programs

HONORS PROGRAMS

Honors Programs are designed to provide individualized programs of study for promising young scholars. The Schools of Agriculture and Life Sciences, Engineering, Forest Resources, Liberal Arts, Physical and Mathematical Sciences, and Textiles have separate plans built around honors courses, supervised research, and special seminars. Students who demonstrate exceptional ability and achievement during their freshman or sophomore year are eligible to participate. Information is available from faculty advisers and from the office of the dean of each school.

COOPERATIVE EDUCATION PROGRAMS

The Schools of Engineering, Forest Resources, Liberal Arts, Physical and Mathematical Sciences and Textiles offer an optional five-year plan under which students may alternate semesters of work in their professional field with on-campus study during the sophomore and junior years. Students who want to participate in a co-op program should discuss the possibilities with their faculty advisers.

The D. H. Hill Library

The D. H. Hill Library's book and bound journal collection totals some 750,000 volumes and is particularly strong in the biological and physical sciences, in engineering, agriculture, and forestry. The arts, humanities, and social sciences are also well represented. The library regularly receives more than 6,500 magazines, journals and other periodical publications.

Three special collections form on-campus branches of the Hill Library—the Burlington Textiles Library in Nelson Hall containing holdings in textile technology and textile chemistry; the Harrye B. Lyons Design Library in Brooks Hall containing holdings in architecture, landscape architecture and product design; and the Forest Resources Library and reading room in Biltmore Hall.

The library's collections are open to all students and faculty for over 100 hours per week.

General Information

FOOD SERVICE

Food Service is provided at the University Student Center, the University Student Center Annex and in six campus snack bars. The average cost of food for the academic year is estimated to be $990.

AUTOMOBILES

Every student desiring to park on campus is required to register his or her vehicle(s) with the Traffic Records Office and pay a registration fee. A booklet of regulations is published and distributed each fall.

No student may register or acquire parking permits for a vehicle not owned by the student, his or her spouse, a parent, or a guardian. The Chancellor shall have authority to establish the number of vehicles which any student may register and operate pursuant to these regulations. Unless increased by the Chancellor, the number of said vehicles shall be one.

LAUNDRY

The University operates a laundry and dry cleaning facility on campus at reasonable prices. Branch offices are located in the residence halls for the convenience of the students.

LINEN AND BLANKET RENTAL

During the regular academic year and summer school the student may rent at a reasonable rate a linen bundle (consisting of 2 twin bed sheets, 3 towels, pillowcase) and/or pillow. The student may exchange his linen weekly at the branch offices in the residence halls or the main laundry on Yarborough Drive. An N. C. State University monogrammed blanket is also sold through this program. These services are available to both on- and off-campus students. Application forms for the regular academic year are mailed in July to each student. Students wishing the service for summer school terms should apply to Office of Auxiliary Services, 203 Holladay Hall, N. C. State University.

Upon withdrawal from the program, and at the request of the user, refunds are made based on weeks used and less a small handling charge.

HEALTH

North Carolina State University seeks to safeguard the health of the student in every way possible. The Student Health Service, located in Clark Hall Infirmary, offers medical care to students on an outpatient and inpatient basis. The 50 bed facility is staffed by full-time physicians, registered nurses and other medical support personnel.

During the scheduled academic sessions, the Health Service is open 24 hours

a day, seven days a week. Physicians maintain regular office hours Monday through Friday and are on call at all times to assist the nurses on duty when the condition of a patient warrants immediate attention.

Each full-time student pays a medical fee which covers professional services either as an outpatient or inpatient; i.e., visits to M.D., routine laboratory procedures and X rays performed in the Student Health Service, and medications available in the student pharmacy.

In all cases of serious illness or injury, notice to the immediate family is strongly encouraged. This notice will be made by the attending physician unless expressly forbidden by the student. All health and medical information is confidential and is not divulged to anyone without the written consent of the patient.

A physical examination is required of all entering full-time students, and the completed examination form should be mailed to the Student Health Service thirty days before a student is scheduled to register for the first time. If the examination is not made before entrance, the student will be given a physical examination at the University for which a fee is charged. Blanks for the physical examination may be obtained from the Office of Admissions.

ACCIDENT AND HEALTH INSURANCE

The University offers annually a plan of student accident and health insurance. The insurance covers the surgical, accident, and hospital needs of the student as a supplement to the services offered through the infirmary. Each year complete information will be made available to students before school opens.

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

ORIENTATION

During the month of June, an orientation program is held for freshmen entering N. C. State for the first time in the fall semester. Freshmen are expected to attend the two-day program that corresponds with their major field of study. In the event an entering freshman cannot attend the summer program in June, a "late" orientation is held in August just prior to the beginning of fall semester.

Transfer students who are entering N. C. State for the first time in the fall semester are encouraged to attend the Transfer Student Orientation Program held on registration day.

Special orientation sessions are held for students who enter in the spring semester or either summer school session.

In addition, the Office of Student Development sponsors an optional orientation program for black students during the fall semester.

COUNSELING

The Counseling Center in Harris Hall has a staff of full-time counselors to help students with adjustment to college life, vocational and curricular choice and other problems a student might wish to discuss with a professionally trained counselor. The Center administers vocational tests and maintains a file of occupational information to help guide students in career selection.

Referral can be made for students needing special kinds of help.

Students may come to the Center on their own accord, or they may be referred by teachers, advisers or other members of the University staff. There normally is no charge for conferences; nominal fees are charged for group counseling and continuing marriage counseling.

FACULTY ADVISERS

At North Carolina State University the primary responsibility for planning an academic program and meeting graduation requirements rests with the student. In order that information and assistance be available when needed, each regular degree student is assigned to a faculty adviser who is usually in the student's major field of study.

School and department coordinators of advising, deans, directors of instruction, department heads and members of the faculty keep office hours and expect students to consult them individually whenever necessary.

FOREIGN STUDENT AND STUDY ABROAD ADVISING

The foreign student and study abroad adviser offers assistance to foreign students with visas, passports, currency permits, tax information, and medical, personal and social problems.

All foreign students are required to take an International Student Orientation course (ISO-100) to acquaint them with University procedures and the practical problems of living in the United States.

Any student desiring information on travel and study abroad may use the facilities of this office. International Student ID Cards may be purchased by qualifying full-time students.

CAREER PLANNING AND PLACEMENT CENTER

The Career Planning and Placement Center offers assistance to all students at North Carolina State University at all degree levels. Service is available on a year round basis. Advice on the relationship of personal career goals to various programs of study and assistance in the identification of individual aptitudes and abilities affecting career potential are available. Students are encouraged to participate in a Career Planning Workshop in the freshman or sophomore year.

This office arranges and coordinates job interviews between students and employer representatives. Seniors are urged to use this placement service for interviewing with potential employers. The staff also recommends contacts with employers not scheduled to visit the campus, and will advise students of job opportunities given to the center by mail or telephone.

COOPERATING RALEIGH COLLEGES

Cooperating Raleigh Colleges is a consortium, or voluntary organization, comprised of North Carolina State University, Meredith College, Peace College, St. Augustine's College, St. Mary's College and Shaw University. The organization promotes interinstitutional cooperation and cooperative educational activities among the six institutions. Agreements provide the opportunity for any student to

enroll at another institution for a course or courses not offered at one's home campus. (Also see Interinstitutional Registration, page 18.)

Student Activities

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

STUDENT BODY GOVERNMENT AND STUDENT JUDICIAL SYSTEM

When students enter North Carolina State University, they become members of a self-governing community. Legislative, executive and judicial authority, insofar as student affairs are concerned, rest with the student body government which operates within the framework of over-all University administration. The student body government members and judicial department members are elected in campus-wide elections.

During each registration period, students are asked to sign either an honor code pledge or a recognition of academic integrity statement. These statements reflect the emphasis that N. C. State student government places upon academic integrity.

CLUBS AND SOCIETIES

Honorary—Honorary societies at N. C. State are Golden Chain, senior leadership; Blue Key, junior leadership; Thirty and Three, sophomore leadership; Phi Eta Sigma, men's freshman scholarship; Alpha Lambda Delta, women's freshman scholarship; and Phi Kappa Phi, junior, and senior and graduate students scholarship.

Professional and Technical—Each school at N. C. State 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 and Sororities—Twenty national social fraternities have chapters at State.

The social fraternities at N. C. State are Alpha Gamma Rho, Alpha Phi Alpha, Delta Sigma Phi, Farm House, Kappa Alpha, Kappa Sigma, Lambda Chi Alpha, 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, Theta Chi, Alpha Sigma Phi and Delta Upsilon.

State has five national social sororities, Sigma Kappa, Alpha Delta Pi, Alpha

Phi, Delta Sigma Theta and Alpha Kappa Alpha.

Other Organizations—There are over 200 campus organizations that a student may join or participate in. These organizations cater to all interests and levels of involvement, and most are open to all students.

STUDENT PUBLICATIONS

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

The four general publications, The *Agromeck*, WKNC-FM, the *Technician*, and the *Windhover* are supported in large part by a publication fee included in each student's fees.

The *Agromeck* is the University yearbook, providing a record of the senior class and of the principal events of the school year. The yearbook recalls in pictures the varied activities of the student body through the year, and is published for the entire student body.

The *Technician* is the student newspaper issued three mornings a week.

Although it is not a publication in the strictest sense of the word, WKNC-FM serves the same function through a different medium. It offers opportunities for extracurricula training in broadcasting techniques as well as training in administration and program planning.

The *Windhover* is the literary magazine for the campus.

Each student receives a copy of the current handbook, which contains detailed information about student organizations, activities, and policies.

Several of the schools have their own publications issued under the general supervision of the particular school and dealing with material of special interest to students in that school. These publications and the school they represent include *Agri-Life*, Agriculture and Life Sciences; the *Pi-Ne-Tum*, Forest Resources; *The Southern Engineer*, Engineering; *The Textile Forum*, Textiles; *The Publications of the School of Design*; and *The Scientist*, Physical and Mathematical Sciences.

ATHLETICS

North Carolina State University offers a variety of athletic activities. In addition to voluntary programs of intramural and intercollegiate sports, freshmen and sophomores are required to take two to four semesters of physical education. Juniors and seniors take physical education as an elective.

Intercollegiate—The Department of Athletics conducts the University's intercollegiate athletics program involving 14 varsity sports for men and seven for women.

The athletics program is administered by the Athletics Director with the Athletics Council, made of seven faculty, three alumni and three students, functioning to exercise institutional responsibility and control of the intercollegiate athletics program. The program is self-sufficient and is operated through gate receipts and student fees. Athletics grants-in-aid are provided through the North Carolina State Student Aid Association (Wolfpack Club).

The University facilities include double-decker Carter Stadium, featuring 41,000 sideline seats, Reynolds Coliseum holding 12,000 for basketball, and Doak

Field having 3,800 seats for baseball. A nine-lane tartan track and a 2,200 seat swimming stadium, with a twenty-five yard by twenty-five meter pool, are also available.

Intramurals—The University maintains a program of intramural sports which is administered by the Department of Physical Education. Intramural activities are divided into three basic programs: traditional sports, sports clubs, and annual events.

In the traditional sports program individual and team sports are offered to both men and women with participation being voluntary. Competition is divided into four divisions: 1) residence halls 2) fraternity 3) open and 4) women. Thirteen sports are offered in the residence hall and fraternity divisions, while 11 sports are offered in the open division. In the women's division competition is offered in 13 different activities.

MUSICAL ORGANIZATIONS

Since the early days of North Carolina State, musical organizations have played an important part in campus life presenting concerts, furnishing music for official University functions and performing at athletic events. The combined membership of these organizations constitutes the largest voluntary student organization on campus. Students may join the bands, choral organizations, orchestras, and pipes and drums by reporting for an audition at the time and location indicated in the orientation schedule. Rehearsals are arranged to avoid conflicts with other classes or with study time. Membership in all musical organizations is open to any regularly enrolled student.

Bands—The Symphonic Band, the Fanfare Band, the Brasschoir Band and the Marching Band make up the four divisions of the N. C. State bands. Each band serves a specific purpose and assignments are made according to individual interests and abilities. The Symphonic, Fanfare and Brasschoir Bands are concert organizations, with the Symphonic Band having the most rigid requirements.

Choral Groups—The Varsity Men's Glee Club, the University Choir, the Women's Chorale, the University Singers and the Chamber Music Singers make up the five choral divisions. Placement in an organization is made according to the student's abilities and interest. These groups present concerts each year, both on and off campus, as well as making radio and television appearances, recordings, tours and providing small ensembles for special occasions.

Orchestras—A wide range of orchestral music is read and performed. Placement in the North Carolina State University Symphony Orchestra is according to individual interest and ability. Several concerts are presented each year on and off campus providing an opportunity to coordinate musical efforts with professional musicians, recognized locally and nationally. Provisions are made for those with an interest in string quartet and other small ensemble experience.

NCS Pipes and Drums—Students may learn an instrument known to many of North Carolina's early settlers and represent the University through a unique and distinctive medium, the NCS Pipes and Drums. The organization performs several times throughout the year at University and community functions. Pipes, drums, and equipment are furnished. No piping experience is necessary.

Musician-in-Residence—North Carolina State University established this special chair in the music department to facilitate the University's cultural development.

Internationally known musicians are appointed to this position on a rotating basis. They are available without charge to all University classes and organizations for concerts and presentations.

Music and the Technical Disciplines—The Schools of Engineering, Liberal Arts and Forest Resources, the Division of University Studies and the Department of Music are cooperating to foster interaction between the technical disciplines and music.

Courses to be offered will undertake the scientific study of musical sounds and the instruments which produce them. An interdisciplinary approach will enable students to combine these courses with their major fields. (For example, see Engineering Operations, page 123.)

UNIVERSITY STUDENT CENTER

The University Student Center, with its branches in the Frank Thompson building and in the Erdahl-Cloyd wing of the D. H. Hill Library, provides a focal point for much of the extra-curricular life on campus. The programs it sponsors include training in all aspects of threatre, plays produced by students, instruction and independent work in all kinds of crafts, a wide range of professional performances in jazz, pops, folk and classical music, dance and threatre. There are student committees working in all of these areas. Other student committees present lectures, films, games tournaments, black cultural programs, coffee houses, gallery exhibits and opportunities for volunteer services.

The facilities in the University Student Center and its branches include two theatres, a craft center, vending areas, newsstands, games rooms, a barber shop, the newspaper offices, yearbook office, radio station, Student Government offices, meeting rooms, offices for the IFC and IRC, off-campus students and space for religious workers.

In the Center and in the Erdahl-Cloyd annex are a wide variety of food service facilities including a cafeteria, two snack bars, a delicatessen, ice cream bar, buffeteria and salad bar.

THOMPSON THEATRE

Thompson Theatre is a student oriented theatre with an emphasis on flexibility and experimentation. Each production is open to all NCSU students, whether experienced or not, as actors, technicians, crew members and directors.

The physical elements of the theatre are flexible, with seating, walls and staging that can be arranged in a variety of combinations to form any kind of theatre from proscenium to in-the-round.

Two types of productions are presented each year. The "Majors" are directed and produced by the professional theatre staff. Experimental Studio Theatre productions are completely produced by students under the guidance and supervision of the professional staff.

Thompson Theatre works closely with the Department of Speech-Communication which offers some courses for those interested in theatre.

The University Players is the student organization within the threatre which recommends theatre operating policies and helps to determine the threatre's program.

STEWART THEATRE

Stewart Theatre, located in the University Student Center, offers an opportunity for students and other members of the University community to see and hear the best in professional performances: plays, jazz, pops, folk and chamber music concerts, both modern dance and ballet, films and lectures. The theatre also sponsors a series of musicals at Memorial Auditorium in downtown Raleigh. Special rates are available to NCSU students.

CRAFTS CENTER

Located on the ground floor of the Thompson building is one of the finest crafts facilities on a university campus in the southeast. Instruction is offered in ceramics, woodworking, photography, textile design, weaving and a host of other crafts. The facilities are also available for independent work. The Crafts Center is open year-round. Supplies for most crafts can be purchased at the Center.

Centralized Computational Resources

North Carolina State University is one of three universities owning the Triangle Universities Computation Center (TUCC) located in Research Triangle Park near Raleigh. Other participating institutions are the University of North Carolina at Chapel Hill and Duke University at Durham.

Central equipment located at TUCC is an IBM System 370 Model 165 with 4.0 million characters of memory. In addition, more than 225 million characters of disk storage are available as well as extensive teleprocessing equipment for communication with member universities and other institutions throughout the State. A Hewlett Packard HP 2000 System provides an interactive service using the BASIC language. There is planned for addition in early 1977 an IBM Model 165-2 with 2 million characters of memory.

Each university has one high-speed terminal and many medium and low-speed devices in key places on campus for communication with TUCC.

The principal computer on the N. C. State campus is an IBM 370 Model 135. It provides high-speed communication with TUCC and simultaneously processes administrative data processing applications. Other terminals include several medium-speed facilities and many typewriter-like and cathode ray tube devices used for faculty and student research and for instruction in credit and noncredit courses. Each of the eight schools and an increasing number of departments utilize these facilities as an important tool in the total educational process.

The University Systems Analysis and Control Center provides centralized computing facilities for data acquisition, control and simulation built around an IBM System 7. The center maintains a versatile hybrid facility for faculty and student use. There are 17 hybrid simulation terminals for instruction. A GT 11-40 is available for graphics, research and instruction. Various mini-computers, small analog computers, and a microprocessor laboratory are available for instruction and research.

University Calendar

SPRING SEMESTER, 1977

January	10	Mon.	Registration Day
January	11	Tues.	Change Day (Late registration, Drop/Add)
January	12	Wed.	First day of classes
January	26	Wed.	Last day to add a course and last day to withdraw (or drop a course) with a refund
February	9	Wed.	Last day to drop a course at 400 level or below without a grade
March	4	Fri.	Mid-semester reports due; spring vacation begins at 10:00 p.m.
March	14	Mon.	Classes resume at 8:00 a.m.
March	18	Fri.	Last day to drop a course at the 500 or 600 level without a grade
April	11	Mon.	Holiday
April	29	Fri.	Last day of classes
April	30-		
May	1	Sat.-Sun.	Reading days
May	2-11	Mon.-Sat. Mon.-Wed.	Final examinations
May	14	Sat.	Commencement

SUMMER SESSION, 1977

First Session

May	24	Tues.	Registration Day
May	25	Wed.	First day of classes
May	30	Mon.	Last day to add a course; last day to withdraw (or drop a course) with a refund
June	3	Fri.	Last day to drop a course at the 400 level or below without a grade
June	10	Fri.	Last day to drop a course at the 500 or 600 level without a grade
June	28	Tues.	Last day of classes
June	29	Wed.	Final examinations

Second Session

July	5	Tues.	Registration Day
July	6	Wed.	First day of classes
July	11	Mon.	Last day to add a course; last day to withdraw (or drop a course) with refund
July	15	Fri.	Last day to drop a course at the 400 level or below without a grade
July	22	Fri.	Last day to drop a course at the 500 or 600 level without a grade
August	9	Tues.	Last day of classes
August	10	Wed.	Final examinations

FALL SEMESTER, 1977

August	25	Thurs.	Registration Day
August	26	Fri.	Change Day (Late registration, Drop/Add)
August	29	Mon.	First day of classes
September	5	Mon.	Holiday
September	12	Mon.	Last day to add a course and last day to withdraw (or drop a course) with a refund
September	26	Mon.	Last day to drop a course at the 400 level or below without a grade

October	14	Fri.	Mid-semester reports due
October	14	Fri.	Fall vacation begins at 10:00 p.m.
October	19	Wed.	Classes resume at 8:00 a.m.
October	28	Fri.	Last day to drop a course at the 500 or 600 level without a grade
November	23	Wed.	Thanksgiving vacation begins at 1:00 p.m.
November	28	Mon.	Classes resume at 8:00 a.m.
December	9	Fri.	Last day of classes
December	10-11	Sat.-Sun.	Reading days
December	12-21	Mon.-Sat. Mon.-Wed.	Final examinations

SPRING SEMESTER, 1978

January	9	Mon.	Registration Day
January	10	Tues.	Change Day (Late registration, Drop/Add)
January	11	Wed.	First day of classes
January	25	Wed.	Last day to add a course and last day to withdraw (or drop a course) with a refund
February	8	Wed.	Last day to drop a course at the 400 level or below without a grade
March	3	Fri.	Mid-semester reports due; spring vacation begins at 10:00 p.m.
March	13	Mon.	Classes resume at 8:00 a.m.
March	18	Fri.	Last day to drop a course at the 500 or 600 level without a grade
March	27	Mon.	Holiday
April	28	Fri.	Last day of classes
April	29-30	Sat.-Sun.	Reading days
May	1-10	Mon.-Sat. Mon.-Wed.	Final examinations
May	13	Sat.	Commencement

SUMMER SESSIONS, 1978

First Session

May	23	Tues.	Registration Day
May	24	Wed.	First day of classes
May	29	Mon.	Last day to add a course; last day to withdraw (or drop a course) with a refund
June	2	Fri.	Last day to drop a course at the 400 level or below without a grade
June	10	Fri.	Last day to drop a course at the 500 or 600 level without a grade
June	27	Tues.	Last day of classes
June	28	Wed.	Final examinations

Second Session

July	5	Wed.	Registration Day
July	6	Thurs.	First day of classes
July	11	Tues.	Last day to add a course; last day to withdraw (or drop a course) with a refund
July	17	Mon.	Last day to drop a course at the 400 level or below without a grade
July	22	Fri.	Last day to drop a course at the 500 or 600 level without a grade
August	9	Wed.	Last day of classes
August	10	Thurs.	Final examinations

FALL SEMESTER, 1978

August	24	Thurs.	Registration Day
August	25	Fri.	Change Day (Late registration, Drop/Add)
August	28	Mon.	First day of classes
September	4	Mon.	Holiday
September	11	Mon.	Last day to add a course and last day to withdraw (or drop a course) with a refund
September	25	Mon.	Last day to drop a course at the 400 level or below without a grade
October	13	Fri.	Mid-semester reports due
October	13	Fri.	Fall vacation begins at 10:00 p.m.
October	18	Wed.	Classes resume at 8:00 a.m.
October	27	Fri.	Last day to drop a course at the 500 or 600 level without a grade
November	22	Wed.	Thanksgiving Vacation begins at 1:00 p.m.
November	27	Mon.	Classes resume at 8:00 a.m.
December	8	Fri.	Last day of classes
December	9-10	Sat.-Sun.	Reading days
December	11-20	Mon.-Sat. Mon.-Wed.	Final examinations

SCHOOLS AND PROGRAMS OF STUDY

There are eight major undergraduate academic divisions at North Carolina State University. These are the Schools of Agriculture and Life Sciences, Design, Education, Engineering, Forest Resources, Liberal Arts, Physical and Mathematical Sciences and Textiles. The programs of study are outlined by school. Information concerning specific courses is given in the section of the catalog on course descriptions.

In addition to information about the schools, this section contains descriptions of the military training program (ROTC), the Graduate School, University Studies, Continuing Education and Summer Sessions.

Throughout the programs of study given in this section, departmental codes, course numbers and course titles are used. The key to the departmental code follows. This key will aid in locating individual courses in the course description section.

Code	Name
AC & ALS	Agriculture and Life Sciences (General Courses)
ACC	Accounting
ANS	Animal Science
ANT	Anthropology
ARC	Architecture
ART	Art
AS	Aerospace Studies (ROTC)
BAE	Biological and Agricultural Engineering
BCH	Biochemistry
BMA	Biomathematics
BO	Botany
BS	Biological Sciences
CE	Civil Engineering
CH	Chemistry
CHE	Chemical Engineering
CS	Crop Science
CSC	Computer Science
DF, DN	Design
E	Engineering (General Courses)
EB	Economics
ED	Education (General Courses)*
EE	Electrical Engineering
EH	Engineering Honors
ENG	English
ENT	Entomology
EO	Engineering Operations
ESM	Engineering Science and Mechanics
FL	Foreign Languages
FLE	Foreign Language—English
FLF	Foreign Language—French
FLG	Foreign Language—German
FLI	Foreign Language—Italian
FLP	Foreign Language—Portuguese
FLR	Foreign Language—Russian
FLS	Foreign Language—Spanish
FOR	Forest Resources**
FS	Food Science
GN	Genetics
GRK	Greek
GY	Geology
HI	History
HS	Horticultural Science
IA	Industrial Arts
IE	Industrial Engineering
ISO	International Student Orientation
LA	Liberal Arts
LAR	Landscape Architecture
LAT	Latin
MA	Mathematics
MAE	Mechanical and Aerospace Engineering
MAS	Marine Sciences
MAT	Materials Engineering
MB	Microbiology
MS	Military Science (ROTC)
MUS	Music
MY	Meteorology
NE	Nuclear Engineering
NTR	Nutrition
OR	Operations Research
OY	Physical Oceanography
PD	Product Design
PE	Physical Education
PHI	Philosophy
PHY	Physiology
PM	Pest Management
PO	Poultry Science
PP	Plant Pathology
PS	Political Science
PSY	Psychology
PVD	Visual Design
PY	Physics
REL	Religion
RRA	Recreation Resources Administration
SOC	Sociology
SP	Speech
SSC	Soil Science
ST	Statistics
SW	Social Work
T	Textiles (General Courses)
TC	Textile Chemistry
TOX	Toxicology
TX	Textile Technology
UNI	University Studies
VET	Veterinary Science
WPS	Wood and Paper Science and Technology
ZO	Zoology

* This includes courses offered by all departments and programs within the School of Education except industrial arts and psychology which are coded separately.

** This includes conservation and forestry.

AGRICULTURE AND LIFE SCIENCES

Patterson Hall

J. E. Legates, *Dean*
E. W. Glazener, *Associate Dean and Director of Academic Affairs*

Modern agriculture is a complex industry built on the principles of science and business. The basic sciences are the foundations for modern agricultural technology. These sciences applied to understanding the functions of living material offer a background as preparation for a professional agriculturist, environmentalist, or as a preparatory program for the medical and health-related sciences. Likewise, the principles of economics and sociology provide background preparation for agricultural business management and public service aspects of society.

The objects of the academic program are:

1) To provide an opportunity for a broad university education
2) To provide a variety of learning experiences
3) To offer a choice of specialization, sufficient for initial employment
4) To provide background for graduate or professional programs

A high percentage of all the gainfully employed persons in the United States are engaged in operations directly or indirectly related to food and fiber. For example, the food industry ranges from those who produce the food, supply material to the producer, and process the finished product to those who sell the products to the consumer. Hundreds of distinct occupations are represented in modern agriculture and biology. About 30 percent of the graduates elect to continue their education in graduate and professional schools.

STUDENT ACTIVITIES

Students in the School of Agriculture and Life Sciences have ample opportunities to take part in broadening extracurricular activities. Most departments have student organizations which provide professional as well as social experience. Representatives of these clubs form the Agri-Life Council. This council is the student organization representing the school. Student tours provide an opportunity to see firsthand the application of classroom principles. In addition, students representing agronomy, animal science, horticultural science, food science, poultry science and soil science compete regionally and nationally in a number of activities providing student members a chance to learn by travel as well as by participation.

CURRICULA OFFERINGS AND REQUIREMENTS

A freshman enrolling in agriculture and life sciences has a common core of courses the first year, courses that are appropriate in all curricula. This method allows the student time to study various programs before selecting a curriculum. In addition to the basic courses in English, biology, and physical and social sciences, the student selects a major in a department, an interdisciplinary program or an individualized course plan.

Departmental majors are offered in three general curricula as follows:

Science—agricultural economics, animal science, biological and agricultural engineering (joint program with the School of Engineering), botany, crop science, entomology, food science, horticultural science, medical technology, poultry science, rural sociology, soil science, wildlife biology and zoology. Premedical sciences are offered in this curriculum.

Business—emphasis on economics, combination programs in technology in animal science, horticultural science and poultry science.

Technology—biological and agricultural engineering, animal science, food science, horticultural science and poultry science.

Interdepartmental and Interdisciplinary Programs—These curricula offer the opportunity to select broad curriculum majors that involve two or more departments or schools:

Biological Sciences—A curriculum with emphasis on biological and physical sciences, especially designed for graduate or professional courses requiring a biology background.

Conservation—A curriculum concentrating on the use, preservation and improvement of natural resources. Administered jointly by the School of Agriculture and Life Sciences and the School of Forest Resources.

Pest Management (for Crop Protection)—A curriculum with emphasis on the application of chemical and biological principles in the control of plant diseases, insects and weeds. The curriculum is administered by the Departments of Crop Science, Entomology, Horticultural Science and Plant Pathology.

Agronomy—A technical curriculum dealing with the fundamentals of crop production and soil management. The curriculum is administered by the Departments of Crop Science and Soil Science.

Individualized Study Program—A curriculum planned by the student with the assistance of a faculty advisory committee.

In addition to these cited curricula, a number of arrangements are available that provide the student an opportunity to select areas of course concentration.

HONORS PROGRAM

The School of Agriculture and Life Sciences has a comprehensive Honors Program for qualified freshmen and sophomores interested in participating in seminar discussion programs on broad topics. These sessions are led by outstanding professors.

Qualified juniors and seniors have an opportunity to participate in an independent research program. Faculty direction is provided on an individual basis to each student. The student has the opportunity to select his project.

INTERNATIONAL ASPECTS

An International Seminar is offered to interested students. In addition, an International Option, requiring modern language and 12 semester hours of appropriate courses in the social sciences, is available for students enrolled in any curricula.

DEGREES

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

The degrees of Master of Science, Master of Agriculture and Master of Life Sciences are offered in the various departments in the School.

The Doctor of Philosophy degree is offered in the following subject areas: animal science, biochemistry, biological and agricultural engineering, botany, crop science, economics, entomology, food science, genetics, horticultural science, marine sciences, microbiology, nutrition, physiology, plant pathology, sociology, soil science, and zoology.

Further information on graduate offerings may be found in the Graduate Catalog.

OPPORTUNITIES

Broad and fascinating opportunities in business, industry, education and government are open to graduates of this school. Some of the areas in which graduates are employed are as follows:

Business and Industry—banking and credit, insurance, farm management, cooprratives, land appraisal, marketing, transportation, food chains, food processing and distribution, machinery and equipment, chemicals, fertilizer, feed manufacturing, seed improvement.

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

Conservation—soil, water, range, forest, fish, wildlife parks, recreation.

Education—high school and college instruction in agriculture, biology, agricultural extension, governmental and industrial agencies.

Farming and Ranching (agricultural production)—general livestock, field crops, fruits, vegetables, poultry, ornamentals.

Preprofessional and Graduate Preparation—premedical programs for training for medical, dental and veterinary colleges; graduate programs.

Research—production, marketing, engineering, processing, biological sciences, conservation, organizational structure, group behavior.

Services—inspection and regulation, production field service, health services, environmental quality, product standards, grading, agricultural technology and consulting.

A placement office, coordinated with the University Career Planning and Placement Center, is maintained to assist graduates in career development and placement.

FRESHMAN YEAR

The curricula in the School of Agriculture and Life Sciences have a common freshman year with the exception of the science program in biological and agricultural engineering. For the science curricula in biological and agricultural engineering freshman year, see freshman year in the School of Engineering.

Fall Semester	*Credits*
ALS 103 Introductory Topics in ALS	1
BS 100 General Biology or CH 101 General Chemistry I	4
ENG 111 Composition and Rhetoric	3
Social Science and Humanities Elective	3
MA 111 Algebra and Trigonometry*	4
Physical Education	1
(Military Science or Air Science may be elected)	
	16

Spring Semester	*Credits*
ENG 112 Composition and Reading	3
MA 112 Analytic Geometry and Calculus A	4
or	
MA 114 Introduction to Finite Mathematics with Applications	3
Social Science and Humanities Elective	3
CH 101 General Chemistry I or CH 107 Principles of Chemistry	
or	
BS 100 General Biology	4
Physical Education	1
(Military Science or Air Science may be elected)	
	14-15

* Does not contribute to the 130 semester hours required in the biological sciences curriculum.

CURRICULA IN AGRICULTURE AND LIFE SCIENCES*

Science, business and technology are three curricula offered in this school. All departments offer the science curriculum. Several departments offer the choice of either science or technology. In addition, several departments are participating in interdisciplinary programs.

A business curriculum is offered in agricultural economics. Combinations in business and technology are offered in animal science, horticultural science and poultry science. Double majors between agricultural economics and other subject areas may be arranged.

All the curricula have a core of required courses on a school basis. Courses peculiar to a specific department are listed under the departmental requirements. Listed on the following pages are the required courses by curriculum on a school basis.

* Group A includes the physical and biological sciences; Group B, economics and business management; Group C, applied science and technology; Group D, social sciences and humanities.

Science

	Credits
ALS 103 Introductory Topics in ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
Electives (English or Modern Language)	6
Social Sciences and Humanities (21 Credits)	
Electives from Group D	21

Physical and Biological Sciences (28-32 Credits)	
BS 100 General Biology	4
Biological Sciences Elective	4
CH 101 General Chemistry I	4
CH 103 General Chemistry II	4
or	
CH 107 Principles of Chemistry	4
MA 111 Algebra and Trigonometry	4
MA 112 Analytic Geometry and Calculus A	4
or	
MA 114 Introduction to Finite Mathematics with Applications	3

PY 221 College Physics 5
or
PY 211, PY 212 General Physics 8

Electives (60-64 Credits)

Restricted Electives from Group A 22-26
Departmental Requirements and Electives 26
Free Electives 12

Subtotal 126
Physical Education 4

Hours Required for Graduation 130**

Business

Accounting		*Credits*
ACC 260	Accounting I—Concepts of Financial Reporting	3
ACC 261	Accounting II—Financial Information Systems	3
ACC 262	Managerial Uses of Cost Data	3
ACC 360	Financial Reporting Theory & Practice I	3
ACC 361	Financial Reporting Theory & Practice II	3
ACC 362	Production Cost Analysis & Control	3
ACC 460	Specialized Financial Reporting Theory & Practice	3
ACC 464	Income Taxation	3
ACC 466	Examination of Financial Statements	3
ACC 468	Professional Accountancy Resumé	3

Production:

EB 303	Farm Management	3
EB 325	Industrial Management	3
EB 551	Agricultural Production Economics	3

Marketing:

EB 311	Agricultural Markets	3
EB 313	Marketing Methods	3
EB 521	Markets and Trade	3

Finance:

EB 304	Financial Institutions	3
EB 415	Farm Appraisal and Finance .	3
EB 420	Corporation Finance	3

Personnel:

EB 326	Personnel Management	3
EB 332	Industrial Relations	3
EB 431	Labor Economics	3

Business Management:

EB 310	Economics of the Firm	3
EB 525	Management Policy and Decision Making	3

Electives:

EB 301	Production and Prices	3
EB 302	Aggregate Economic Analysis: Theory and Policy	3
Group B Courses		

Students in the business curriculum complete a minimum of 24 semester hours in Group B courses. One course is required in the areas of accounting, production, marketing, finance and personnel. In addition, three courses are elected from Group B course offerings.

Technology

		Credits
ALS 103	Introductory Topics in ALS ..	1

Language (12 Credits)

ENG 111	Composition and Rhetoric ...	3
ENG 112	Composition and Reading ...	3
SP 231	Expository Speaking	3
Electives (English or Modern Language)		3

Social Sciences and Humanities (21 Credits)

Electives from Group D 21

Physical and Biological Sciences (32-33 Credits)

BS 100	General Biology	4
Biological Sciences Elective		4
CH 101	General Chemistry I	4
CH 103	General Chemistry II	4
	or	
CH 107	Principles of Chemistry	4
MA 111	Algebra and Trigonometry ...	4
MA 112	Analytic Geometry and Calculus A	4
	or	
MA 114	Introduction to Finite Mathematics with Applications	3
PY 221	College Physics	5
SSC 200	Soil Science	4

Electives (59-60 Credits)

Restricted Electives from Groups A, B or C 20-21
Departmental Requirements and Electives 27
Free Electives 12

Subtotal 126
Physical Education 4

Hours Required for Graduation 130**

** All curricula require the completion of one course in literature.

ELECTIVES

The following lists provide typical courses that are elected from the four block groupings—A, B, C and D. Additional courses may be selected by checking with the office of the Director of Academic Affairs.

Group A

PHYSICAL AND BIOLOGICAL SCIENCES

Animal Science

ANS 401 Reproductive Physiology
ANS 405 Lactation
ANS (NTR, PO) 415 Comparative Nutrition
ANS (NTR) 416 Quantitative Nutrition
ANS (PHY) 502 Reproductive Physiology of Vertebrates
ANS (GN) 508 Genetics of Animal Improvement
ANS (PHY) 580 Mammalian Endocrine Physiology

*Biochemistry**

BCH 351 Elementary Biochemistry
BCH 352 Elementary Biochemistry Laboratory
BCH 551 General Biochemistry
BCH 552 Experimental Biochemistry
BCH (PHY) 553 Physiological Biochemistry
BCH 554 Radioisotope Techniques in Biology
BCH (GN, MB) 561 Biochemical and Microbial Genetics

Biological and Agricultural Engineering

BAE 303 Energy Conversion in Biological Systems

Biological Sciences

All courses listed with the BS designation.

*Biomathematics**

All Courses

Botany

BO 200 Plant Life
BO (ZO) 360 Introduction to Ecology
BO 400 Plant Diversity
BO (CS) 402 Economic Botany
BO 403 Systematic Botany
BO (ZO) 414 Cell Biology
BO 421 Plant Physiology
BO 480 Air Pollution Biology
BO (MB) 574 Phycology
BO (MB, PP) 575 The Fungi
BO (MB, PP) 576 The Fungi-Laboratory

*Chemistry**

All Courses

*Computer Science**

All Courses

Crop Science

CS (BO) 402 Economic Botany

Entomology

ENG 301 Introduction to Forest Insects
ENT 312 Introduction to Economic Insects
ENT 502 Insect Diversity
ENT 503 Functional Systems of Insects

Food Science

FS 331 Food Engineering
FS 402 Food Chemistry
FS (MB) 405 Food Microbiology
FS 503 Food Analysis
FS 504 Food Proteins and Enzymes
FS 506 Advanced Food Microbiology

Forestry

FOR 273 Quantitative Methods in Forest Resources

*Geosciences**

All Courses

Genetics

GN 411 The Principles of Genetics
GN 412 Elementary Genetics Laboratory
GN 504 Human Genetics
GN (ANS) 508 Genetics of Animal Improvement
GN (ZO) 532 Biological Effects of Radiations
GN (ZO) 540 Evolution
GN (ZO) 550 Experimental Evolution
GN (BCH, MB) 561 Biochemical and Microbial Genetics

*Mathematics**

All Courses

*Meteorology**

All Courses

Microbiology

MB 401 General Microbiology
MB (FS) 405 Food Microbiology
MB 501 Advanced Microbiology
MB 511 Bacterial Pathogenesis
MB 514 Microbial Metabolism
MB 521 Microbial Ecology
MB 551 Immunology and Serology
MB (BCH, GN) 561 Biocehmical and Microbial Genetics
MB 571 Virology
MB (BO) 574 Phycology
MB (BO, PP) 575 The Fungi
MB (BO, PP) 576 The Fungi-Laboratory

Nutrition

NTR (ANS, PO) 415 Comparative Nutrition
NTR (ANS) 416 Quantitative Nutrition

*Physics**

All Courses

Physiology

PHY (ANS) 502 Reproductive Physiology of Vertebrates
PHY (BCH) 553 Physiological Biochemistry
PHY (ANS) 580 Mammalian Endocrine Physiology

Plant Pathology

PP (BO, MB) 575 The Fungi
PP (BO, MB) 576 The Fungi-Laboratory

Poultry Science

PO 405 Avian Physiology
PO (ANS, NTR) 415 Comparative Nutrition
PO (ZO) 524 Comparative Endocrinology

*Soil Science**

SSC 200 Soil Science
SSC 511 Soil Physics
SSC 520 Soil and Plant Analysis
SSC 522 Soil Chemistry

*Statistics**

All Courses

Zoology

ZO 201 General Zoology
ZO 202 Invertebrate Zoology
ZO 203 Vertebrate Zoology
ZO 212 Basic Anatomy and Physiology
ZO 315 General Parasitology
ZO 323 Comparative Anatomy
ZO 345 Histology
ZO (BO) 360 Introduction to Ecology
ZO 361 Vertebrate Embryology
ZO (BO) 414 Cell Biology
ZO 415 Cellular and Animal Physiology Laboratory
ZO 420 Fishery Science
ZO 421 Vertebrate Physiology
ZO 441 Ichthyology
ZO 442 Ichthyology Laboratory
ZO 510 Adaptive Behavior of Animals
ZO 513 Comparative Physiology
ZO 515 Growth and Reproduction of Fishes
ZO 517 Population Ecology
ZO (PO) 524 Comparative Endocrinology
ZO (GN) 532 Biological Effects of Radiations
ZO (GN) 540 Evolution
ZO (GN) 550 Experimental Evolution

* Courses in these blocks are considered Physical Sciences.

Group B

ECONOMICS AND BUSINESS

Accounting

ACC 260 Accounting I—Concepts of Financial Reporting
ACC 261 Accounting II—Financial Information Systems
ACC 262 Managerial Uses of Cost Data
ACC 360 Financial Reporting Theory and Practice I
ACC 361 Financial Reporting Theory and Practice II
ACC 362 Production Cost Analysis and Control
ACC 460 Specialized Financial Reporting Theory and Practice
ACC 464 Income Taxation
ACC 466 Examination of Financial Statements
ACC 468 Professional Accountancy Resume

Biological and Agricultural Engineering

BAE 461 Analysis of Agricultural System

Economics and Business

EB 301 Production and Prices
EB 302 Aggregate Economic Analysis: Theory and Policy
EB 303 Farm Management
EB 304 Financial Institutions
EB 307 Business Law I
EB 308 Business Law II
EB 310 Economics of the Firm
EB 311 Agricultural Markets
EB 313 Marketing Methods
EB 325 Industrial Management
EB 326 Personnel Management
EB 332 Industrial Relations
EB (ST) 350 Economics and Business Statistics
EB 415 Farm Appraisal and Finance
EB 420 Corporation Finance
EB 430 Agricultural Price Analysis

Mathematics

MA 122 Mathematics of Finance

Statistics

ST (EB) 350 Economics and Business Statistics

Group C

APPLIED SCIENCE AND TECHNOLOGY

Agricultural Communications

AC 311 Communication Methods and Media

Animal Science

ANS 200 Introduction to Animal Science
ANS 204 Livestock Feeds and Feeding
ANS (FS, NTR) 301 Nutrition and Man
ANS 302 Selecting Dairy and Meat Animals
ANS 308 Advanced Selection Dairy and Meat Animals
ANS 402 Beef Cattle Management
ANS 403 Swine Management
ANS 404 Dairy Cattle Management
ANS 406 Sheep Management
ANS (FS) 409 Meat and Meat Products
ANS 410 Horse Management
ANS 411 Breeding and Improvement of Domestic Animals
ANS (VET) 505 Diseases of Farm Animals
ANS 520 Tropical Livestock Production

Biological and Agricultural Engineering

BAE 201 Shop Practices
BAE 211 Farm Machinery
BAE (SSC) 321 Water Management
BAE 332 Farm Structures
BAE 341 Farm Electrifications and Utilities
BAE 411 Farm Power and Machinery
BAE 433 Processing Agricultural Products

BAE (SSC) 471 Agricultural Water Management
BAE (CE) 578 Agricultural Waste Management

Civil Engineering

CE (BAE) 578 Agricultural Waste Management

Crop Science

CS 211 Crop Science
CS 214 Crop Science Laboratory
CS 312 Pastures and Forage Crops
CS 315 Turf Management
CS 411 Environmental Aspects of Crop Production
CS 413 Plant Breeding
CS 414 Weed Science
CS (SSC) 462 Soil-Crop Management Systems
CS 511 Tobacco Technology
CS 513 Physiological Aspects of Crop Production
CS (HS) 514 Principles and Methods in Weed Science

Entomology

ENT 201 Insects and Man
ENT 550 Fundamentals of Insect Control
ENT 562 Agricultural Entomology
ENT (ZO) 582 Medical and Veterinary Entomology

Food Science

FS 201 Food Science and Man's Food
FS (ANS, NTR) 301 Nutrition and Man
FS 400 Foods and Nutrition
FS (PO) 404 Poultry Products
FS (ANS) 409 Meat and Meat Products

Genetics

GN 301 Genetics in Human Affairs
GN (PO) 520 Poultry Breeding

Horticultural Science

HS 101 Plants for Home and Pleasure
HS 201 Principles of Horticulture
HS 301 Plant Propagation
HS 342 Landscape Horticulture
HS 411 Nursery Management
HS 421 Tree Fruit Production
HS 432 Vegetable Production
HS 441 Floriculture I
HS 442 Floriculture II
HS 471 Arboriculture
HS (CS) 514 Principles and Methods in Weed Science

Nutrition

NTR (ANS, FS) 301 Nutrition and Man

Pest Management

PM 415 Principles of Pest Management

Plant Pathology

PP 315 Plant Diseases
PP 318 Forest Pathology
PP 450 Nematode Diseases of Plants and Their Control
PP 500 Plant Disease Control

Poultry Science

PO 201 Poultry Science and Production
PO 301 Evaluation of Live Poultry
PO 351 Grading and Evaluation of Poultry Products
PO (VET) 401 Poultry Diseases
PO 402 Commercial Poultry Enterprises
PO (FS) 404 Poultry Products
PO 410 Production and Management of Game Birds in Confinement
PO (GN) 520 Poultry Breeding

Soil Science

SSC 205 Soils as a Natural Resource
SSC (BAE) 321 Water Management
SSC 341 Soil Fertility and Fertilizers
SSC 352 Soil Classification
SSC 461 Soil Physical Properties and Plant Growth
SSC (CS) 462 Soil-Crop Management Systems
SSC (BAE) 471 Agricultural Water Management
SSC 472 Forest Soils

Veterinary Science

VET 300 Laboratory Animal Management
VET (PO) 401 Poultry Diseases
VET (ANS) 505 Diseases of Farm Animals

Zoology

ZO 221 Conservation of Natural Resources
ZO 353 Wildlife Management
ZO 400 Biological Basis of Man's Environment
ZO (ENT) 582 Medical and Veterinary Entomology

Group D

SOCIAL SCIENCES AND HUMANITIES

The student is required to complete 21 semester hours of Group D courses in all degree programs. Not more than six semester hours are to come from one department. It is strongly recommended that the student be exposed to courses in each of the major course areas outlined below, although the final selection is with the student and his adviser.

AREA I

Anthropology

All Courses

Economics

EB 201 Economics I
EB 202 Economics II
EB 212 Economics of Agriculture
EB (HI) 370 The Rise of Industrialism
EB (HI) 371 Evolution of the American Economy
EB 401 Economic Analysis for Nonmajors
EB 410 Public Finance
EB 413 Competition, Monopoly and Public Policy
EB 422 Investments and Portfolio Management
EB 431 Labor Economics

EB 435 Urban Economics
EB 436 Environmental Economics
EB 442 Evolution of Economic Ideas
EB 448 International Economics
EB 475 Comparative Economic Systems

Psychology, Sociology

All Courses

AREA II

History, Political Science, University Studies

All Courses

AREA III

Art

Courses that relate to the appreciation and history of art.

English

Literature Courses Only

Foreign Language, Music

Courses numbered 200 and above

Philosophy, Religion

All Courses

Adult and Community College Education

(See Education.)

The adult and community college education faculty offers instruction primarily at the graduate level. The department is jointly administered by the Schools of Agriculture and Life Sciences and Education. For details, see Education, pages 97.

Agronomy

Students may earn a Bachelor of Science degree under the technology curriculum of Agriculture and Life Sciences with a major in agronomy. The agronomy option is administered jointly by the Departments of Crop Science and Soil Science. For further information, see crop science, page 63, or soil science, page 79.

CURRICULUM IN CROP SCIENCE AND SOIL SCIENCE

TECHNOLOGY (AGRONOMY) PROGRAM

	Credits
ALS 103 Introductory Topics in ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
SP 231 Expository Speaking	3
Literature Elective	3
Social Sciences and Humanities (21 Credits)	
Electives	21
Physical and Biological Sciences (32-33 Credits)	
MA 111 Algebra and Trigonometry	4
MA 112 Analytic Geometry and Calculus A	4
or	
MA 114 Introduction to Finite Mathematics with Applications	3
CH 101 General Chemistry I	4
CH 103 General Chemistry II	4
PY 221 College Physics	5
BS 100 General Biology	4
SSC 200 Soil Science	4
BO 421 Plant Physiology	4
Physical Education	
Physical Education	4
Free Electives	
Free Electives	12
Group A,B,C, Courses (19-20 Credits)	
CH 220 Introductory Organic Chemistry	4
GN 411 The Principles of Genetics	3
PP 315 Plant Diseases	3
Electives in A, B, or C Courses	9-10

Animal Science

Polk Hall

Professor C. A. Lassiter, *Head of the Department*
Professor R. M. Myers, *Coordinator of Advising*

TEACHING AND RESEARCH

Professors: E. R. Barrick, A. J. Clawson, D. G. Davenport, E. J. Eisen, L. Goode, J. M. Leatherwood, J. G. Lecce, J. E. Legates, B. T. McDaniel, R. D. Mochrie, R. M. Myers, I. D. Porterfield, A. H.

Rakes, H. A. Ramsey, O. W. Robison, H. A. Schneider, L. C. Ulberg; *Professors Emeriti:* F. H. Smith, H. A. Stewart, G. H. Wise; *Associate Professors:* E. V. Caruolo, E. U. Dillard, R. W. Harvey, B. H. Johnson, W. L. Johnson, E. E. Jones, J. J. McNeill, J. C. Wilk; *Assistant Professor:* W. D. Armstrong; *Adjunct Assistant Professor:* B. D. Harrington; *Associate Members of the Faculty:* S. B. Tove (Biochemistry); C. H. Hill (Poultry Science); E. G. Batte, D. J. Moncol (Veterinary Science)

EXTENSION

Professor J. W. Patterson, *In Charge, Animal Husbandry Extension*
Professor M. E. Senger, *In Charge, Dairy Husbandry Extension*
Professor D. G. Spruill, *In Charge, Swine Husbandry Extension*

Professors: R. F. Behlow, T. C. Blalock, G. Hyatt Jr., G. S. Parsons, F. D. Sargent, J. R. Woodard; *Extension Professors Emeriti:* A. V. Allen, J. S. Buchanan; *Associate Professors:* J. R. Jones, F. N. Knott, C. M. Stanislaw, D. P. Wesen; *Assistant Professors:* K. R. Butcher, T. M. Leonard, D. G. Levis, J. M. Tibbs; *Assistant Professor Emeritus:* R. R. Rich; *Extension Specialists:* B. C. Allison, J. K. Butler, J. W. Parker, E. B. Shankle II, H. W. Webster III; *Extension Specialist Emeriti:* J. A. Arey, R. L. Wynne

Undergraduate students study subjects related to various phases of animal industry. Training is provided in nutrition, physiology, breeding and disease and there are opportunities for the application of basic scientific training in the husbandry areas. Options for course selection by each student make it possible for those with varying backgrounds and wide-ranging interests to become involved in stimulating and rewarding training.

OPPORTUNITIES

Opportunities for animal science majors include farm, dairy and livestock management careers, jobs as fieldmen for breed association and livestock organizations, agricultural extension, education work in business and industries serving agriculture, meat grading, agricultural communications in animal science, feed manufacturing, sales work in feeds and equipment, marketing dairy cattle and dairy products, and supervising livestock and farm loans with banks and lending agencies. Many students in veterinary science obtain degrees in animal science as well. Students may elect graduate study, after which they will find opportunities in teaching, research and development. See pages 12-13 for graduate degrees offered.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in animal science may be obtained under any of the three curricula offered in Agriculture and Life Sciences. For the basic requirements and freshman year see page 49.

CURRICULUM IN ANIMAL SCIENCE

SCIENCE PROGRAM

		Credits
ALS 103	Introductory Topics in ALS	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
Literature	Elective	3
Language	Elective	3
	Social Sciences and Humanities (21 Credits)	
Electives		21
	Physical and Biological Sciences	
MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry & Calculus A or MA 114, Introduction to Finite Math	4 or 3
CH 101	General Chemistry I	4
CH 103	General Chemistry II	
	or	
CH 107	Principles of Chemistry	4
PY 221	College Physics or PY 211 & 212, General Physics	5 or 8
BS 100	General Biology	4
ZO 421	Vertebrate Physiology	3

Physical Education

Physical Education	4

Free Electives

Free Electives	12

Group A, B, C Courses (26 or 27 Credits)

CH 220 Introductory Organic Chemistry or	
CH 221 Organic Chemistry I	4
GN 411 The Principles of Genetics	3
MB 401 General Microbiology	4
Electives in A, B or C Courses	15

Departmental Requirements and Electives (26 Credits)

ANS 200 Introduction to Animal Science		4
ANS 490 Animal Science Seminar		1
Animal Science Electives as follows:		21
A minimum of 9 credits from:		
ANS 401 Reproductive Physiology	3	
ANS 405 Lactation	3	
ANS 411 Breeding & Improvement of Domestic Animals	3	
ANS (NTR, PO) 415 Comparative Nutrition	3	
ANS (VET) 505 Diseases of Farm Animals	3	(9)
Remaining from A & C Courses		(12)*
Hours Required for Graduation		130

* Dependent upon whether MA 112 or MA 114 and PY 221 or PY 211 & 212 were elected.

CURRICULUM IN ANIMAL SCIENCE

TECHNOLOGY PROGRAM

	Credits
ALS 103 Introductory Topics in ALS	1

Languages (12 Credits)

ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
SP 231 Expository Speaking	3
Literature Elective	3

Social Sciences and Humanities (21 Credits)

Electives	21

Physical and Biological Sciences

MA 111 Algebra and Trigonometry	4
MA 112 Analytical Geometry & Calculus A or MA 114, Introduction to Finite Math	4 or 3
CH 101 General Chemistry I	4
CH 103 General Chemistry II or CH 107, Principles of Chemistry	4
PY 221 College Physics or PY 211 & 212, General Physics	5 or 8
BS 100 General Biology	4
ZO 421 Vertebrate Physiology	3
SSC 200 Soil Science	4

Physical Education

Physical Education	4

Free Electives

Free Electives	12

Group A, B, C Courses (21 Credits)

CH 220 Introductory Organic Chemistry	4
GN 411 The Principles of Genetics	3
Electives in A, B, or C Courses	14

Departmental Requirements and Electives (27 Credits)

ANS 200 Introduction to Animal Science	4
ANS 204 Livestock Feeds and Feeding	3
ANS 490 Animal Science Seminar	1

Animal Science Electives as follows:		
A minimum of 9 credits from:		
ANS 401 Reproductive Physiology	3	
ANS 405 Lactation	3	
ANS 411 Breeding and Improvement of Domestic Animals	3	
ANS (NTR, PO) 415 Comparative Nutrition	3	
ANS (VET) 505 Diseases of Farm Animals	3	(9)
A minimum of 5 credits from:		
ANS 302 Selecting Dairy and Meat Animals	2	
ANS 402 Beef Cattle Management	3	
ANS 403 Swine Management	3	
ANS 404 Dairy Cattle Management	3	
ANS 406 Sheep Management	3	
ANS 410 Horse Management	3	(5 or 6)
Remaining from A & C Courses		(6)*
Hours Required for Graduation		130

* Dependent upon whether MA 112 or MA 114 or PY 221 or PY 211 & 212 were elected.

BUSINESS PROGRAM

All required courses in the Technology Program plus 24 hours in Economics and Business Management. (See page 56.)

Hours Required for Graduation 130

Biochemistry

Polk Hall

Professor S. B. Tove, *Head of the Department*
Professor F. B. Armstrong, *Coordinator of Advising*

Professors: H. R. Horton, J. S. Kahn, I. S. Longmuir, A. R. Main; *Associate Professors:* J. A. Knopp, E. C. Sisler, E. C. Theil; *Assistant Professor:* W. L. Miller; *Associate Members of the Faculty:* E. E. Jones (Animal Science), L. W. Aurand, H. E. Swaisgood (Food Science), J. Bordner, W. P. Tucker (Chemistry)

The Department of Biochemistry offers instruction at the undergraduate and graduate levels. Undergraduate courses provide students from a number of curricula with a fundamental background in biochemistry.

The graduate program trains scientists for research and teaching careers in biochemistry and related fields. For graduate degrees offered, see pages 12-13.

Biochemistry is jointly administered by the Schools of Agriculture and Life Sciences and Physical and Mathematical Sciences.

UNDERGRADUATE CURRICULUM

The undergraduate curriculum leads to the Bachelor of Science degree in the biological sciences with an option in biochemistry.

BIOLOGICAL SCIENCES CURRICULUM (BIOCHEMISTRY OPTION)

Orientation	*Credits*
ALS 103 Introductory Topics in ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
FL Foreign Language	6
Social Sciences and Humanities (21 Credits)	
Electives	21
Mathematical Sciences (12-18 Credits)†	
MA 112 Analytic Geometry and Calculus A	
or MA 102* *or* Analytic Geometry and Calculus I	4

MA 212 Analytic Geometry and Calculus B	
or MA 201* *or* Analytic Geometry and Calculus II	3-4*
MA 114 Introduction to Finite Mathematics with Applications	
or MA 202* *or* Analytic Geometry and Calculus III	3-4*
MA 301* Applied Differential Equations I	3*
CSC, ST, or MA Elective in Computer Science, Statistics, or Mathematics	2-3
Physical Education	
Physical Education	4
Physical and Biological Sciences (64-73 Credits)†	
CH 101 General Chemistry I	4
CH 107 Principles of Chemistry	4
CH 221, 223 Organic Chemistry I and II	4, 4
CH 315 Quantitative Analysis	
or CH 428* *or* Quantitative Organic Analysis	4 *or* 3*
CH 331 Introductory Physical Chemistry	
or CH 431*, 433* *or* Physical Chemistry I and II	4 *or* 3*, 3*
BS 100 General Biology	4
BO 200 Plant Life	4
ZO 201 General Zoology	4
BO (ZO) 360 Introduction to Ecology	4
BO 421 Plant Physiology	
or ZO 414 *or* Cell Biology	3-4
or ZO 421 *or* Vertebrate Physiology	
BCH 351 Elementary Biochemistry	3
BCH 551* General Biochemistry	3*
BCH 352 Elementary Biochemistry Laboratory	
or BCH 552* *or* Experimental Biochemistry	2 or 3*
PY 211, 212 General Physics	4, 4
or PY 205*, 208* General Physics	or 4*, 4*
MB 401 General Microbiology	4
GN 411 The Principles of Genetics	3
GN 412 Elementary Genetics Laboratory	1
ALS 499 Honors Student Research	
or BCH 490* *or* Special Studies in Biochemistry	3*
Free Electives (Up to 15 Credits)	
Electives	0-15
Hours Required for Graduation	130

Biological and Agricultural Engineering

(Also see Engineering.)

David S. Weaver Laboratories

Professor F. J. Hassler, *Head of Department*
Professor G. B. Blum Jr., *Coordinator of Advising*

TEACHING AND RESEARCH

Professors: H. D. Bowen, G. B. Blum Jr., J. W. Dickens (USDA), J. M. Fore, D. H. Howells, B. K. Huang, E. G. Humphries, W. H. Johnson, G. J. Kriz, W. F. McClure, C. W. Suggs, E. H. Wiser, J. H. Young; *Professors Emeriti:* G. W. Giles, J. W. Weaver Jr.; *Associate Professors:* G. R. Baughman, E. L. Howell, M. R. Overcash, R. P. Rohrbach, R. W. Skaggs, R. S. Sowell, T. B. Whitaker (USDA); *Assistant Professors:* C. F. Abrams Jr., P. W. Westerman, D. H. Willits Jr., D. W. Winter (USDA); *Adjunct Asst. Professor:* L. S. Rosenstein; *Associate Members of the Faculty:* D. D. Hamann, V. A. Jones (Food Science), A. E. Hassan (Forestry)

EXTENSION

Associate Professor: F. J. Humenik, *Associate Head in Charge of Extension*

Professor Emeritus: H. M. Ellis; *Associate Professors:* E. O. Beasley, L. B. Driggers, J. W. Glover, R. E. Sneed, R. W. Watkins; *Associate Professor Emeritus:* J. C. Ferguson, W. C. Warrick; *Assistant Professor:* J. C. Barker; *Visiting Assistant Professor:* J. F. W. Schulze

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† The grade "D" will not be accepted as a passing grade in any mathematics or science courses.
* Courses required for the Honors Program in Biochemistry; recommended for students preparing for graduate study in Biochemistry.

Biological and agricultural engineering students train to deal with problems of agriculture that are engineering in nature. Scientific and engineering principles are applied 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.

Two curricula are offered, technology and science, which are explained below. Science graduates receive a B.S. in biological and agricultural engineering. Technology students receive the B.S. in agriculture.

OPPORTUNITIES

Graduates of 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. This curriculum, accredited by the Engineering Council for Professional Development, also provides adequate training for post-graduate work leading to advanced degrees. For information on graduate study, see pages 12-13.

Those trained in 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.

CURRICULUM IN BIOLOGICAL AND AGRICULTURAL ENGINEERING

SCIENCE PROGRAM

The science curriculum develops young people 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 are directed to those methods of thought and techniques whereby science can be applied with understanding and judgment to engineering situations related to agricultural operations.

Since biological and agricultural engineering involves two distinct technical fields—agriculture and engineering—the science curriculum is a joint responsibility of Agriculture and Life Sciences and Engineering and is so administered. Undergraduate students in this curriculum may officially enroll in either school; duplicate undergraduate records are maintained in both schools.

For the program in agricultural engineering science, refer to the freshman year in the School of Engineering and the curriculum as shown on pages 116-117.

CURRICULUM IN BIOLOGICAL AND AGRICULTURAL ENGINEERING

TECHNOLOGY PROGRAM

The technology curriculum is for those who wish to work at the applied level in the agribusiness complex. Graduates are equipped to apply to the farm the new technology as developed and revealed by the professional agricultural engineer. The courses are presented and directed toward the solution of consumer problems with emphasis on the techniques employed.

Listed below are the departmental requirements in the technology program.

TECHNOLOGY PROGRAM

	Credits
ALS 103 Introductory Topics in ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Compositions and Reading	3
SP 231 Expository Speaking	3
Literature Elective	3
Social Sciences and Humanities (21 Credits)	
Group D Electives	18
EB 212 Economics of Agriculture	3
Physical and Biological Sciences (23 or 24 Credits)	
MA 111 Algebra and Trigonometry	4

MA 114	Introduction to Finite Mathematics with Applications	3
	or	
MA 112	Analytical Geometry and Calculus A	4
CH 101	General Chemistry I	4
CH 103	General Chemistry II	4
BS 100	General Biology	4
Biological Science Elective		4

Physical Education (4 Credits)

PE 100	Health and Physical Fitness	1
Physical Education		3

Free Electives (12 Credits)

Free Electives	12

Group A, B, C Courses (27 or 28 Credits)

PY 211	General Physics	4
PY 212	General Physics	4
CSC 200	Introduction to Computers and Their Uses	3
SSC 200	Soil Science	4
Management Elective		3
Electives in A, B, or C courses		8 or 9

Departmental Requirements and Electives (30 Credits)

E 101	Engineering Graphics	2
BAE 201	Shop Practices	2
BAE 211	Farm Machinery	3
BAE 321	Water Management	4
BAE 341	Farm Electrification and Utilities	4
BAE 433	Processing Agricultural Products	4
BAE 461	Analysis of Agricultural Systems	3
BAE 332	Farm Structures	3
BAE 411	Farm Power and Machinery	3
BAE 303	Energy Conversion in Biological Systems	2
	Hours Required for Graduation	130

Biological Sciences

Gardner Hall

Professor J. L. Apple, *Assistant Director of Academic Affairs and Research for the Biological Sciences*

Professor C. F. Lytle, *Coordinator of Advising*

The biological sciences curriculum is an interdepartmental program leading to a B.S. degree and designed for students desiring a comprehensive rather than a narrowly specialized education in the biological sciences. It is especially suitable for students preparing for graduate study in a specialized field of biology, for students planning to teach high school biology, and for students preparing for careers in business or industry.

Experience indicates one of the best preparations for graduate study in biology is a broad training in the basic biological sciences supplemented with a strong background in the physical and mathematical sciences. The biological sciences curriculum incorporates these features and provides the student with maximum flexibility and options for graduate specialization.

Students may concentrate on a specific field in the biological sciences curriculum by selecting appropriate free and restricted elective courses in consultation with their advisers. Such programs within the biological sciences curriculum are available to provide options in biochemistry, microbiology, and nutrition. Courses may be selected from the School of Education to provide a concentration in biology and teaching.

PROGRAMS IN THE BIOLOGICAL SCIENCES CURRICULUM

GENERAL

		Credits
ALS 103	Introductory Topics in the Agricultural and Life Sciences	1

Languages (12 Credits)

ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
Modern (foreign) Language		6

Social Sciences and Humanities (21 Credits)

Electives	21

Physical Sciences and Mathematics (34-36 Credits)

MA 114	Intr. to Finite Mathematics with Applications	3
	and	
MA 112, 212	Analytic Geometry and Calculus A and B	4+3
	or	
MA 102, 201, 202	Analytic Geometry & Calculus I, II and III	4+4+4
CH 101	General Chemistry I	4
CH 107	Principles of Chemistry	4
CH 221, 223	Organic Chemistry I and II	4+4
PY 211, 212	General Physics	4+4

Biological Sciences (31-33 Credits)

BS 100	General Biology	4
BO 200	Plant Life	4
ZO 201	General Zoology	4
BO 421	Plant Physiology	4
	or	
ZO 421	Vertebrate Physiology	3
	or	
BO (ZO) 414	Cell Biology	3
MB 401	General Microbiology	4
BCH 351	Elementary Biochemistry	3
BO (ZO) 360	Introduction to Ecology	4
GN 411	Principles of Genetics	3
GN 412	Elementary Genetics Lab	1

NOTE: Students electing ZO 421 or BO (ZO) 414 must also elect either

ZO 415	Cellular and Animal Physiology Laboratory	2
	or	
BCH 352	Experimental Biochemistry	2

*Electives (23-27 Credits)**

Restricted Electives from Groups A, B, C, and D	11-15
Free Electives	12
Sub Total	126
Physical Education	4
Hours Required for Graduation	130

BIOCHEMISTRY OPTION

For the requirements in the biological sciences curriculum, biochemistry emphasis, see BIOCHEMISTRY.

MICROBIOLOGY OPTION

Along with the general curriculum for the biological sciences, two additional microbiology electives are required; MB 411 and MB 501 are usually recommended. MB 401 is required in the BLS curriculum. For graduation, 130 semester credit hours are required.

NUTRITION OPTION

Three courses in nutrition are required along with the general curriculum for the biological sciences (NTR 415, NTR 416, and NTR 490 are the usual requirements). For graduation, 130 semester credit hours are required.

Botany

Gardner Hall

Professor G. R. Noggle, *Head of the Department and Coordinator of Advising*

Professors: C. E. Anderson, R. J. Downs, J. W. Hardin, W. W. Heck (USDA), H. E. Pattee (USDA), H. Seltmann (USDA), J. L. Thomas, J. R. Troyer; *Professors Emeriti:* D. B. Anderson, H. T. Scofield, B. W. Wells, L. A. Whitford; *Adjunct Professor:* A. Krochmal; *Associate Professors:* U. Blum, D. W. DeJong (USDA), R. C. Fites, R. L. Mott, E. D. Seneca, A. M. Witherspoon; *Assistant Professors:* J. F. Reynolds, H. H. Rogers Jr. (USDA), J. M. Stucky, C. G. Van Dyke, T. R. Wentworth, T. E. Wynn; *Adjunct Assistant Professor:* G. M. Jividen; *Associate Members of the Faculty:* A. W. Cooper (Forestry), J. S. Kahn (Biochemistry), D. H. Timothy (Crop Science), D. E. Moreland (USDA Crop Science), B. W. Smith (Genetics), M. M. Goodman (Statistics), R. J. Thomas (Wood and Paper Science), B. J. Copeland (Zoology)

The instructional program provides classroom, laboratory, and field experience in the major areas of plant science. Undergraduates majoring in botany are given a broad background in the humanities and physical sciences and are encouraged to participate in independent study in the senior year. Majors are prepared for advanced study in botany and other biological fields, as well as in the applied plant sciences such as horticulture, crop science, resource management and environmental biology.

* Group A includes the physical and biological sciences; Group B, economics and business management; Group C, applied science and technology; Group D, social sciences and humanities.

OPPORTUNITIES

Many majors continue with graduate studies; see pages 12-13. There is need for such persons for teaching positions in community and junior colleges, colleges and universities, for research positions in federal and state government laboratories and in private industry.

Recent federal and state legislation has created a need for botanists in environmental quality studies. Persons with a Bachelor of Science degree may work in air and water quality control programs, in air pollution and in environmental impact studies. Field botanists and naturalists are needed in park systems and nature programs.

UNDERGRADUATE CURRICULUM

The Bachelor of Science degree with a major in botany is offered under the science curriculum of the School of Agriculture and Life Sciences. The freshman year program is shown on page 49. Other basic requirements are on pages 50-54.

The Bachelor of Science degree with double concentration—one in economics, English, history, philosophy or political science, and another in botany—is available in the School of Liberal Arts. See pages 148-151 for details.

BOTANY

SCIENCE PROGRAM

	Credits
ALS 103 Introductory Topics in the ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
Literature Elective	3
Language Elective	3
Social Sciences and Humanities (21 Credits)	
Electives	21
Physical and Biological Sciences (29 Credits)	
MA 111 Algebra and Trigonometry	4
MA 112 or 114 Analytic Geo. and Calc. A or Intro. to Finite Math.	4
CH 101 General Chemistry I	4
CH 103 or 107 General Chemistry II or Princ. of Chem.	4
PY 221 College Physics	5
BS 100 General Biology	4
ZO 201 Animal Life	4
Physical Education (4 Credits)	
Physical Education	4
Free Electives (20 Credits)	
Free Electives	20
Group A, B, C Courses (20 Credits)	
CH 220 Introductory Organic Chemistry	4
GN 411 The Principles of Genetics	3
GN 412 Elementary Genetics Laboratory	1
MB 401 General Microbiology	4
SSC 200 Soil Science	4
Science Elective	4
Departmental Requirements and Electives (23 Credits)	
BO 200 Plant Life	4
BO (ZO) 360 Introduction to Ecology	4
BO 400 Plant Diversity	4
BO 403 Systematic Botany	4
BO 421 Plant Physiology	4
Departmental Elective	3
Hours Required for Graduation	130

Conservation

(Also see Forest Resources.)

Williams, Gardner and Biltmore Halls

M. G. Cook, *Major Adviser, School of Agriculture and Life Sciences*

L. C. Saylor, *Major Adviser, School of Forest Resources*

J. J. Nicholaides III, *Coordinator of Advising*

Conservation is the wise use, perpetuation, or improvement of natural resources, without waste, for the long-time benefit of society. This baccalaureate degree program is offered jointly by the Schools of Agriculture and Life Sciences and Forest Resources. Faculty members in botany, entomology, forestry, plant pathology, recreation, soil science and wildlife are directly involved in various aspects of education in conservation.

Rapid urbanization and industrialization concomitant with population growth and changes in lifestyles are bringing increased pressures on the use of land for providing food, water, fiber, wood and pleasure. These trends present challenges to resource managers who must be well trained in the basic concepts of several disciplines in order to apply a conservation philosophy to many of our current natural resource problems.

CONSERVATION CURRICULUM

Students may enroll in either Agriculture and Life Sciences or Forest Resources, depending on their primary area of interest in conservation. The freshman common core of courses for either school is acceptable. All students take a prescribed core of subjects in conservation; specialty areas are developed through the use of electives. Students desiring an education with more professional emphasis may combine the conservation curriculum with another curriculum, e.g., forestry, soil science, zoology, to obtain a second degree.

SCIENCE PROGRAM

		Credits
ALS 103	Introductory Topics in the ALS	
	or	
FOR 101	Introduction to Forestry	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
English Elective (Literature)		3
English Elective		3
	Social Sciences and Humanities (21 Credits)	
Electives		21
	Physical and Biological Sciences	
MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry and Calculus A	4
CH 101	General Chemistry I	4
CH 103	General Chemistry II	
	or	
CH 107	Principles of Chemistry	4
PY 221	College Physics	5
BS 100	General Biology	
	or	
BO 200	Plant Life	4
ZO 201	General Zoology	
	or	
BO 200	Plant Life	4
	Physical Education	
Physical Education		4
	Free Electives	
Free Electives		13
	Group A, B, C Courses	
ST 311	Introduction to Statistics	3
BO (ZO) 360	Introduction to Ecology	4
Biological Science Electives		9
	Departmental Requirements and Electives	
GY 120	Elements of Physical Geology	2
GY 110	Physical Geology Lab	1
ZO 221	Conservation of Natural Resources	3
SSC 200	Soil Science	4
FOR 472	Renewable Resource Management	3
RRA 241	Recreation Resource Relationships	3
ZO 353	Wildlife Management	3
Conservation Electives		13
	Hours Required for Graduation	128

Elective courses may be used for emphasizing subject areas in communications, soils, wildlife biology, education and others.

Crop Science

Williams Hall

Professor B. E. Caldwell, *Head of the Department*
Professor D. A. Emery, *Coordinator of Advising*

TEACHING AND RESEARCH

Professors: C. A. Brim (USDA), J. C. Burns (USDA), T. H. Busbice (USDA), D. S. Chamblee, J. F. Chaplin (USDA), W. K. Collins, W. A. Cope (USDA), W. T. Fike, D. U. Gerstel, W. B. Gilbert, W. C. Gregory, H. D. Gross, G. L. Jones, K. R. Keller, J. A. Lee (USDA), W. M. Lewis, T. J. Mann, R. P. Moore, D. E. Moreland (USDA), L. L. Phillips, J. C. Rice, D. L. Thompson (USDA), D. H. Timothy, J. B. Weber, E. A. Wernsman, J. A. Weybrew, A. D. Worsham; *Adjunct Professors:* J. S. Campbell, W. E. Wessling; *Professors Emeriti:* G. K. Middleton, P. H. Harvey; *Associate Professors:* F. T. Corbin, G. R. Gwynn (USDA), R. C. Long, C. F. Murphy, R. P. Patterson, W. W.

Weeks; *Assistant Professors:* J. W. Burton (USDA), J. C. Wynne; *Instructor:* C. Collins; *Associate Members of the Faculty:* E. C. Sisler (Biochemistry), T. J. Sheets (Entomology and Horticultural Science)

EXTENSION

Professor G. L. Jones, *In Charge, Crop Science Extension*

Professors: C. T. Blake, S. N. Hawks, F. W. McLaughlin, A. Perry; *Professors Emeriti:* R. R. Bennett, S. H. Dobson, A. D. Stuart; *Associate Professors:* H. D. Coble, E. L. Kimbrough, W. G. Toomey; *Assistant Professors:* E. J. Dunphy, E. G. Krenzer, J. P. Mueller, G. A. Sullivan; *Assistant Professor Emeritus:* R. H. Crouse

The increase in human populations, the continuing evolution of pests and diseases, the challenge of new natural and artificial environments and the decrease of farmland are all critical current world issues.

This department's curricula were designed to give the crop science major an awareness and a sense of personal involvement in these issues. The student receives a working knowledge of the fundamental principles of plant science which tend to shape modern crop production practices. He or she is trained in the economics of various crop management procedures which may influence long-range investments.

OPPORTUNITIES

The opportunities within the state for crop science graduates in county extension programs, in farm management, as salesmen of seed and agricultural chemicals and in the several governmental agencies remain good. Demand for qualified students in national and international concerns is increasing.

For crop science graduate programs, see pages 12-13.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in crop science is offered under the science curricula of the School of Agriculture and Life Sciences. The science curriculum follows.

Students may also earn a Bachelor of Science under the technology curriculum with a major in agronomy. The agronomy option is administered jointly by the Departments of Crop Science and Soil Science. For that curriculum, see page 54.

The Departments of Crop Science, Entomology, Horticultural Science and Plant Pathology offer a joint undergraduate major in pest management (for crop protection). See pages 73-74 for details.

CURRICULUM IN CROP SCIENCE

SCIENCE PROGRAM

		Credits
ALS 103	Introductory Topics in the ALS	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
Literature Elective		3
Language Elective		3
	Social Sciences and Humanities (21 Credits)	
Electives		21
	Physical and Biological Sciences	
MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry and Calculus A	4
CH 101	General Chemistry I	4
CH 107	Principles of Chemistry	4
PY 221	College Physics	5
BS 100	General Biology	4
BO 200	Plant Life	4
	Physical Education	
Physical Education		4
	Free Electives	
Free Electives		12
	Group A, B, C Courses (24 Credits)	
CH 221	Organic Chemistry I	4
CH 223	Organic Chemistry II	4
GN 411	The Principles of Genetics	3
GN 412	Elementary Genetics Laboratory	1
MA 114	Introduction to Finite Mathematics with Applications or	
MA 212	Analytic Geometry and Calculus B	3
MB 401	General Microbiology	4
PP 315	Plant Diseases	3
Electives in A, B, or C Courses		2

Departmental Requirements and Electives (27 Credits)

BO 421	Plant Physiology	4
CS 211	Crop Science	4
CS 214	Crop Science Lab	1
CS 312	Pastures and Forage Crops	3
CS 414	Weed Science	4
CS 490	Senior Seminar in Crop Science	1
ENT 312	Introduction to Economic Insects	3
SSC 200	Soil Science	4
Soil Science Electives		3
	Hours Required for Graduation	130

TECHNOLOGY (AGRONOMY) PROGRAM

Departmental Requirements (28 Credits)

CS 211	Crop Science	4
CS 214	Crop Science Laboratory	1
CS 312	Pastures and Forage Crops	3
	or	
CS 315	Turf Management	3
CS 411	Environmental Aspects of Crop Production	2
CS 413	Plant Breeding	2
CS 414	Weed Science	4
CS 490	Senior Seminar in Crop Science	1
	or	
SSC 492	Senior Seminar in Soil Science	1
SSC 341	Soil Fertility and Fertilizers	3
SSC 342	Soil Fertility Laboratory	1
SSC 352	Soil Classification	4
SSC (CS) 462	Crop Management Systems	3
	Hours Required for Graduation	130

Dairy Science

(See Animal Science, pages 54-57.)

Economics and Business

Patterson Hall

Professor W. D. Toussaint, *Head of the Department*

Professor B. M. Olsen, *Assistant Head of the Department and Coordinator of Advising*

H. T. Daniel, *Scheduling Officer*

TEACHING AND RESEARCH

Professors: A. J. Coutu, E. W. Erickson, R. M. Fearn, D. M. Hoover, L. A. Ihnen, P. R. Johnson, R. A. King, G. A. Mathia, E. C. Pasour Jr., R. A. Schrimper, J. A. Seagraves, R. L. Simmons, C. B. Turner, J. C. Williamson Jr.; *Professors Emeriti:* A. J. Bartley, D. R. Dixon, J. G. Sutherland (USDA), E. W. Swanson; *Associate Professors:* D. S. Ball, G. A. Carlson, J. S. Chappell, M. M. El-Kammash, R. S. Fenwick, A. R. Gallant, B. L. Gardner, H. C. Gilliam Jr. (USDA), C. W. Harrell Jr., D. M. Holthausen, D. N. Hyman, Thomas Johnson, C. P. Jones, E. W. Jones, F. A. Mangum Jr., C. J. Messere, R. J. Peeler Jr., R. K. Perrin, J. C. Poindexter Jr., R. E. Sylla, J. W. Wilson; *Assistant Professors:* R. L. Clark, L. E. Danielson, D. B. Diamond, D. J. Flath, T. J. Grennes, C. R. Knoeber, J. S. Lapp, M. P. Loeb, R. B. McBurney Jr., M. B. McElroy, L. B. Perkinson (USDA), W. P. Pinna, T. M. Reynolds, W. J. Wessels; *Visiting Assistant Professors:* G. M. Scobie, R. B. Vernon; *Assistant Professors Emeriti:* J. C. Matthews Jr., O. G. Thompson; *Instructors:* A. M. Beals Jr., W. P. Brown, M. R. Hilliard, M. T. Holcomb, D. M. Holmes, J. M. Jefferys, E. W. Leonard, T. N. Taylor; *Special Lecturers:* C. L. Bergold, G. A. Gunderson, W. P. Windham; *Associate Members of the Faculty:* R. H. Bernhard (Industrial Engineering), W. D. Cooper (Textile Technology), D. L. Holley (Forestry)

EXTENSION

Professor F. D. Sobering, *Assistant Head of the Department, In Charge of Extension*

Professors: R. C. Brooks, D. G. Harwood, H. L. Liner, T. E. Nichols Jr., E. A. Proctor, C. R. Pugh, W. L. Turner, C. R. Weathers, R. C. Wells; *Associate Professors:* J. G. Allgood, R. D. Dahle, L. H. Hammond, H. A. Homme, D. F. Neuman, P. S. Stone; *Associate Professor Emeritus:* R. S. Boal; *Assistant Professor:* J. E. Easley Jr.; *Assistant Professors Emeriti:* E. M. Stallings, R. P. Uzzle; *Extension Specialists:* C. E. Hammond, S. C. Riddick, S. R. Sutter

Agricultural economics, leading to a B.S. degree, is one of several fields of specialization offered by the Department of Economics and Business. The department is administered jointly by the Schools of Agriculture and Life Sciences and Liberal Arts. For information on fields of economics and business other than agricultural economics see Liberal Arts, pages 149-151.

The department's general objectives in agricultural economics are: 1) To train students in the fundamentals of business organization and to make sound decisions in organizing and managing farms and other agricultural businesses; 2) To instruct students in economic theory which may be used as a basis for understanding the relationship of agriculture to other parts of the economy and for the evaluation of agricultural policy and economic changes which affect agriculture; 3) To train graduate students in advanced economic theory and research techniques. For a list of graduate degrees, see pages 12-13.

OPPORTUNITIES

The growing number of companies processing and manufacturing agricultural products has created an increasing demand for people trained in agricultural economics. Opportunities 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.

Many graduates are employed in research and educational work by various agencies of the Federal and state governments. These include the Agricultural Extension Service, the Agricultural Experiment Station, the State Department of Agriculture and other agencies of the United States Department of Agriculture.

AGRICULTURAL ECONOMICS CURRICULUM

SCIENCE PROGRAM

	Credits
ALS 103 Intro. Topics in the ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
Electives—English or Literature	6
Social Sciences and Humanities (21 Credits)	
EB 212 Econ. of Agriculture	3
EB 202 Econ. II	3
Electives	15
Physical and Biological Sciences	
MA 111 or MA 114 Alg. & Trig. or Intro. to Finite Math	4 or 3
MA 112 Analy. Geom. & Calc. A	4
MA 212 Analy. Geom. & Calc. B	3
CH 101 General Chem. I	4
CH 103 General Chem. II	4
BS 100 or BS 105 General Biology	4
Bio. Sc. Elec.	4
PY 221 College Physics	5
Phy. Ed. & Free Electives (16 Credits)	
P. E.	4
Free Electives	12
Group A, B, or C Electives	
ACC 260 Accounting I—Concepts of Fin. Reporting	3
EB 350 or ST 311 Econ. & Bus. Statistics or Intro. to Statistics	3
Electives	16 or 17
Major Requirements and Electives (26 Credits)	
EB 301 Production and Prices	3
EB 302 Agg. Econ. Analysis: Theory & Price	3
EB 303 or EB 325 or EB 551 Production Elective	3
EB 311 or EB 313 or EB 521 Mkt. Elective	3
EB 304 or EB 415 or EB 420 Finance Elective	3
EB 413 or EB 533 Policy Elective	3
Electives in Support of Major	8
Hours Required for Graduation	130

BUSINESS PROGRAM

	Credits
ALS 103 Introductory Topics in the ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
ENG Literature	3
SP 231 Expository Speaking	3
Social Science and Humanities (21 Credits)	
EB 212 Econ. of Agriculture	3
EB 202 Econ. II	3
Electives	15
Physical and Biological Sciences (24-25 Credits)	
MA 111 Algebra & Trig. or	4
MA 114 Intro. to Finite Math with Appl.	3
MA 112 Analy. Geol. & Cal. A	4
CH 101 General Chemistry I	4
PY 221 College Physics	5
BS 100 or BS 105 General Biology or Biol. in Mod. World	4
Bio. Science Elective	4
Phy. Ed. & Free Electives (16 Credits)	
P. E.	4
Free Electives	12

Group B (24 Credits)

ACC 260 Accounting I 3
EB 303 or EB 325 or EB 551 Production Elective ... 3
EB 311 or EB 313 or EB 521 Marketing Elective ... 3
EB 304 or EB 415 or EB 420 Finance Elective ... 3
EB 326 or EB 332 or EB 431 Personnel Elective ... 3
EB 413 or EB 533 Policy Elective 3
Group B Electives 6

Groups A or C

Electives in A or C courses 5-6

Major Requirements and Electives (26 Credits)

EB 301 Production and Prices 3
EB 302 Agg. Ec. Analy. 3
EB 350 Econmics and Business Statistics or 3
ST 311 Introduction to Statistics
Electives in Support of Major 17

Hours Required for Graduation 130

Entomology

Gardner Hall

Professor Kenneth L. Knight, *Head of the Department and Coordinator of Advising*

TEACHING AND RESEARCH

Professors: R. C. Axtell, W. V. Campbell, W. C. Dauterman, M. H. Farrier, F. E. Guthrie, Ernest Hodgson, W. J. Mistric Jr., H. B. Moore Jr., H. H. Neunzig, R. L. Rabb, G. C. Rock, T. J. Sheets, C. F. Smith, C. G. Wright, D. A. Young Jr.; *Adjunct Professors:* A. L. Chasson, J. R. Fouts; *Professors Emeriti:* C. H. Brett, T. B. Mitchell; *Associate Professors:* J. R. Bradley Jr., W. M. Brooks, R. T. Yamamoto; *Assistant Professors:* K. D. Elsey (USDA), F. P. Hain, G. G. Kennedy, R. E. Stinner; *Adjunct Assistant Professors:* Gordon Gordh, R. M. Philpot; *Associate Member of the Faculty:* D. S. Grosch

EXTENSION

Professor: G. T. Weekman, *Specialist-in-Charge*

Professor: R. L. Robertson; *Professor Emeritus:* G. D. Jones; *Associate Professor:* J. M. Falter, K. A. Sorensen; *Assistant Professors:* J. T. Ambrose, J. R. Baker, R. C. Hillmann, T. E. Reagan, J. W. Van Duyn

The entomology curriculum offers broad training at the undergraduate and graduate levels (see pages 12-13) in basic biology and related sciences, particularly as they relate to the study of insects. In addition, several courses in entomology are offered at the undergraduate level for non-majors.

OPPORTUNITIES

Opportunities include development, production, control and sales positions in the pesticide field, consultative positions in pest management, regulatory and extension positions with state and federal agencies, and research technician positions in universities, agricultural experiment stations and industry. The curriculum also provides training suitable for admission to the graduate entomology departments of the country.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in entomology is offered under the science curriculum of the School of Agriculture and Life Sciences. Students are encouraged to gain through judicious use of their electives a strong background in the sciences. For the related undergraduate major in pest management (for crop protection) see pages 73-74.

CURRICULUM IN ENTOMOLOGY

SCIENCE PROGRAM

Credits

ALS 103 Introductory Topics in ALS 1

Languages (12 Credits)

ENG 111 Composition and Rhetoric 3
ENG 112 Composition and Reading 3
Literature Elective 3
Language Elective 3

Social Sciences and Humanities
(21 Credits)

Electives 21

Physical and Biological Sciences
(28-29 Credits)

MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry and Calculus A	4
	or	
MA 114	Introduction to Finite Mathematics with Applications	3
CH 101	General Chemistry I	4
CH 103	General Chemistry II or	4
CH 107	Principles of Chemistry	4
PY 221	College Physics	5
BS 100	General Biology	4
Biological Sciences Elective		4

Physical Education

Physical Education 4

Free Electives

Free Electives 12

Group A, B, C Courses
(22-24 Credits)

CH 220	Introductory Organic Chemistry	4
BCH 351	Elementary Biochemistry	3
GY 120	Elements of Physical Geology	2
	or	
SSC 200	Soil Science	4
ST 311	Introduction to Statistics	3
GN 411	The Principles of Genetics	3
ZO 421	Vertebrate Physiology	3
BO (ZO) 360	Introduction to Ecology	4

Departmental Requirements and Electives
(27 Credits)

ENT 312	Introduction to Economic Insects	3
ENT 401	Bibliographic Research in Biology	1
ENG 502	Insect Diversity	4
ENT 503	Functional Systems of Insects	4
Entomology Electives		15

Hours Required for Graduation 130

Food Science

Schaub Food Science Building

Professor W. M. Roberts, *Head of the Department*

Professor F. G. Warren, *Coordinator of Advising*

TEACHING AND RESEARCH

Professors: L. W. Aurand, T. A. Bell (USDA), T. N. Blumer, H. B. Craig, D. D. Hamann, M. W. Hoover, A. E. Purcell (USDA), M. L. Speck, H. E. Swaisgood; *Professors Emeriti:* J. E. Etchells, I. D. Jones; *Associate Professors:* H. R. Ball Jr., D. E. Carroll Jr., H. P. Fleming (USDA), S. E. Gilliland, A. P. Hansen, V. A. Jones, W. M. Walter Jr., (USDA); *Assistant Professors:* D. M. Adams Jr., G. G. Giddings; *Adjunct Associate Professor:* W. Y. Cobb; *Instructor:* L. G. Turner

EXTENSION

Professor J. A. Christian, *In Charge*

Professors: E. Cofer, M. E. Gregory, N. C. Miller Jr., F. R. Tarver Jr., F. B. Thomas; *Assistant Professors:* M. K. Hill, N. L. Kehrberg; *Specialists:* C. N. Callaway, R. E. Carawan, T. M. Miller

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

The department maintains modern fully equipped laboratories for teaching and research in food microbiology and fermentation, food chemistry, food engineering and dairy, fruit, meat, poultry, seafood and vegetable products.

OPPORTUNITIES

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

Food industries career opportunities are: management, research and development, process supervision, quality control, procurement, distribution, sales and merchandising. Positions include sales and services in allied industries, consulting and trade association activities and promotional and educational services.

Food Science graduates hold teaching, research and extension positions with colleges and universities. Governmental agencies employ food scientists whose

work is directed toward research, regulatory control and the development of food standards.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in food science is offered under the science or technology curriculum of the School of Agriculture and Life Sciences.

For graduate degrees offered, see pages 12-13.

CURRICULA IN FOOD SCIENCE

SCIENCE PROGRAM

		Credits
ALS 103	Introductory Topics in the ALS	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
Literature	Elective	3
Language	Elective	3
	Social Sciences and Humanities (21 Credits)	
Electives		21
	Physical and Biological Sciences (31 Credits)	
MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry and Calculus A	4
MA 114	Introduction to Finite Mathematics with Applications	3
CH 101	General Chemistry I	4
CH 103	General Chemistry II *or*	
CH 107	Principles of Chemistry	4
BS 100	General Biology	4
PY 211	General Physics	4
PY 212	General Physics	4
	Physical Education (4 Credits)	
Electives		4
	Free Electives (12 Credits)	
Electives		12
	Group A, B, C Courses (23 Credits)	
CH 220	Introductory Organic Chemistry *or*	
CH 221	Organic Chemistry I	4
CH 223	Organic Chemistry II *or*	
CH 315	Quantitative Analysis	4
MB 401	General Microbiology	4
Electives		11
	Departmental Requirements and Electives (26 Credits)	
FS 201	Food Science and Man's Food	3
FS 331	Food Engineering	3
FS 402	Food Chemistry	3
FS 405	Food Microbiology	3
FS 490	Food Science Seminar	1
Electives		13
	Hours Required for Graduation	130

TECHNOLOGY PROGRAM

		Credits
ALS 103	Introductory Topics in the ALS	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
SP 231	Expository Speaking	3
Literature	Elective	3
	Social Sciences and Humanities (21 Credits)	
Electives		21
	Physical and Biological Sciences (28 Credits)	
MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry and Calculus A	4
MA 114	Introduction to Finite Mathematics with Applications	3
CH 101	General Chemistry I	4
CH 103	General Chemistry II *or*	
CH 107	Principles of Chemistry	4
BS 100	General Biology	4
PY 221	College Physics	5
	Physical Education (4 Credits)	
Electives		4
	Free Electives (12 Credits)	
Electives		12
	Group A, B, C Courses (25 Credits)	
CH 220	Introductory Organic Chemistry *or*	
CH 221	Organic Chemistry I	4
CH 223	Organic Chemistry II *or*	
CH 315	Quantitative Analysis	4
MB 401	General Microbiology	4
Electives		13
	Departmental Requirements and Electives (27 Credits)	
FS 201	Food Science and Man's Food	3
FS 331	Food Engineering	3
FS 402	Food Chemistry	3
FS 405	Food Microbiology	3
FS 490	Food Science Seminar	1
Electives		14
	Hours Required for Graduation	130

Genetics

Gardner Hall

Professor J. G. Scandalios, *Head of the Department*

Professors: D. S. Grosch, W. D. Hanson, W. E. Kloos, C. S. Levings III, T. J. Mann, D. F. Matzinger, L. E. Mettler, R. H. Moll, Gene Namkoong (USFS), H. E. Schaffer, B. W. Smith, C. W. Stuber (USDA), A. C. Triantaphyllou; *Professors Emeriti:* C. H. Bostian, S. G. Stephens; *Adjunct Professor:* H. V. Malling; *Associate Professor:* L. G. Burk (USDA); *Assistant Professors:* G. C. Bewley, W. H. McKenzie, J. C. Sorenson; *Associate Members of the Faculty:* E. U. Dillard, E. J. Elsen, J. E. Legates, B. T. McDaniel, O. W. Robison (Animal Science); F. B. Armstrong (Biochemistry and Microbiology); C. A. Brim (USDA), J. F. Chaplin (USDA), W. A. Cope (USDA), D. A. Emery, D. U. Gerstel, W. C. Gregory, G. R. Gwynn (USDA), J. A. Lee (USDA), P. A. Miller, C. F. Murphy, L. L. Phillips, C. F. Tester (USDA), D. L. Thompson (USDA), D. H. Timothy, E. A. Wernsman (Crop Science); C. C. Cockerham, M. M. Goodman, J. O. Rawlings (Statistics); J. W. Duffield, T. O. Perry, L. C. Saylor, B. J. Zobel (Forestry); F. D. Cochran, G. J. Galletta, F. L. Haynes Jr. (Horticultural Science); J. L. Apple, T. T. Hebert, N. T. Powell (Plant Pathology); D. M. Briggs, E. W. Glazener, G. A. Martin (Poultry Science)

The genetics faculty offers instruction at advanced undergraduate and graduate levels. The undergraduate courses are designed to support other departments, giving students a background in genetics. The graduate program is designed to train scientists for research and teaching careers in basic genetics and in its application in plant and animal breeding. For graduate degrees offered, see pages 12-13.

CURRICULUM

Since there is no genetics baccalaureate program, undergraduates are encouraged to pursue a biological sciences program.

Horticultural Science

Kilgore Hall

Professor J. W. Strobel, *Head of the Department*

Professor W. E. Ballinger, *Coordinator of Advising*

TEACHING AND RESEARCH

Professors: F. D. Cochran, G. J. Galletta, F. L. Haynes Jr., R. A. Larson, R. L. Lower, C. H. Miller, P. V. Nelson; *Adjunct Professor:* R. L. Sawyer; *Professors Emeriti:* J. M. Jenkins, D. T. Pope, G. O. Randall; *Associate Professors:* L. K. Hammett, W. R. Henderson, T. R. Konsler, T. J. Monaco, W. B. Nesbitt, D. M. Pharr, J. C. Raulston, R. M. Southall, C. R. Unrath, D. C. Zeiger; *Assistant Professors:* J. R. Ballington, W. C. Fonteno; *Research Assistant Professor:* W. W. Collins; *Instructors:* R. K. Kimmins, V. H. Underwood; *Associate Members of the Faculty:* R. J. Downs (Botany); R. L. Mott (Botany); T. J. Sheets (Entomology, Crop Science); R. H. Moll (Genetics); R. Aycock (Plant Pathology); R. J. Volk (Soils)

EXTENSION

Professor A. A. Banadyga, *In Charge*

Professors: J. R. Brooks, M. H. Kolbe, J. W. Love, W. A. Skroch, H. J. Smith; *Professors Emeriti:* H. M. Covington, J. H. Harris; *Associate Professors:* G. R. Hughes, C. M. Mainland, W. W. Reid, D. C. Sanders, L. G. Wilson, J. H. Wilson Jr.; *Assistant Professor:* M. A. Cohen

Undergraduate programs in horticultural science offer broad training in physical and biological sciences and business and a sound cultural background. Students can concentrate studies in the areas of fruit and vegetable crops, floriculture, nursery management, or landscape horticulture. They are prepared for either graduate study (see pages 12-13) or for diverse professional service.

North Carolina's varied climatic conditions make possible the production of a wide variety of horticultural crops on a commercial scale, as well as in parks and gardens. These crops now represent an important segment of N. C. agriculture with further expansion to be realized with the development of adapted varieties,

mechanization and intensification of cultural practices, improvement of handling and marketing methods and the development of the food processing industry.

OPPORTUNITIES

Horticulture graduates fill positions in production, processing, sales and service. Among these are county extension agents; vocational agricultural teachers; 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. The student may also prepare for a career in research, teaching, extension, etc. in horticulture.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in horticultural science can be earned in one of the three curricula—business, science, or technology—offered by the School of Agriculture and Life Sciences. Under these curricula, specialized training is offered in fruit and vegetable crops, and in floriculture, ornamental horticulture (nursery management), and landscape horticulture. (There is also a joint undergraduate major in pest management for crop protection; see pages 73-74.

For the freshman year and basic requirements, see pages 49-54.

For the business curriculum see page 50. Twenty-four credit hours of business courses are substituted for an equal number of hours in the technology curriculum.

CURRICULUM IN HORTICULTURAL SCIENCE

TECHNOLOGY PROGRAM

	Credits
ALS 103 Introductory Topics in the ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
SP 231 Expository Speaking	3
Literature Elective	3
Social Sciences and Humanities (21 credits)	
Electives	21
Physical and Biological Sciences	
MA 111 Algebra and Trigonometry	4
MA 112 Analytic Geometry and Calculus A *or*	4
MA 114 Intro. to Finite Mathematics with Applications	3
CH 101 General Chemistry I	4
CH 103 General Chemistry II	4
PY 221 College Physics	5
BS 100 General Biology	4
BO 200 Plant Life	4
SSC 200 Soil Science	4
Physical Education	
Physical Education	4
Free Electives	
Free Electives	12

Group A, B, C Courses (20 Credits)	
HS 201 Principles of Horticulture (LH)	3
ENT 312 Introduction to Economic Insects	3
PP 315 Plant Diseases	3
SSC 341 Soil Fertility and Fertilizers (FV,OH,F)	3
BO 421 Plant Physiology	4
HS 301 Plant Propagation (FV,OH,F)	3
GN 412 Elementary Genetics Lab (FV,OH,F)	1
Departmental Requirements and Electives (27-28 Credits)	
HS 491 Senior Seminar in Horticultural Science	1
GN 411 The Principles of Genetics (FV,H,F)	3
Technical Elective (FV,OH,F)	3
Departmental Elective (FV-14) (OH-8) (F-11)	Variable
HS 421 Tree Fruit Production (FV)	3
HS 432 Vegetable Production (FV)	3
HS 562 Post Harvest Physiology (FV)	3
HS 211 Ornamental Plants (OH,F,LH)	3
HS 212 Ornamental Plants (OH,F,LH)	3
HS 411 Nursery Management (OH,LH)	3
HS 414 Residential Landscape (OH,LH)	4
HS 471 Arboriculture (OH,LH)	3
HS 441 Floriculture I (F)	3
HS 442 Floriculture II (F)	3
LAR 211 Introduction to Landscape Architecture (LH)	3
HS 342 Landscape Horticulture (LH)	3
LAR ___ 321, 322; or 411, 412 (LH)	6
LAR 410 Site Planning (LH)	3
HS 495 Special Topics in Horticultural Science	2
Hours Required for Graduation	130

(FV—Fruits and Vegetables, OH—Ornamental, F—Floriculture, LH—Landscape)

SCIENCE PROGRAM

	Credits
ALS 103 Introductory Topics in the ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
Literature Elective	3
Language Elective	3
Social Sciences and Humanities (21 Credits)	
Electives	21
Physical and Biological Sciences	
MA 111 Algebra and Trigonometry	4
MA 112 Analytic Geometry and Calculus A *or*	4
MA 114 Intro. to Finite Math. with Applications	(3)
CH 101 General Chemistry I	4
CH 103 General Chemistry II	4
PY 221 College Physics *or*	5
PY 211, 212 General Physics	(8)
BS 100 General Biology	4
BO 200 Plant Life	4
Physical Education	
Physical Education	4
Free Electives	
Free Electives	12

Group A, B, C Courses (20-26 Credits)	
CH 220 Organic Chemistry	4
MB 401 Microbiology	4
BO 421 Plant Physiology	4
ENG 312 Introduction to Economic Insects	3
PP 315 Plant Diseases	3
SSC 200 Soil Science	4
Group A Electives	4
Departmental Requirements and Electives (26 Credits)	
HS 201 Principles of Horticulture	3
GN 411 The Principles of Genetics	3
GN 412 Genetics Lab	1
HS 491 Senior Seminar in Horticultural Science	1
HS 411 Nursery Management (OH)	3
HS 471 Arboriculture (OH)	3
HS 211 Ornamental Plants (OH,F)	3
HS 212 Ornamental Plants (OH,F)	3
HS 301 Plant Propagation (OH,F)	3
SSC 341 Soil Fertility and Fertilizers (OH,F)	3
HS 441 Floriculture I (F)	3
HS 442 Floriculture II (F)	3
HS 421 Tree Fruit Production (FV)	3
HS 432 Vegetable Production (FV)	3
HS 562 Post Harvest Physiology (FV)	3
Horticultural Science Electives (FV)	9
Hours Required for Graduation	130

FV—Fruits and Vegetables, OH—Ornamental, F—Floriculture

BUSINESS PROGRAM

All required courses in the Technology Program plus 24 hours in Economics and Business (see page 50).

	Credits
Hours Required for Graduation	130

INDIVIDUALIZED STUDY PROGRAM

Professor E. W. Glazener, *Coordinator of Advising*

The individualized study program entails a curriculum planned by the student with the assistance of a faculty advisory committee. Interested students are requested to follow details of the program through the Director of Academic Affairs, 115 Patterson Hall.

Medical Technology

Gardner Hall

G. C. Miller, *Coordinator of Advising*

North Carolina State University has two parallel programs in medical technology. One is a four-year curriculum with a Bachelor of Science in zoology followed by a year of training in a hospital laboratory school.

The second program is designed to be completed in four calendar years. The student takes a prescribed curriculum for three years at North Carolina State University. The fourth year consists of a 12-month course in medical technology at an affiliated clinical program. Upon completion, a Bachelor of Science degree will

be granted from N. C. State and a certificate in medical technology from the affiliated hospital. (See zoology, page 83.)

Microbiology

Gardner Hall

Professor J. B. Evans, *Head of the Department*

Professors: W. J. Dobrogosz, G. H. Elkan, P. B. Hamilton, J. J. Perry; *Professor Emeritus:* J. L. Etchells; *Adjunct Associate Professors:* R. E. Kanich, J. J. Tulis; *Assistant Professors:* R. E. Johnston, G. H. Luginbuhl; *Adjunct Assistant Professor:* D. H. King; *Associate Members of the Faculty:* J. G. Lecce, J. J. McNeill (Animal Science); F. B. Armstrong (Biochemistry); J. L. Etchells, M. L. Speck (Food Science); W. E. Kloos (Genetics); D. G. Simmons (Veterinary Science); A. G. Wollum II (Soil Science)

The microbiology program provides basic preparation for professional microbiologists, a microbiology background for students in other sciences, and an awareness of the microbial world as it relates to our daily lives for non-science majors.

Microbiology is concerned with the growth and development, physiology, classification, ecology, genetics and other aspects of the life processes of an array of tiny, generally single-celled, organisms. These organisms may serve as model systems for elucidation of fundamental processes that are common to all living cells.

Most of the major discoveries that have produced the spectacular advances in biology during the past decade have resulted from studies of microbial systems. Future developments in environmental quality, production of food and fuel, and human health, will rely heavily on understanding microbial processes.

OPPORTUNITIES

Microbiologists are employed in research laboratories, diagnostic and control laboratories, teaching, and technical sales and service positions.

CURRICULUM

There is no microbiology undergraduate major, so students with a primary interest in microbiology are advised to take the biological sciences curriculum with the microbiology option (see pages 60-61). Generally as few as 12 credits in microbiology may be recommended. This requires 3 courses (9 credits) in microbiology in addition to MB 401, which is part of the basic biological sciences requirements. However, if a student does not plan to go beyond the Bachelor of Science level, and desires to qualify for registration or a civil service position as a microbiologist, 20 credits in microbiology should be taken.

For graduate degree programs, see pages 12-13.

Pest Management (for Crop Protection)

Gardner, Kilgore and Williams Halls

K. L. Knight, *Coordinator of Advising*

The major in pest management (for crop protection) is an interdepartmental program involving crop science, entomology, horticultural science and plant pathology.

Students in pest management for crop protection receive training in the concepts of controlling crop pests in an ecologically sound manner. Crop losses from diseases, insects, nematodes and weeds annually run into the billions of dollars in the United States. Environmental concerns dictate that control efforts against these organisms must be integrated into a total crop production management program on a systems approach basis. A high degree of flexibility in electives permits the student either to become generally proficient across the field or to develop an area of strength against a particular class of pest organisms.

OPPORTUNITIES

Opportunities basically involve improving farm efficiency to meet our ever-growing need for food and fiber. Current federal and state statutes require a high degree of expertise in the accomplishment of pest control. Completion of the training provided by this curriculum qualifies the graduate for positions as county extension agents, as federal and state regulatory agents, as technicians in scientific research organizations, as pest control specialists in agribusiness concerns, and as custom pest management operators.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in pest management (for crop protection) is offered under the agricultural science curriculum of the School of Agriculture and Life Sciences.

For the freshman year and basic requirements see page 49.

CURRICULUM IN PEST MANAGEMENT

SCIENCE PROGRAM

		Credits
ALS 103	Introductory Topics in the ALS	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
Literature	Elective	3
Language	Elective	3
	Social Sciences and Humanities (21 Credits)	
Electives		21
	Physical and Biological Sciences (24-25 Credits)	
MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry and Calculus A	4
	or	
MA 114	Introduction to Finite Mathematics with Applications	3
CH 101	General Chemistry I	4
CH 103	General Chemistry II	4
	or	
CH 107	Principles of Chemistry	4
PY 221	College Physics	5
BS 100	General Biology	4
	Physical Education	
Physical	Education	4
	Free Electives	
Free	Electives	12
	Group A, B, C Courses (19 Credits)	
CH 220	Introductory Organic Chemistry	4
BCH 351	Elementary Biochemistry	3
BO (ZO) 360	Introduction to Ecology	4
SSC 200	Soil Science	4
BO 421	Plant Physiology	4
	Major Requirements and Electives (56 Credits)	
ENT 312	Introduction to Economic Insects	3
ENT 550	Fundamentals of Insect Control	3
PP 315	Plant Diseases	3
PP 500	Plant Disease Control	3
CS 414	Weed Science	3
CS (HS) 514	Principles and Methods in Weed Science	3
CS 211	Crop Science	4
PM 415	Principles of Pest Management	3
Advised	Electives	11
	Hours Required for Graduation	130

Plant Pathology

Gardner Hall

Professor R. Aycock, *Head of the Department*

TEACHING AND RESEARCH

Professors: J. L. Apple, K. R. Barker, C. N. Clayton, E. B. Cowling, E. Echandi, G. V. Gooding Jr., L. F. Grand, T. T. Hebert, S. F. Jenkins Jr., G. B. Lucas, R. D. Milholland, N. T. Powell, J. P. Ross (USDA), J. N. Sasser, H. W. Spurr Jr. (USDA), D. L. Strider, H. H. Triantaphyllou, R. E. Welty (USDA), N. N. Winstead; *Professors Emeriti:* D. E. Ellis, L. W. Nielsen, C. J. Nusbaum, F. L. Wellman; *Adjunct Professors:* G. H. Hepting, J. W. Koenigs, E. G. Kuhlman; *Associate Professors:* M. K. Beute, A. S. Heagle (USDA), K. J. Leonard (USDA), L. T. Lucas, C. E. Main, R. A. Reinert (USDA); *Assistant Professors:* D. M. Benson, Jeng-sheng Huang, J. W. Moyer, D. P. Schmitt, T. B. Sutton, C. G. Van Dyke; *Adjunct Assistant Professor:* N. A. Lapp (NCDA); *Associate Members of the Faculty:* C. B. Davey (Forestry), M. P. Levi (Forestry)

EXTENSION

Associate Professor H. E. Duncan, *In Charge*

Professors: F. A. Todd, J. C. Wells; *Associate Professors:* C. W. Averre III, R. K. Jones, P. B. Shoemaker, J. H. Wilson Jr.

Undergraduate instruction in plant pathology is designed to provide introductory and advanced courses on the nature and control of plant diseases to students majoring in crop science, horticultural science, pest management, agricultural education and forestry. It can also provide fundamental training necessary for graduate study in plant pathology.

The Department of Plant Pathology cooperates in training pest management majors, but does not offer an undergraduate major in plant pathology. For graduate degrees offered, see pages 12-13.

OPPORTUNITIES

Employment in research, extension and teaching is available to graduates with advanced degrees in plant pathology. Research openings are with the U. S. Department of Agriculture, state experiment stations and in industry. The rapid development of agricultural chemicals and other methods for disease control offers numerous opportunities. See pest management (for crop protection), pages 73-74.

Poultry Science

Scott Hall

Professor R. E. Cook, *Head of the Department*

Associate Professor W. R. Prince, *Coordinator of Advising*

TEACHING AND RESEARCH

Professors: W. E. Donaldson, E. W. Glazener, P. B. Hamilton, C. H. Hill, J. B. Ward; *Adjunct Professor:* K. N. May; *Professor Emeritus:* C. W. Barber; *Associate Professors:* J. D. Garlich, C. R. Parkhurst, J. P. Thaxton; *Adjunct Associate Professor:* Neil Chernoff; *Associate Professors Emeriti:* W. L. Blow, F. W. Cook; *Assistant Professors:* F. W. Edens, K. K. Krueger, G. W. Morgan Jr.; *Associate Members of the Faculty:* W. M. Colwell, D. G. Simmons (Veterinary Science)

EXTENSION

Professor W. C. Mills Jr., *In Charge*

Professors: W. G. Andrews, J. R. Harris, G. A. Martin; *Professors Emeriti:* C. R. Parrish, T. B. Morris; *Associate Professor:* T. A. Carter; *Assistant Professor:* M. H. Gehle; *Instructor:* J. R. West; *Extension Specialist:* C. E. Brewer

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

Through teaching, research and extension, the department serves students, poultrymen and allied industries. Poultry production has increased rapidly during the last two decades and ranks second in North Carolina as a source of agricultural income. North Carolina ranks fourth nationally in the production of poultry products; the climatic and economic conditions in the State provide a sound base for continued expansion.

OPPORTUNITIES

The change from small farm operations to large commercial poultry enterprises has created more specialized positions than there are available poultry graduates. Off-the-farm operations in activities such as processing and distribution offer new job opportunities. The allied industries—feed, equipment, financing and drugs—need more employees trained in poultry science. Graduates hold positions as managers and field representatives for businesses identified with or serving the poultry

industry. Graduates are also employed in communication and public relations and as teachers and extension and research specialists. Some graduates have their own poultry businesses.

UNDERGRADUATE CURRICULUM

Students desiring the Bachelor of Science with a major in poultry science may choose any of three curricula offered by Agriculture and Life Sciences. (For graduate degrees, see pages 12-13.) One may obtain a double major in certain other curricula through careful use of electives and/or summer school attendance. The student should consult the undergraduate advisors in the department(s) concerned. Currently, the pre-veterinary science student may utilize all requirements toward a Bachelor of Science degree in the science option.

For the freshman year and basic requirements see page 49.

POULTRY SCIENCE CURRICULUM

BUSINESS PROGRAM

This curriculum is for students desiring a background related to the operation and management of business firms on a sound economic basis. The general requirements for the business program (24 semester hours) are listed on page 50. The student must complete the required courses listed below for the technology program, substituting the business program courses for electives in the technology program.

SCIENCE PROGRAM

This curriculum is for the student interested in the basic biological and physical sciences. The student is better prepared for advanced study in various disciplines such as genetics, nutrition, physiology and pathology. Several preveterinary students are currently enrolled in this curriculum and are seeking a Bachelor of Science degree in poultry science.

TECHNOLOGY PROGRAM

This is a more generalized program of study as the curriculum offers a greater selection of courses in the applied science and technology areas. The student in the business option must complete the required courses in the technology program and substitute 24 hours of restricted Group B courses for the electives in technology shown below.

CURRICULUM IN POULTRY SCIENCE

SCIENCE PROGRAM

		Credits
ALS 103	Introductory Topics in the ALS	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
Literature Elective		3
Language Elective		3
	Social Sciences and Humanities (21 Credits)	
Electives		21
	Physical and Biological Sciences (28 Credits)	
MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry and Calculus A	4
	or	
MA 114	Introduction to Finite Mathematics with Applications	3
	or	
MA 102	Analytic Geometry and Calculus I	4
CH 101	General Chemistry I	4
CH 107	Principles of Chemistry	4
PY 211	General Physics	4
	or	
PY 221	College Physics	5
BS 100	General Biology	4
MB 401	General Microbiology	4
	Physical Education (4 Credits)	
PE Electives		4
	Free Electives (12 Credits)	
Free Electives		12
	Group A, B, C Courses (26 Credits)	
PY 212	General Physics (If PY 211 was taken)	4
GN 411	Principles of Genetics	3
CH 221	Organic Chemistry I	4
Elective in Group A (Biological Science)		4
Electives in A, B or C Courses		11

Departmental Requirements and Electives
(28 Credits)

PO 201 Poultry Science and Production ... 4
PO 401 Poultry Diseases 4
PO 404 Poultry Products 3
PO 405 Avian Physiology 4
PO 415 Comparative Nutrition 3
PO 490 Poultry Seminar 1
PO 520 Poultry Breeding 3
PO 524 Comparative Endocrinology 4

Hours Required for Graduation 130

TECHNOLOGY PROGRAM

ALS 103 Introductory Topics in the ALS .. 1

Language (12 Credits)

ENG 111 Composition and Rhetoric 3
ENG 112 Composition and Reading 3
SP 231 Expository Speaking 3
Literature Elective 3

Social Sciences and Humanities
(21 Credits)

Electives 21

Physical and Biological Sciences
(31 to 33 Credits)

MA 111 Algebra and Trigonometry 4
MA 112 Analytical Geometry and Calculus A 4
or
MA 114 Introduction to Finite Mathematics with Applications 3
or
MA 102 Analytical Geometry and Calculus I 4
CH 101 General Chemistry I 4
CH 103 General Chemistry II 4
or
CH 107 Principles of Chemistry 4
PY 221 College Physics 5
or
PY 211 General Physics 4
BS 100 General Biology 4
MB 401 General Microbiology 4
Elective in Group A (Biological Science) ... 4

Physical Education
(4 Credits)

PE Electives 4

Free Electives
(12 Credits)

Free Electives 12

Group A, B, C, Courses
(19 to 22 Credits)

GN 411 The Principles of Genetics 3
CH 220 Introductory Organic Chemistry ... 4
or
CH 221 Organic Chemistry I 4
PY 212 General Physics (If PY 211 was taken) 4
Electives in A, B, or C Courses .....11 to 15

Poultry Science Requirements
(28 Credits)

PO 201 Poultry Science and Production ... 4
PO 301 Evaluation of Live Poultry 2
PO 401 Poultry Diseases 4
PO 402 Commercial Poultry Enterprises .. 4
PO 404 Poultry Products 3
PO 405 Avian Physiology 4
PO 415 Comparative Nutrition 3
PO 490 Poultry Seminar 1
PO 520 Poultry Breeding 3

Hours Required for Graduation 130

BUSINESS PROGRAM

All required courses in the Technology Program plus 24 hours in Economics and Business Management (see page 50).

Hours Required for Graduation 130

Premedical Sciences

Gardner Hall and Grinnells Laboratory

J. R. Roberts and W. C. Grant, *Coordinators of Advising*

Premedical, predental and preveterinary programs are offered as a group of core courses in several curricula tracts in the School of Agriculture and Life Sciences. Requirements for all the premedical sciences are similar. Requirements may be met either through the science curriculum or the biological sciences curriculum. A number of students are accepted each year in leading medical colleges; several have received outstanding scholarships.

For further details on the preveterinary curriculum, see veterinary science, pages 80-81.

For the premedical and predental details, see zoology, pages 81-85, and the biological sciences curriculum, pages 60-61.

Sociology and Anthropology

(Also see Liberal Arts)

1911 Building

Professor S. C. Mayo, *Head of the Department*

Associate Professor E. M. Suval, *Assistant Head of the Department*

Professor J. N. Young, *Coordinator of Advising*

Associate Professor A. C. Davis, *Coordinator of Advising (Rural Sociology)*

TEACHING AND RESEARCH

Professors: L. W. Drabick, C. P. Marsh, G. C. McCann, H. D. Rawls, M. M. Sawhney; *Professor Emeritus:* C. H. Hamilton; *Associate Professors:* R. C. Brisson, W. B. Clifford II, C. V. Mercer, R. L. Moxley, R. D. Mustian, G. S. Nickerson, I. E. Russell, O. Uzzell, R. C. Wimberley; *Visiting Associate Professor:* K. D. Kim; *Assistant Professors:* W. T. Austin, C. G. Dawson, R. S. Ellovich, L. R. Della Fave, V. A. Hiday, T. M. Hyman, P. T. McFarlane, J. G. Peck, L. J. Rhoades, J. O. Shurling, P. L. Tobin, M. L. Walek, J. M. Wallace, M. T. Zingraff; *Visiting Assistant Professors:* H. L. Atkins, J. F. Denny, R. L. Gilmore

EXTENSION

Professor J. N. Collins, *In Charge of Community Development*

Professors: J. D. George, M. E. Voland; *Professor Emeritus:* J. W. Crawford; *Associate Professors:* V. E. Hamilton, T. N. Hobgood Jr., C. E. Lewis, P. P. Thompson; *Assistant Professor:* C. W. Moody

This department teaches students the principles and techniques for understanding human group behavior. More specifically the department seeks: (1) to train students to become leaders in organizing groups and communities and in administering their programs; (2) to qualify exceptional students on the undergraduate and graduate levels for 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.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in rural sociology is offered under the science curriculum of the School of Agriculture and Life Sciences. Majors in this department are offered an option in criminal justice.

For graduate degrees, see pages 12-13.

CURRICULUM IN RURAL SOCIOLOGY

SCIENCE PROGRAM

		Credits
ALS 103	Introductory Topics in the ALS	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
Literature Elective		3
Language Elective		3
	Social Sciences and Humanities (21 Credits)	
SOC 202	Principles of Sociology	3
Electives		18
	Physical and Biological Sciences (29 Credits)	
MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry and Calculus A	4
CH 101	General Chemistry I	4
CH 103	General Chemistry II	4
	or	
CH 107	Principles of Chemistry	
PY 221	College Physics	5
BS 100	General Biology	4
Botany or Zoology Elective		4
	Physical Education (4 Credits)	
Physical Education		4
	Free Electives (12 Credits)	
Free Electives		12
	Group A, B C, D Courses	
GN 411	The Principles of Genetics	3
	or	
GN 301	Genetics in Human Affairs	

GY 120	Elements of Physical Geology	2
GY 110	Physical Geology Laboratory	1
ST 311	Introduction to Statistics	3
Electives in A, B, C, or D Courses		15

Departmental Requirements and Electives

SOC 341	Rural Society, USA	3
SOC 301	Human Behavior	3
SOC 342	Rural Societies Around the World	3
SOC 416	Research Methods	3
SOC 411	Community Relationships	3
ANT 252	Cultural Anthropology	3
Sociology and Anthropology Electives		9
Hours Required for Graduation		130

Soil Science

Williams Hall

Professor C. B. McCants, *Head of the Department*

Professor M. G. Cook, *Coordinator of Advising*

Professors: S. W. Buol, F. R. Cox, R. B. Daniels (USDA), J. W. Gilliam, W. A. Jackson, E. J. Kamprath, R. J. Volk, S. B. Weed, W. G. Woltz; *Adjunct Professors:* L. J. Metz, C. G. Wells; *Professors Emeriti:* W. V. Bartholomew, J. W. Fitts, J. F. Lutz, W. W. Woodhouse Jr.; *Associate Professors:* G. R. Burns (USDA), D. K. Cassel, G. A. Cummings, E. E. Gamble (USDA), R. E. McCollum, C. D. Raper, P. A. Sanchez, A. G. Wollum II; *Visiting Associate Professors:* R. B. Cate, J. L. Walker; *Associate Professors Emeriti:* W. D. Lee, A. Mehlich, J. R. Piland, W. H. Rankin; *Assistant Professors:* B. L. Carlile, D. W. Israel, H. J. Kleiss, C. K. Martin, G. S. Miner, J. F. Shelton; *Adjunct Assistant Professor:* D. W. Eaddy; *Visiting Assistant Professors:* L. E. Aull, L. D. King, J. J. Nicholaides III; *Associate Members of the Faculty:* R. W. Skaggs (Biological and Agricultural Engineering), E. D. Seneca (Botany), J. B. Weber (Crop Science), C. B. Davey (Forestry)

EXTENSION

Professors: J. V. Baird, J. A. Phillips; *Assistant Professor:* G. C. Naderman

The Department of Soil Science trains students in fundamentals of soils, develops an understanding and appreciation of soils as a resource, and presents principles of soil management and utilization for both farm and non-agricultural purposes. Soils constitute one of the largest capital investments in farming and proper soil management is essential for efficient production. Future world food needs will require people conversant in soil resources and use of fertilizers. Soil properties are important considerations in urban-suburban planning and development. Also, knowledge of soil and its interactions with potential pollutants are useful in conserving environmental quality. Therefore, the demand for people trained in soils by agribusiness, research, service, planning-development, education and conservation-related agencies should continue to be great.

OPPORTUNITIES

Soil science graduates fill positions of leadership and service in agricultural, conservation and resource planning work. Among these are opportunities as farm operators and managers, county agricultural extension agents and employees of other public advisory agencies, Soil Conservation Service and other conservation-related agencies concerned with soil resources, and as technical representatives and salesmen in fertilizer companies and other agribusiness.

Provision is made for students wishing a more thorough training in biological sciences, chemistry, mathematics and physics leading to graduate study. (For graduate degrees, see pages 12-13.) Students with advanced degrees have wide opportunities in teaching, research, service and extension with state, federal and private educational and research institutions and agencies. Also, there are increasing opportunities in support of agribusiness.

UNDERGRADUATE CURRICULUM

The Bachelor of Science degree may be obtained in the Department of Soil Science under any of three curricula—science, technology, or conservation. For the basic requirements and freshman year, see pages 49-54. The conservation curriculum is shown on pages 62-63. The agronomy curriculum is on page 54.

CURRICULUM IN SOIL SCIENCE

SCIENCE PROGRAM

		Credits
ALS 103	Introductory Topics in the ALS	1
	Languages (12 Credits)	
ENG 111	Composition and Rhetoric	3
ENG 112	Composition and Reading	3
Literature Elective		3
Language Elective		3
	Social Sciences and Humanities (21 Credits)	
Electives		21
	Physical and Biological Sciences (31 Credits)	
MA 111	Algebra and Trigonometry	4
MA 114	Introduction to Finite Mathematics with Applications	3
CH 101	General Chemistry I	4
CH 103	General Chemistry II *or*	
CH 107	Principles of Chemistry	4
PY 211	General Physics	4
PY 212	General Physics	4
BS 100	General Biology	4
BO 200	Plant Life	4
	Physical Education	
Physical Education		4
	Free Electives	
Free Electives		12
	Group A, B, C Courses (22 Credits)	
MA 112	Analytical Geometry and Calculus A	4
MA 212	Analytical Geometry and Calculus B	3
Chemistry Elective		4
Chemistry Elective		4
BO 421	Plant Physiology	4
GY 110	Physical Geology Lab	1
GY 120	Elements of Physical Geology	2
	Departmental Requirements and Electives (27 Credits)	
SSC 200	Soil Science	4
SSC 341	Soil Fertility and Fertilizers	3
SSC 342	Soil Fertility Laboratory	1
SSC 352	Soil Classification	4
SSC 461	Soil Physical Properties and Plant Growth	3
SSC (CS) 462	Soil-Crop Management Systems	3
SSC 492	Senior Seminar in Soil Science	1
Departmental Electives		8
	Hours Required for Graduation	130

Veterinary Science

Grinnells Animal Health Laboratory

Professor T. M. Curtin, *Head of the Department*

Professor W. M. Colwell, *Coordinator of Advising*

Professors: E. G. Batte, D. J. Moncol; *Associate Professors:* R. C. Dillman, D. G. Simmons; *Adjunct Associate Professor:* M. A. Ross; *Assistant Professor:* E. C. Hodgin; *Adjunct Assistant Professors:* A. W. Macklin, F. B. McCashin, T. B. Ryan; *Associate Members of the Faculty:* R. F. Behlow (Animal Science), J. R. Harris (Poultry Science), K. E. Muse (Zoology)

PREVETERINARY CURRICULUM

Veterinary science department faculty serve as advisers to students enrolled in the preventerinary curriculum. Dr. E. W. Glazener, Director of Academic Affairs, serves as secretary of the N. C. Veterinary Certification Committee.

A preveterinary curriculum is offered under the science curriculum of Agriculture and Life Sciences as part of the North Carolina Veterinary Medical Education Program. After satisfactory completion of the preveterinary curriculum, North Carolina resident students are certified as eligible to seek admission to Auburn University, Ohio State University, Tuskegee Institute and other colleges of veterinary medicine in which the State may enter into agreements through the Southern Regional Education Board or other contracts for veterinary students to attend at in-state tuition rates.

Preveterinary students work toward a Bachelor of Science degree in a discipline of their choice while fulfilling requirements of the preveterinary program. If a student is accepted in a college of veterinary medicine before completion of his or her undergraduate degree, some course credits may be transferred from the veterinary program back to N. C. State and applied toward completion of the Bachelor of Science degree. Arrangements for this procedure should be made with degree-granting department prior to entering veterinary college.

The courses listed below are minimum requirements for all students applying for entrance into veterinary college under the Southern Regional Education Board contract.* A grade of C or better on each course and an overall grade point average of 2.7 on required courses are minimum requirements for certification by the North Carolina Certification Committee.

Languages:		*Semester Hours*
ENG 111, 112	English Composition	6
VET 333	Medical Vocabulary	2
	(or 6 sem. hrs. college credit in a foreign language)	

Social Sciences/Humanities:

(A minimum of 18 semester hours is required by most schools of veterinary medicine and 21 hours are required for a B.S. degree at NCSU.)

PS 201	American Governmental System	3
History or Literature	*Two* courses in Western Civilization, World History of one course in World Literature and one course in history to be chosen from: HI 204, HI 205, HI 207, HI 233 or ENG 205	6
Additional Social Sciences/Humanities Electives		9

Physical and Biological Sciences:

MA 111 or MA 114	Algebra and Trigonometry or Introduction to Finite Mathematics with Applications	4
MA 112	Analytic Geometry and Calculus A	4
CH 101	General Chemistry I	4
CH 107	Principles of Chemistry	4
CH 221, 223	Organic Chemistry I, II	8
PY 211, 212	General Physics	8
BS 100	General Biology	4
ZO 323 or ZO 203	Comparative Anatomy or Vertebrate Zoology	4
GN 411	Principles of Genetics	3
GN 412	Elementary Genetics Laboratory	1
MB 401	General Microbiology	4
BCH 351	Elementary Biochemistry	3
BCH 352	Elementary Biochemistry Laboratory	1

Applied Science and Technology:

ANS 200	Introduction to Animal Science (Recommended as prerequisite for ANS 204 or 415)	4
ANS 204 or 415	Livestock Feeds and Feeding or Comparative Nutrition	3 3

* Based on requirements of Auburn University**

** Ohio State University requirements differ from Auburn University requirements in that they strongly recommend courses in speech, communications, economics, sociology and psychology, but they do not have specific requirements for VET 333, PS 201, HI 204, HI 205, HI 207 or HI 233.

** Tuskegee Institute requirements differ from Auburn University requirements in that they require PO 201 (Poultry Science and Production), but do not have specific requirements for VET 333, PS 201, BCH 351, BCH 352 or MB 401.

As students progress through the preveterinary course requirements they should concentrate on courses to complete a degree program and work toward an alternate career objective.

Zoology

Gardner Hall

Professor R. Harkema, *Acting Head of the Department and Coordinator of Advising*

Professor F. S. Barkalow, *Coordinator of Advising in Wildlife Biology*

Professors: W. W. Hassler, C. F. Lytle, B. S. Martof, G. C. Miller, T. L. Quay, J. F. Roberts, D. E. Smith; *Adjunct Professors:* J. B. Funderburg, J. E. Hobbie, T. R. Rice, J. G. Vandenbergh, P. N. Witt; *Professors Emeriti:* B. B. Brandt, D. E. Davis; *Associate Professors:* P. C. Bradbury, M. T. Huish (USDI), K. E. Muse, J. M. Whitsett II; *Adjunct Associate Professor:* D. E. Gardner; *Assistant*

Professors: G. T. Barthalmus, P. D. Doerr, W. C. Grant, J. H. Kerby (USDI), J. M. Miller, G. G. Shaw, H. A. Underwood, T. G. Wolcott; *Adjunct Assistant Professors:* F. A. Cross, R. L. Ferguson, D. E. Hoss, G. R. Huntsman, D. S. Peters, L. W. Reiter, G. W. Thayer; *Visiting Assistant Professors:* W. L. Rickards Jr., O. T. Sanders Jr.; *Instructor:* W. A. Luebke; *Visiting Instructors:* F. M. Garner, L. R. Grimes; *Adjunct Instructors:* W. B. Baker, R. B. Hamilton, R. B. Hazel; *Associate Members of the Faculty:* B. J. Copeland (Botany, Sea Grant Program), D. S. Grosch, L. E. Mettler (Genetics); D. W. Hayne (Statistics)

The Department of Zoology provides undergraduate and graduate instruction in specialized biological sciences areas. Undergraduates study all levels of biological organization from the molecular to the community. Zoology majors are adequately prepared for graduate work in zoology and related fields of sciences. For graduate degrees, see pages 12-13. Participation in supervised programs of research is strongly encouraged. Basic training is also available for students planning to enter dentistry, medicine and veterinary medicine and allied health sciences, such as medical technology. Ecology is emphasized, including wildlife, fisheries, conservation, parasitology and marine science.

OPPORTUNITIES

Students may continue with graduate research work leading to advanced degrees in zoology and wildlife. However, numerous employment opportunities are available for Bachelor of Science graduates. Majors are qualified for positions in the medical sciences, various government agencies and private industries.

UNDERGRADUATE CURRICULA

The Bachelor of Science degree with a major in zoology, wildlife biology or medical technology is offered under the science curriculum of the School of Agriculture and Life Sciences. Within these majors a student may specialize depending upon interest and ability.

The zoology sequence prepares students for graduate school while the premedical, predental and preveterinary options prepare students for entrance into these respective professional schools. Certain professional schools have specific requirements which differ slightly from the zoology curriculum. Students should consult catalogs of specific professional schools to ensure completion of any special requirements.

Other options include the fisheries and marine science program and the medical technology program outlined below. The clinical year for the medical technology program is taken at an affiliated hospital. Students are advised, especially in their junior and senior years, by faculty in their specialty.

Basic requirements are listed in the science curriculum on page 49.

CURRICULUM IN ZOOLOGY

SCIENCE PROGRAM

	Credits
ALS 103 Introductory Topics in the ALS	1
Languages (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
Literature Elective	3
Language Elective	3
Social Sciences and Humanities (21 Credits)	
Electives	21
Physical and Biological Sciences	
MA 111 Algebra and Trigonometry	4
MA 112 Analytic Geometry and Calculus A	4
CH 101 General Chemistry I	4
CH 103 or CH 107 Gen. Ch. I or Principles of Chemistry	4
PY 211, 212 General Physics	8
or	
PY 221 College Physics	5
BS 100 General Biology	4
Physical Education	
Physical Education	4
Free Electives	
Free Electives	12
Group A Courses (27-31 Credits)	
CH 220, BCH 351 Introductory Organic Chemistry, Elementary Biochemistry	8
or	
CH 221, CH 223 Organic Chemistry I, II	8
GN 411 The Principles of Genetics	3
GN 412 Elementary Genetics Laboratory	1
Advised Electives	15-19

Departmental Requirements and Electives
(24 or 25 Credits)

ZO 202, ZO 203 Invertebrate Zoology, Vertebrate Zoology 8
or
ZO 201, ZO 323 General Zoology, Comparative Anatomy ... 8
ZO 421 Vertebrate Physiology 3
or
ZO 414 Cell Biology 3
ZO 415 Cellular and Animal Physiology Laboratory 2
ZO 360 Introduction to Ecology 4
or
ZO 361 Vertebrate Embryology 4
Zoology Electives .....3 or 4

Hours Required for Graduation 130

CURRICULUM IN WILDLIFE BIOLOGY

SCIENCE PROGRAM

Credits

ALS 103 Introductory Topics in the ALS .. 1

Languages (12 Credits)

ENG 111 Composition and Rhetoric 3
ENG 112 Composition and Reading 3
English Elective 3
Literature Elective 3

Social Sciences and Humanities
(21 Credits)

Electives 21

Physical and Biological Sciences
(40 Hours)

BO 200 Plant Life 4
BS 100 General Biology 4
CH 101 General Chemistry I 4
CH 103 General Chemistry II 4
MA 111 Algebra and Trigonometry 4
MA 112 Analytic Geometry and Calculus A 4
PY 221 College Physics 5
ZO 202 Invertebrate Zoology 4
ZO 203 Vertebrate Zoology 4
ST 311 Introduction to Statistics 3

Physical Education

Physical Education 4

Free Electives

Free Electives 13

Group A, B, C Courses
(21 Hours)

BCH 351 Elementary Biochemistry 3
BO 403 Systematic Botany 4
CH 220 Introductory Organic Chemistry ... 4
GN 411 The Principles of Genetics 3
ZO 360 Ecology 4
ZO 421 Vertebrate Physiology 3

Departmental Requirements and Electives
(18 Hours)

ENT (BS) 410 Biology of Insects 3
ZO 221 Conservation of Natural Resources 3
ZO 353 Wildlife Management 3
ZO 420 Fishery Science 3
ZO 501 Ornithology or ZO 544 Mammalogy 3
ZO 553 Principles of Wildlife Science 3

Hours Required for Graduation 130

SCIENCE PROGRAM IN MEDICAL TECHNOLOGY

G. C. Miller, *Coordinator of Advising*

Two programs are available in medical technology. The first is a four-year collegiate curriculum with a Bachelor of Science degree in zoology (see above) followed by a year of training in any hospital clinical laboratory approved by the American Medical Association. The second program is designed to be completed in four calendar years. The student takes the prescribed curriculum for three years at North Carolina State University and a fourth year (12 months) of clinical training at an affiliated hospital. Successful completion of this program qualifies the student for a Bachelor of Science degree in medical technology from N. C. State. Acceptance by the clinical laboratory is competitive and students in either program outlined above must apply for clinical training. After completion of either program the student is eligible to take the national examination of the Board of Registry of Medical Technologists.

For the freshman year see page 49.

CURRICULUM IN MEDICAL TECHNOLOGY

Courses *Credits*

ALS 103 Introductory Topics in the Ag. & Life Sciences 1

Languages (12 Credits)

ENG 111 Composition & Rhetoric 3
ENG 112 Composition & Reading 3
Literature Elective 3
English, Speech, or Language Elective 3

Social Sciences & Humanities

Electives (no more than two in any one Department) 21

Physical and Biological Sciences

MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry & Calculus A	4
CH 101	General Chemistry I	4
CH 107	Principles of Chemistry	4
PY 211	General Physics	4
BS 100	General Biology	4
ZO 201	General Zoology	4

Physical Education

Physical Education 4

Free Electives

Free Electives 12

Group A, B, C Courses (26 or 27 Credits)

CH 220	Intro. Organic Chemistry and	4
BCH 351	Elem. Biochemistry	3
	or	
CH 221	Organic Chem. I & CH 223 Organic Chem. II	8
PY 212	General Physics	4
MB 401	General Microbiology	4
MB 411	Medical Microbiology	3
GN 411	The Principles of Genetics	3
GN 412	Elementary Genetics Laboratory	1
CH 315	Quantitative Analysis	4

Departmental Requirements and Electives

ZO 203	Vert. Zoology *or* ZO 212 Basic Anatomy *or* ZO 323 Comparative Anatomy	4
ZO 421	Vert. Physiology *or* ZO 414 Cell Biology	3

plus

Twleve-month course in Medical Technology at an affiliated hospital—40 to 50 credits transferred to NCSU

Microbiology	Hematology
Blood Bank-Coagulation	Serology-Immunology
Clinical Chemistry	Urinalysis

Hours Required for Graduation 150

OPTION IN ZOOLOGY CURRICULUM

Students desiring to emphasize certain areas within zoology may choose an option:

CURRICULUM IN PREMEDICAL-PREDENTAL OPTION

Courses		*Credits*
ALS 103	Introductory Topics in the Ag. & Life Sciences	1

Languages (12 Credits)

ENG 111	Composition & Rhetoric	3
ENG 112	Composition & Reading	3
Literature Elective		3
Language Elective		3

Social Sciences & Humanities (21 Credits)

Electives 21

Physical and Biological Sciences (28 Credits)

MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry & Calculus A	4
CH 101	General Chemistry I	4
CH 107	Principles of Chemistry	4
PY 211	General Physics	4
BS 100	General Biology	4
ZO 201	General Zoology (Animal Life)	4

Physical Education

Physical Education 4

Free Electives

Free Electives 12

Group A Courses (26 Credits)

CH 221	Organic Chemistry I	4
CH 223	Organic Chemistry II	4
CH 315	Quantitative Analysis	4
PY 212	General Physics	4
GN 411	The Principles of Genetics	3
GN 412	Elementary Genetics Laboratory	1
Advised Electives		6

Departmental Requirements & Electives (26 Credits)

ZO 323	Comparative Anatomy	4
ZO 415	Cellular & Physiology Laboratory	2
ZO 421	Vertebrate Physiology	3
ZO 361	Vertebrate Embryology	4
Advised Electives		13

Hours Required for Graduation 130

CURRICULUM IN FISHERIES AND MARINE SCIENCE OPTION

Courses		*Credits*
ALS 103	Introductory Topics in Ag. & Life Science	1

Languages (12 Credits)

ENG 111	Composition & Rhetoric	3
ENG 112	Composition & Reading	3
English Elective		3
Literature Elective		3

Social Sciences & Humanities

Electives (no more than two in any one Department) 21

Physical and Biological Sciences (28 Credits)

MA 111	Algebra and Trigonometry	4
MA 112	Analytic Geometry & Calculus A	4
CH 101	General Chemistry I	4
CH 103	General Chemistry II	4
PY 221	College Physics	4
BS 100	General Biology	4
ZO 201	General Zoology*	
	or	
ZO 203	Vertebrate Zoology	4

Physical Education

Physical Education	4

Free Electives

Free Electives	12

Group A Courses (25 Credits)

CH 220	Introductory Organic Chemistry	4
BCH 351	Elementary Biochemistry	3
BCH 352	Elementary Biochemistry Lab	1
ENT 301	Introduction to Forest Insects	3
GN 411	The Principles of Genetics	3
ST 311	Introduction to Statistics	4
Advised Electives		7

Departmental Requirements (27 Credits)

ZO 323	Comparative Anatomy	4
	or	
ZO 202	Invertebrate Zoology	4
ZO 221	Conservation of Natural Resources	3
ZO 420	Fishery Science	3
ZO 421	Vertebrate Physiology	3
ZO 360	Introduction to Ecology	4
ZO 441	Ichthyology	3
ZO 519	Limnology	4
Fishery Elective		3
	Hours Required for Graduation	130

* If ZO 201 is taken, then ZO 323 should be elected rather than ZO 202.

Agricultural Experiment Station

J. E. Legates, *Dean of Agriculture and Life Sciences*

K. R. Keller, *Director of Research*

The Agricultural Experiment Station is the agricultural and forestry research agency of the State of North Carolina. It is funded principally by appropriations from the North Carolina General Assembly and an allocation of federal funds.

The purpose of the Agricultural Experiment Station is to conduct research on (1) the development and maintenance of an effective agricultural and forestry industry in North Carolina, including economically sound sources of supplies and equipment needed in agriculture and forestry and market outlets for the products of agriculture and forestry, (2) the improvement of rural homes, rural life and rural environment, and (3) the maintenance of a reliable supply of agricultural and forestry products for the consuming public. This requires research to solve current problems and research to provide a foundation of scientific knowledge in the biological, physical and social sciences.

The faculty conducts experiments in the phytotron greenhouses and laboratories of the University and throughout the State on 15 strategically located experimental farms and on rented farm land.

The Agricultural Experiment Station faculty brings well trained personnel to the University, whose teaching in many specialized fields of agriculture assures the maintenance of curricula of high standards. It contributes 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 bulletins and scientific papers on research results conducted by the staff. Single copies of these publications are sent free upon request to anyone in the State.

SERVICES

The faculty and staff diagnoses and interprets problems for farmers and agribusiness firms in North Carolina. Station personnel counsel farmers and others interested in the agricultural and forestry industry, present radio and television programs devoted to the discussion of farm and forestry procedures, and write letters and articles on more specific problems of agriculture at the request of farmers, garden club members, newspapers, agricultural magazines and manufacturers of fertilizer and pesticides. Researchers also take part in administrative functions of the University.

Agricultural Extension Service

J. E. Legates, *Dean of the School of Agriculture and Life Sciences*

George Hyatt Jr., *Associate Dean and Director of the Agricultural Extension Service*

The Agricultural Extension Service of North Carolina State University is a cooperative undertaking among the United States Department of Agriculture, the State of North Carolina and the 100 counties in the State. Its work is supported by federal funds made available under the Smith-Lever Act of 1914, as amended, and by state and county appropriations.

The federal and state appropriations are used to maintain an Administrative and Specialist staff and to pay a portion of the salary and the travel expenses of the County Extension Agents. Under this cooperative arrangement, the Agricultural Extension Service serves as the "educational arm" of the United States Department of Agriculture, and as the "field faculty" of North Carolina State University in the areas of agricultural production and marketing; family living; 4-H and youth; and, community and natural resource development.

OBJECTIVES

The primary purpose of the North Carolina Agricultural Extension Service is to take to the people of the State the latest and best information obtainable—particularly that which is related to agriculture; home economics and youth; and, rural development—and help them to interpret and use this information in building a more prosperous and satisfying life.

To accomplish this purpose, the Institution maintains a staff of trained specialists in each of the major subject matter areas. These specialists work primarily with and through the County Agricultural, Home Economics and 4-H Agents in the conduct of a state-wide educational program.

This program has sufficient flexibility to permit special attention to the problems, needs and interests of the people in each county. Educational assistance is given to individuals, families, industrial processing and marketing firms, other businesses and certain organizations. This includes work with adult men and women and boys and girls in both the city and the rural areas.

In carrying out this educational program, a variety of methods and techniques are employed: method and result demonstrations; meetings; visits to farms, homes and businesses; organized groups of men, women and youth; tours; leaflets, pamphlets and other printed materials and mass media.

The basic sources of information to be taught through this educational program are the findings and recommendations resulting from research conducted by Experiment Stations in this and other states and by the United States Department of Agriculture.

Agricultural Institute

Patterson Hall

J. E. Legates, *Dean of Agriculture and Life Sciences*

E. W. Glazener, *Associate Dean and Director of Academic Affairs*

H. B. Craig, *Associate Director of Academic Affairs and Director of the Agricultural Institute*

The Agricultural Institute is a two-year, terminal academic program which provides training in agriculture and related areas. It is part of the School of Agriculture and Life Sciences at North Carolina State University. This program was begun in 1959 and was funded by legislative appropriation.

Its objective is to train those desiring a comprehensive education in agriculture and agribusiness.

Individuals with Institute training command attractive salaries, assume a more prominent role of leadership and become a distinct asset to various segments of agricultural society. They make significant contributions to their community, state and nation by being involved in the world's most vital industry.

The instructional programs are organized and conducted as a part of the over-all resident instruction program for Agriculture and Life Sciences. The Institute is an addition to and not a substitute for, the School's regular degree granting program. However, the faculty in residence for the four-year programs are responsible for organizing and teaching courses offered by the Institute.

People with training similar to that of the Institute are in demand by agricultural industries. As demand changes, courses will be evaluated and alterations will be made accordingly. Such a re-evaluation also aids the technical manpower needs of agricultural industry.

OPPORTUNITIES

Rapid technical advancement has been important in changing agriculture from a small production industry to the nation's largest industry. Closely associated with production agriculture are those areas related to recreation and beautification such as turfgrass management, flowers and ornamental plants. Increased production and consumer demand for convenience type foods have stimulated the food processing industry, in turn increasing food distribution requirements.

Today's complex agriculture requires a larger work force. This work force must be able to deal with a vast array of problems and opportunities and Institute graduates can assume responsible positions in the total agricultural industry. Some career examples are: farm and herd managers, research technicians, salesmen, retail farm supply and equipment outlet managers, golf course superintendents, nursery managers, agricultural pest control specialists, quality control technicians, food service supervisors and others. More job opportunities than graduates make salaries attractive.

The School maintains a Placement Office to assist graduates in finding employment.

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 admission consideration. Each application will be reviewed and evaluated by the Institute director.

For additional information write: Director, Agricultural Institute, 107 Patterson Hall, Raleigh, N. C. 27607.

PROGRAMS OF STUDY

Graduates of the Agricultural Institute are awarded the Associate in Applied Agriculture degree. The 10 programs of study are: Agricultural Equipment Technology; Agricultural Pest Control; Field Crops Technology; Flower and Nursery Crops Technology; Food Processing, Distribution and Service; General Agriculture; Livestock Management and Technology (animal husbandry option and dairy husbandry option); Soil Technology; and Turfgrass Management.

DESIGN

Brooks Hall

C. E. McKinney, *Dean*

H. K. Zschau, *Librarian*

R. P. Burns, *Coordinator*

The School of Design, since its beginning in 1948, has addressed design in the broadest sense involving the disciplines of architecture, landscape architecture, product and visual design in a context of educational innovation. While the designer's traditional role is understood as that of giving meaningful form to the environment, the School gives attention to the larger responsibility of design in human, social, economic, political and behavioral terms. The School seeks to develop the designer's perception, knowledge base, skills and analytical problem solving abilities.

The expanding range of career opportunities in design, professional and otherwise, is equaled by the varied interests possessed by our students. Through a selective admissions process, the School's student population is highly motivated and heterogeneous. Our faculty represents an equally broad spectrum of educational and professional expertise. The diversity of the faculty, both professionally and philosophically, provide unique opportunities for student development. These three factors in our educational matrix (career opportunities, student interests, and faculty expertise) are supported with a curriculum which affords each student the ability to shape, with faculty advice, a plan of study capable of facilitating his or her interests. While the School embraces the design disciplines of architecture, landscape architecture, product and visual design within a program structure, it functions as a unified educational center, interactive and dedicated to preparing designers who are capable of shaping the environment in whatever scale they choose but in response to the needs of society.

CURRICULA AND DEGREES

The School of Design offers undergraduate instruction leading to a Bachelor of Environmental Design degree in the disciplines of architecture, landscape architecture and product design with a visual design option.

The learning activities for our students are divided into three curriculum areas: (1) general courses including English, mathematics, social science, humanities, physical science and other University courses; (2) core courses which deal with bodies of knowledge and skills applicable to design and common to all disciplines; including communication and graphics, behavior, environment, history and philosophy, physical elements and systems, methods and management (these courses are largely taught within the School but include selected University courses as well); (3) studio courses providing the arena in which students apply their skills and knowledge to problems that are both real and theoretical. These synthetic activities are time intensive and are fundamental to design education.

After the common experience in first year, these studios relate to the student's declared disciplinary major. The flexibility of this curriculum plan affords the student the greatest opportunity to concentrate in a single discipline but facilitates his or her contact with other design disciplines. The curriculum reflects the reality of the environmental marketplace where designers relate to a broad range of design and development professionals—not in isolation.

Graduate studies are also offered in architecture, landscape architecture and product design. See the Graduate Catalog for information on the Master's programs.

DESIGN FUNDAMENTALS PROGRAM

Assistant Professor M. Pause, *Program Director*

Professors: D. R. Stuart, J. H. Cox; *Associate Professors:* G. L. Bireline Jr., R. W. Musselwhite, E. W. Taylor; *Assistant Professor:* P. Tesar

The design fundamentals program is focused on exposure to basic design concepts and provides counseling, orientation and an historical structure for the fields of design in general and for future studies in the School and the University. The student develops through exploration and investigation of physical form.

Architecture

Brooks Hall

Professor J. Loss, *Program Director*

Professors: R. P. Burns Jr., H. Sanoff, V. Shogren, D. R. Stuart; *Professors Emeriti:* H. H. Harris, H. L. Kamphoefner; *Associate Professors:* P. Batchelor, R. H. Clark, G. J. P. Reuer, E. W. Taylor; *Assistant Professors:* D. W. Barnes, S. Kanda, M. Pause, J. O. Tector, P. Tesar; *Visiting Instructor:* W. Place

Architecture finds itself at a critical stage in its historical development. The architect's traditional role of giving meaningful form to our physical environment remains a chief concern, but this task has been vastly complicated by the forces of accelerating world urbanization. The evolution of society in social and technological terms rapidly alters every facet of contemporary life. The changing conditions in our urban centers have modified attitudes about obsolescence and inefficiency in all of our life support systems, including housing, transportation, commerce, and numerous others. We are looking at our environment in different terms with innovation, conservation, preservation and adaptive use of our existing man-made forms to meet society's changing needs. The architecture program attempts to prepare individuals with an understanding of man and his cultural context with a commitment to the ordering of the physical environment and with the tools for accomplishing these objectives.

The curriculum, while providing a broad basic structure common to all students, encourages individual diversity through a major elective program of in-depth study in one of the several design related fields, through interdisciplinary studies in the School and the University, and through the use of outside consultants. The interdependence of the architect with related professionals is strongly emphasized. The design studio is a working laboratory in which analysis and synthesis become real and meaningful activities to the students. Considering the expanding requirements in the field of architecture and the increasing complexity of the architect's role, a six-year, two-degree curriculum has been established. After a common first year in design fundamentals, the sophomore, junior and senior years mark the formal introduction to architectural studies and lead to the undergraduate, non-professional degree, the Bachelor of Environmental Design in Architecture. For students not advancing to graduate studies, the four-year undergraduate curriculum is designed as a terminal program qualifying students to enter architecture at an intermediate level or related fields outside of architecture. Students who later wish to pursue the professional, accredited degree in architecture must enroll in the Master of Architecture program. See the Graduate Catalog for information on the Master's program.

OPPORTUNITIES

The graduate with a Bachelor of Environmental Design in Architecture is qualified for positions in public agencies, development organizations, building research, building construction firms and private architectural offices. State law now requires the graduate with an accredited, professional degree in architecture to work not less than three years in the offices of registered architects and then pass a written examination given by the North Carolina Board of Architecture prior to being licensed as an "architect". Graduates with the non-professional Bachelor's degree have additional work and examination requirements which vary with State laws.

ARCHITECTURE PROGRAM CURRICULUM

Degree: Bachelor of Environmental Design in Architecture

FIRST YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DF 101 Environ. Des. I	6	DF 102 Environ. Des. II	6
DN 141 Hist. of Des. I	3	DN 142 Hist. of Des. II	3
ENG 111 Comp. & Rhet.	3	ENG 112 Comp. & Read.	3
Math[1]	3	Math[1]	4/3
Phy. Ed.	1	Phy. Ed.	1
	16		17/16

SECOND YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Studio[2]	6	Studio[2]	6
Nat. Science Elec.[3]	4	Nat. Science Elec.[3]	4
Soc. Sci./Hum. Elec.[4]	3	Soc. Sci./Hum. Elec.[4]	3
Core[6]	3	Core[6]	3
Phy. Ed.	1	Phy. Ed.	1
	17		17

THIRD YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Studio[2]	6	Studio[2]	6
Soc. Sci./Hum.[4]	3	Soc. Sci./Hum.[4]	3
Advised Elec.[5]	3	Advised Elec.[5]	3
Core[6]	3	Core[6]	3
Core[6]	3		
	18		15

FOURTH YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Advised Elec.[5]	3	Free Elec.	3
Free Elec.	3	Free Elec.	3
Free Elec.	3	Core[6]	3
Core[6]	3	Core[6]	3
Core[6]	3	Core[6]	3
	15		15

Hours Required for Graduation .....129[7]

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[1] Must include one calculus course and may include one computer science course. May not include credit for Math 111.

[2] A minimum for four 400 series studios are required with a minimum of three of the four being ARC 400. The four studios may be taken at any time during the final six semesters; however, no more than one studio may be taken in any semester.

[3] Selected from natural, physical, or biological sciences, but not to include math or computer science courses.

[4] The University requires 18 hours in social science/humanities area. This requirement met by DN 141, 142 in freshman year and 12 hours of electives. Courses not limited to any specific departments but may include any courses which have humanities or social science orientation—normally courses from Anthropology (ANT), Economics and Business (ACC, EB), Foreign Languages (GRK, LAT, FLF, FLG, FLI, FLR, FLS), History (HI), Literature (ENG), Philosophy (PHI), Political Science (PS), Psychology (PSY), Religion (REL), Social Work (SW), Sociology (SOC), and University Studies (UNI).

[5] Advised electives are to be selected after consultation with the advisor. They may include studios and core courses from the School of Design or courses from the University at large but may not include credit for Art (ART), Military Science (AS, MS), Music (MUS) below 200 level, or Physical Education (PE).

[6] Each architecture student is required to take a minimum of one entry course in four of the six cores (Graphics and Communications, Behavior, Environment, History and Philosophy, Physical Elements and Systems, and Methods and Management). DF 101 and DF 102 satisfy this requirement for the Communications and Graphics Core, DN 141 and DN 142 satisfy this requirement for the History and Philosophy Core. In the remaining cores the entry courses are designated by "2" as the first digit in the course number. *Note:* A student in this program must have an architecture faculty member as advisor.

[7] In order to receive two degrees from School of Design a student must complete 30 credit hours above the 129 hour requirement. These 30 hours are to include 18 credits in 400 level studio and 12 credits in core courses above those described above.

Landscape Architecture

Brooks Hall

Associate Professor A. Sullivan, *Program Director*

Professor: R. R. Wilkinson; *Professor Emeritus:* E. G. Thurlow; *Associate Professor:* R. T. Hester Jr.; *Assistant Professors:* G. Gumz, L. Jewell, D. Wood; *Lecturer:* R. Stipe; *Visiting Associate Professor:* S. Baker; *Associate Members of the Faculty:* T. O. Perry (Forestry), J. C. Raulston (Horticulture)

Landscape architecture is the profession concerned with design and development of man-made features on the land and enhancement of the visual landscape, seeking to shape these features in concert with the natural environment. There are approximately 8,000 practicing landscape architects in the United States whose activities range from site planning for urban complexes, community design, park and open space design, to campus planning and development of regional land management systems. U. S. Forest Service, National Park Service, city planning, state and local park agencies and private design offices are major employment sources. Types of work range from program development studies to detailed projects. The landscape architecture faculty is concerned with preparing students for professional careers. In addition, the faculty is committed to establishing a strong educational and intellectual base for each student facilitating his or her continued opportunity for growth.

OPPORTUNITIES

Graduates of the program with a Bachelor of Environmental Design in Landscape Architecture gain employment with private offices practicing all phases of landscape architecture. Others gain employment with public agencies such as state park departments, community planning offices and environmental protection agencies. Many stay in North Carolina and participate in the expansion of the profession and its involvement in the development of the State.

LANDSCAPE ARCHITECTURE PROGRAM CURRICULUM

Degree: Bachelor of Environmental Design in Landscape Architecture

FIRST YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DF 101 Environ. Des. I	6	DF 102 Environ. Des. II	6
DN 141 Hist. of Des. I	3	DN 142 Hist. of Des. II	3
ENG 111 Comp. & Rhet.	3	ENG 112 Comp. & Read.	3
Math[1]	3	Math[1]	4/3
Phy. Ed.	1	Phy. Ed.	1
	16		17/16

SECOND YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Studio[2]	6	Studio[2]	6
Nat. Science Elec.[3]	4	Nat. Science Elec.[3]	4
Soc. Sci./Hum. Elec.[4]	3	Soc. Sci./Hum. Elec.[4]	3
Core[6]	3	Core[6]	3
Phy. Ed.	1	Phy. Ed.	1
	17		17

THIRD YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Studio[2]	6	Studio[2]	6
Soc. Sci./Hum.[4]	3	Soc. Sci./Hum.[4]	3
Advised Elec.[5]	3	Advised Elec.[5]	3
Core[6]	3	Core[6]	3
Core[6]	3		
	18		15

FOURTH YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Advised Elec.[5]	3	Free Elec.	3
Free Elec.	3	Free Elec.	3
Free Elec.	3	Core[6]	3
Core[6]	3	Core[6]	3
Core[6]	3	Core[6]	3
	15		15

Hours Required for Graduation .....129[7]

VISUAL DESIGN OPTION

The increasing importance of communication in our society has created a demand for designers who have operational knowledge and creative abilities in various visual media. The elements of this field were historically found in various crafts, skills, commercial and production art. These have been integrated into a new design discipline; and the scope of educational development includes typography, photography, illustration, printing, production materials and methods. The applications include publication design (books, pamphlets and brochures), package design, signing and symbol design, advertising design (including newspapers, magazines, television and cinema), exhibit and display design. In relation to a broader view of the environment, the discipline includes the development of techniques for analyzing the visual character of our urban environment and its relation to social and behavioral functions; also, the exploration of visual means for solving socially defined problems. Working through a broad range of visual creative experiences, the student will develop an understanding of the elements and principles of organization common to all visual communication.

OPPORTUNITIES

Graduates with a Bachelor of Environmental Design in Product Design with the Visual Design Option pursue varied careers in professional design offices, corporate design offices, advertising agencies, corporations involved in printing, production, media development and communication. Others choose to enter graduate school for continued study in specific areas, both natural and man-made.

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[1] Must include one calculus course and may include one computer science course. May not include credit for Math 111.

[2] A minimum of four 400 series studios are required with a minimum of three of the four being LAR 400. The four studios may be taken at any time during the final six semesters; however, no more than one studio may be taken in any semester.

[3] Selected from natural, physical, or biological sciences, but not to include math or computer science courses.

[4] The University requires 18 hours in social science/humanities area. This requirement met by DN 141, 142 in freshman year and 12 hours of electives. Courses not limited to any specific departments but may include any courses which have humanities or social science orientation—normally courses from Anthropology (ANT), Economics and Business (ACC, EB), Foreign Languages (GRK, LAT, FLF, FLG, FLI, FLR, FLS), History (HI), Literature (ENG), Philosophy (PHI), Political Science (PS), Psychology (PSY), Religion (REL), Social Work (SW), Sociology (SOC), and University Studies (UNI).

[5] Advised electives are to be selected after consultation with the advisor. They may include studios and core courses from the School of Design or courses from the University at large but may not include credit for Art (ART), Military Science (AS, MS), Music (MUS) below 200 level, or Physical Education (PE).

[6] Each landscape architecture student is required to take a minimum of one entry course in four of the six cores (Graphics and Communications, Behavior, Environment, History and Philosophy, Physical Elements and Systems, and Methods and Management). DF 101 and DF 102 satisfy this requirement for the Communications and Graphics Core, DN 141 and DN 142 satisfy this requirement for the History and Philosophy Core. In the remaining cores the entry courses are designated by "2" as the first digit in the course number.

Note: A student in this program must also take the following which satisfy core requirements: DN 221/231, DN 430 (3 credits above entry level in Behavior Core, 3 credits above entry level in Environment Core), and either DN 443 or DN 444.

[7] In order to receive two degrees from School of Design a student must complete 30 credit hours above the 129 hour requirement. These 30 hours are to include 18 credits in 400 level studio and 12 credits in core courses above those described above.

Product Design

Associate Professor V. M. Foote, *Program Director*

Associate Professor: J. Wittkamp; *Assistant Professors:* M. Aufmuth, A. V. Cooke, C. Kieffer; *Instructor:* J. DeMao

Upon completion of design fundamental requirements, the student selecting the Product Design Program elects as a major area of concentration the product or visual design option. The product design option is concerned with all the human aspects of machine-made products and their relationship to the environment. In some areas, this design discipline is referred to as industrial design. The designer is responsible for the product's human engineering, safety, shape, color, texture, maintenance and cost. Product design deals with consumer products as well as industrial products. In order to achieve these ends, it is necessary for the designer to involve himself or herself in three major design and research activities: man's behavior; the man-product-machine relationship; the product itself.

Areas of investigation include furniture, housewares, appliances, transportation, machine tools, farm equipment, medical electronic instruments, recreational support equipment and others.

OPPORTUNITIES

Graduates with a Bachelor of Environmental Design in Product Design have career opportunities in three general areas: corporate design offices in manufacturing companies, independent design offices, or governmental agencies.

PRODUCT DESIGN PROGRAM CURRICULUM

Degree: Bachelor of Environmental Design in Product Design

FIRST YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DF 101 Environ. Des. I	6	DF 102 Environ. Des. II	6
DN 141 Hist. of Des. I	3	DN 142 Hist. of Des. II	3
ENG 111 Comp. & Rhet.	3	ENG 112 Comp. & Read.	3
Math[1]	3	Math[1]	4/3
Phy. Ed.	1	Phy. Ed.	1
	16		17/16

[1] Must include one calculus course and may include one computer science course. May not include credit for Math 111.

[2] A minimum of four 400 series studios are required with a minimum of three of the four being PD 400. The four studios may be taken at any time during the final six semesters; however, no more than one studio may be taken in any semester.

[3] Selected from natural, physical, or biological sciences, but not to include math or computer science courses.

[4] The University requires 18 hours in social science/humanities area. This requirement may be met by DN 141, 142 in freshman year and 12 hours of electives. Courses not limited to any specific departments but may include any courses which have humanities or social science orientation—normally courses from Anthropology (ANT), Economics and Business (ACC, EB), Foreign Language (GRK, LAT, FLF, FLG, FLR, FLS), History (HI), Literature (ENG), Philosophy (PHI), Political Science (PS), Psychology (PSY), Religion (REL), Social Work (SW), Sociology (SOC), and University Studies (UNI).

[5] Advised electives are to be selected after consultation with the advisor. They may include studios and core courses from the School of Design or courses from the University at large but may not include credit for Art (ART), Military Science (AS, MS), Music (MUS) below 200 level, or Physical Education (PE).

[6] Each product design student is required to take a minimum of one entry course in four of the six cores (Graphics and Communications, Behavior, Environment, History and Philosophy, Physical Elements and Systems, and Methods and Management). DF 101 and DF 102 satisfy this requirement for the Communications and Graphics Core, DN 141 and DN 142 satisfy this requirement for the History and Philosophy Core. In the remaining cores the entry courses are designated by "2" as the first digit in the course number. *Note:* A student in this program must also take the following which satisfy the core requirements: DN 255 and DN 256.

[7] In order to receive two degrees from School of Design a student must complete 30 credit hours above the 129 hour requirement. These 30 hours are to include 18 credits in 400 level studio and 12 credits in core courses above those described above.

SECOND YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Studio[2]	6	Studio[2]	6
Nat. Science Elec.[3]	4	Nat. Science Elec.[3]	4
Soc. Sci./Hum. Elec.[4]	3	Soc. Sci./Hum. Elec.[4]	3
Core[6]	3	Core[6]	3
Phy. Ed.	1	Phy. Ed.	1
	17		17

THIRD YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Studio[2]	6	Studio[2]	6
Soc. Sci./Hum.[4]	3	Soc. Sci./Hum.[4]	3
Advised Elec.[5]	3	Advised Elec.[5]	3
Core[6]	3	Core[6]	3
Core[6]	3		
	18		15

FOURTH YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Advised Elec.[5]	3	Free Elec.	3
Free Elec.	3	Free Elec.	3
Free Elec.	3	Core[6]	3
Core[6]	3	Core[6]	3
Core[6]	3	Core[6]	3
	15		15

Hours Required for Graduation ..... 129[7]

PRODUCT DESIGN/VISUAL DESIGN OPTION

Degree: Bachelor of Environmental Design in Product Design/Visual Design Option

FIRST YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
DF 101 Environ. Des. I	6	DF 102 Environ. Des. II	6
DN 141 Hist. of Des. I	3	DN 142 Hist. of Des. II	3
ENG 111 Comp. & Rhet.	3	ENG 112 Comp. & Read.	3
Math[1]	3	Math[1]	4/3
Phy. Ed.	1	Phy. Ed.	1
	16		17/16

SECOND YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Studio[2]	6	Studio[2]	6
Nat. Science Elec.[3]	4	Nat. Science Elec.[3]	4
Soc. Sci./Hum. Elec.[4]	3	Soc. Sci./Hum. Elec.[4]	3
Core[6]	3	Core[6]	3
Phy. Ed.	1	Phy. Ed.	1
	17		17

[1] Must include one calculus course and may include one computer science course. May not include credit for Maty 111.

[2] A minimum of four 400 series studios are required with a minimum of three of the four being PVD 400. The four studios may be taken at any time during the final six semesters; however, no more than one studio may be taken in any semester.

[3] Selected from natural, physical, or biological sciences, but not to include math or computer science courses.

[4] The University requires 18 hours in social science/humanities area. This requirement met by DN 141, 142 in freshman year and 12 hours of electives. Courses not limited to any specific departments but may include any courses which have humanities or social science orientation—normally courses from Anthropology (ANT), Economics and Business (ACC, EB), Foreign Languages (GRK, LAT, FLF, FLG, FLI, FLR, FLS), History (HI), Literature (ENG), Philosophy (PHI), Political Science (PS), Psychology (PSY), Religion (REL), Social Work (SW), Sociology (SOC), and University Studies (UNI).

THIRD YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Studio[2]	6	Studio[2]	6
Soc. Sci./Hum.[4]	3	Soc. Sci./Hum.[4]	3
Advised Elec.[5]	3	Advised Elec.[5]	3
Coare[6]	3	Core[6]	3
Core[6]	3		
	18		15

FOURTH YEAR

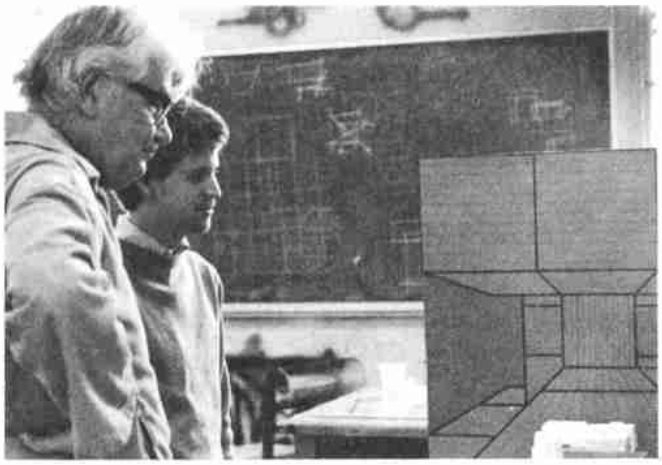
Fall Semester	*Credits*	*Spring Semester*	*Credits*
Advised Elec.[5]	3	Free Elec.	3
Free Elec.	3	Free Elec.	3
Free Elec.	3	Core[6]	3
Core[6]	3	Core[6]	3
Core[6]	3	Core[6]	3
	15		15

Hours Required for Graduation 129

[5] Advised electives are to be selected after consultation with the advisor. They may include studios and core courses from the School of Design or courses from the University at large but may not include credit for Art (ART), Military Science (AS, MS), Music (MUS) below 200 level, or Physical Education (PE).

[6] Each visual design student is required to take a minimum of one entry course in four of the six cores (Graphics and Communications, Behavior, Environment, History and Philosophy, Physical Elements and Systems, and Methods and Management). DF 101 and DF 102 satisfy this requirement for the Communications and Graphics Core, DN 141 and DN 142 satisfy this requirement for the History and Philosophy Core. In the remaining cores the entry courses are designated by "2" as the first digit in the course number. *Note:* A student in this program must also take the following which satisfy the core requirements: DN 415 and DN 416.

[7] In order to receive two degrees from School of Design a student must complete 30 credit hours above the 129 hour requirement. These 30 hours are to include 18 credits in 400 level studio and 12 credits in core courses above those described above.



A design student and professor examine the large scale interior view of a three dimensional model.

Biological sciences students run a behavioral experiment with drugged Siamese fighting fish.

The School of Textiles equipment includes machines used in the processing of both man-made and natural fibers.

At his convenience, a student in the Education Curriculum Materials Center can "dial" a program produced in another area or on film.

EDUCATION

Poe Hall

C. J. Dolce, *Dean*

R. T. Williams, *Associate Dean*

The School of Education is concerned with the problems of human development from both psychological and educational perspectives. With emphases upon the preparation of secondary and post-secondary school teachers, counselors, administrators and psychologists, the school seeks students who are dedicated to the improvement of mankind through education and service and who are sensitive to the complexity of the teaching/learning processes.

The School is composed of the Departments of Adult and Community College Education, Curriculum and Instruction, Mathematics and Science Education, Guidance and Personnel Services, Psychology and Occupational Education. The School also houses a national research center, the Center for Occupational Education.

Undergraduate degree programs are offered in agricultural education, industrial arts education, vocational industrial education, technical education, mathematics education, secondary education, science education and psychology.

Graduate degree programs are offered in adult and community college education, agricultural education, curriculum and instruction, educational administration and supervision, guidance and personnel services, industrial arts education, mathematics education, occupational education, psychology, science education, special education, and vocational industrial education.

Graduates of the undergraduate programs in education receive a Bachelor of Science degree in education and normally qualify for an "A" Certificate to teach in their chosen fields. Graduates of the undergraduate program in psychology receive a Bachelor of Arts in Psychology degree. Graduate programs confer the Master of Science or Master of Education degrees, and the Doctor of Philosophy or Doctor of Education degrees.

Professional education courses are provided for those students enrolled in the School of Liberal Arts who wish to become teachers of English, social studies, and modern foreign languages. Students enrolled in the School of Agriculture and Life Sciences, and science or mathematics departments, may also double-major in the School of Education and obtain a North Carolina teacher's certificate.

The modern School of Education building is named Poe Hall. It includes a curriculum materials center, an instructional materials production center, a computer facility, and a learning assistance center. The building houses laboratories for industrial arts, science, psychology, and guidance and testing activities, as well as a children's play area with an observation room. A closed circuit TV system with a studio has also been designed into the building.

Adult and Community College Education

(Also see Agriculture and Life Sciences.)

Poe Hall and Ricks Hall

Professor E. J. Boone, *Head of the Department*

Professor Curtis Trent, *Coordinator of Advising*

TEACHING, RESEARCH AND EXTENSION

Professors: M. Burt, M. Knowles; *Extension Professors:* W. L. Carpenter, J. D. George; *Adjunct Professors:* B. E. Fountain Jr., I. E. Ready Sr.; *Associate Professors:* J. C. Glass, W. L. Gragg, G. E. Parsons, R. W. Shearon; *Extension Associate Professors:* C. Black, M. Brown; *Visiting Associate Professor:* E. E. White; *Assistant Professors:* J. L. Compton, K. B. Segner III; *Extension Assistant Professors:* L. S. Brown, L. Hawkins, D. Proctor; *Adjunct Assistant Professors:* C. M. Barrett, C. J. Law Jr., J. R. Parrott Jr.

The adult and community college education faculty offers instruction at advanced undergraduate and graduate levels. Advanced undergraduate courses are designed to support other departments of the institution, giving students a background in adult and community college education. The department does not have a program leading to a bachelor's degree.

The graduate program is designed to increase the professional competence of adult and community college educators in developing and administering adult and community college education programs and in conducting scholarly research in the field. For graduate degrees, see pages 12-13 and the Graduate Catalog.

Agricultural Education

Poe Hall

Associate Professor J. R. Clary, *Coordinator of Advising*

Professors Emeriti: J. R. Kirkland, C. C. Scarborough; *Associate Professors:* C. D. Bryant, T. R. Miller; *Adjunct Assistant Professor:* W. R. Robinson

Agricultural education, in its broadest sense, encompasses areas of study which will enable one to participate effectively in planning, promoting and initiating programs in education in agriculture.

The department offers a program leading to a Bachelor of Science degree. Programs are designed for the teachers of vocational agriculture in the secondary schools, technical institutes and community colleges. For details of the master's degree programs (for degrees offered, see pages 12-13) consult the Graduate Catalog.

OPPORTUNITIES

The demand for agricultural education teachers exceeds present supply. Graduates who obtain certification in the Bachelor's degree program generally have a choice of positions in the Carolinas and Virginia and throughout the nation.

AGRICULTURAL EDUCATION CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
MA 111 Algebra and Trigonometry	4	Mathematics Elective**	3
BS 100 General Biology	4	Poultry Science or Animal Science Elective	4
Plant Science Elective*	3-4	History Elective	3
ED 102 Objectives in Agricultural Education	1	Agricultural Elective	3-4
Physical Education	1	Physical Education	1
	16-17		17-18

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EB 201 Economics I or EB 212 Economics of Agriculture	3	"B" Agricultural Elective	3
CH 101 General Chemistry I	4	CH 103 General Chemistry II	4
BAE 211 Farm Machinery	3	ED 313 Contemporary Vocational Agriculture	3
Agricultural Elective	3-4	Agricultural Specialty***	3-4
Physical Education	1	Physical Education	1
	14-15		14-15

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 344 School and Society	3	SSC 200 Soil Science	4
SOC 202 Principles of Sociology	3	Literature Elective	3
PSY 304 Educational Psychology	3	PSY 376 Human Growth and Development	3
Free Elective	3	Agricultural Specialty***	3-4
"A" or "B" Elective in Agriculture****	3-4	Speech Elective	3
		ED 490 Senior Seminar in Agricultural Education	1
	15-16		17-18

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 411H Student Teaching in Agriculture	8	Humanities Electives*****	6
ED 412H Teaching Adults	2	Agricultural Specialty***	3
ED 413H Planning Educational Programs	2	Political Science Elective	3
SOC 416A Research Methods	3	Free Electives	6
	15		18

Hours Required for Graduation 126

Curriculum and Instruction

Associate Professor B. M. Parramore, *Head*

Assistant Professor C. W. Harper Jr., *Coordinator of Undergraduate Advising*

Adjunct Professor: T. L. Roundtree; *Associate Professors:* L. J. Betts Jr., S. D. Ivie, T. N. Walters; *Adjunct Associate Professor:* H. G. Royall Jr.; *Associate Professor Emeritus:* P. J. Rust; *Assistant Professors:* B. G. Beezer, B. J. Fox, C. W. Harper Jr., D. R. Kniefel, C. C. Mahmoud; *Assistant Professor Emeritus:* K. A. McCutchen; *Instructor:* D. D. Girardi; *Teaching Technician:* J. R. Gibson

The Department of Curriculum and Instruction offers foundation and general courses required for all teacher educational programs. This department advises all unclassified undergraduate education students while they remain unclassified, and therefore not in a degree-granting program. The department also offers the Secondary Education program which is described below.

SECONDARY EDUCATION

The program in Secondary Education is designed to fulfill several objectives: Students who do not desire to teach, but who are interested in education as a field of study enroll in this program. The basic curriculum provides a relatively large number of free electives. Students who wish to prepare for teaching in newly-developing fields for which no teacher preparation programs have been developed may also select this program. This allows for the development of a particular specialty in depth, depending upon student interest. Those Liberal Arts students interested in preparing to be teachers of English (majors in English) and social studies (majors in history, sociology, economics and political science) may also declare a double major in order to receive a degree in education as well as in liberal arts. Students in English and social studies education follow basically the same programs of study as those enrolled in the School of Liberal Arts.

OPPORTUNITIES

Students earning a degree in this program generally have the same options as graduates of related programs: teaching in secondary schools, graduate study, or employment in governmental and private agencies involved in formal or non-formal education.

GRADUATE STUDY

The Department of Curriculum and Instruction offers graduate programs designed to prepare directors of instruction/curriculum specialists related to the student's teaching field, and researchers in curriculum development and the teaching-learning process. For a list of graduate degrees see pages 12-13 and consult the Graduate Catalog.

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* Includes courses in crop science, horticulture or forestry.

** Select from MA 102, 112, 114, 122.

*** These three courses, when related to other ALS courses, should total a minimum of 12 semester hours for a "specialty" in ALS.

**** Select from "A" or "B" electives in agriculture and related to "specialty." (Consult pages 00-00 for listing of "A" and "B" courses in School of Agriculture and Life Sciences.)

***** Humanities electives should be selected from the areas of philosophy, religion, art, and/or music.

SECONDARY EDUCATION CURRICULUM*

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Reading	3
MA 111 Algebra & Trigonometry	4	MA 112 Analytic Geometry and Calculus A	4
History	3	History	3
Social Science	3	Social Science	3
Physical Education	1	PSY 200 Introduction to Psychology	3
	14	Physical Education	1
			17

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Literature	3	Literature	3
Natural Science	3-5	Natural Science	3-5
Speech	3	ED 205 Introduction to Teaching Humanities & Social Studies	3
PHI 205 Problems & Types of Philosophy	3	Electives	3
Social Science	3	Social Science	3
Physical Education	1	Physical Education	1
	16-18		16-18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PSY 304 Educational Psychology	3	PSY 376 Human Growth and Development	3
ED 344 School & Society	3	ED (SOC) 318 Introduction to the Sociology of Education	3
Natural Science	3-5	Electives	6
Electives	3	Social Science	3
Social Science	3		15
	15-17		

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PSY 370 Psychology of Personality & Adjustment	3	ED 496 Senior Seminar in Education	3
ED 483 An Introduction to Instructional Media	3	ED 420 Principles of Guidance	3
ED (PHI) 304 Philosophy of Education	3	ED 440 Vocational Education	2
Electives	6	Electives	6
	15		14
		Hours Required for Graduation	124-128

Special Education

Assistant Professor C. C. Mahmoud, *Coordinator of Advising*

Adjunct Associate Professor: H. G. Royall Jr.; *Assistant Professor Emeritus:* K. A. McCutchen

The program in special education is designed for educators who wish to pursue advanced study relating to the learning problems and the education of children and youth. This program offers a general background in all areas of exceptionality, intellectual, physical and emotional, with specialization in mental retardation and sensory impairment. There is no undergraduate program in this field at North Carolina State University, but graduate degrees are offered. For further information consult the Graduate Catalog, pages 12-13.

* This is a general program outline. Those seeking a double major follow the program outline listed for their academic area by Liberal Arts.

Education Administration and Supervision

Professor C. J. Dolce, *Coordinator of Advising*

Adjunct Professor: A. C. Phillips; *Assistant Professors:* D. R. Kniefel, R. T. Williams

There is no undergraduate program in this field. Graduate programs are individually designed by the student in consultation with the program staff (for degrees, see pages 12-13. These programs prepare the student for a variety of administrative, supervisory or policy-making roles. For further information consult the Graduate Catalog.

Guidance and Personnel Services

Poe Hall

Professor W. E. Hopke, *Head of the Department and Coordinator of Advising*

Professor Emeritus: C. G. Morehead; *Associate Professors:* L. K. Jones, B. C. Talley Jr.; *Assistant Professors:* D. C. Locke, J. G. McVay; *Adjunct Assistant Professors:* M. A. Connors Jr., R. H. Massengill, C. L. Quinn

The department offers work leading to graduate degrees (see pages 12-13) with a major in guidance and personnel services (or counselor education). The degrees are designed to prepare individuals for guidance and personnel positions at various levels in elementary and secondary schools, junior and community colleges, trade and technical schools and institutes, and other institutions of higher education. For further information consult the Graduate Catalog.

Industrial Arts Education

Poe Hall

Associate Professor T. B. Young, *Coordinator of Advising*

Professors Emeriti: I. Hostetler, D. W. Olson; *Associate Professor:* G. E. Baker; *Assistant Professor:* R. T. Troxler; *Instructor:* H. T. Leeper

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

The industrial arts education curriculum performs the function of preparing teachers and supervisors of industrial arts for secondary schools.

OPPORTUNITIES

The graduates of the industrial arts program find opportunities for employment in the public schools. For graduate degrees offered see pages 12-13 and consult the Graduate Catalog.

INDUSTRIAL ARTS EDUCATION CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
IA 111 Intro. to Industrial Arts	1	IA 122 Metal Technology I	3
E 101 Engineering Graphics I	2	SOC 202 Prin. of Sociology	3
IA 115 Wood Processing I	3	MA Elective	3
MA 111 Algebra and Trigonometry	4	ENG 112 Composition and Reading	3
ENG 111 Composition and Rhetoric	3	Humanities or Soc. Sciences	3
Physical Education	1	Physical Education	1
	14		16

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
IA 231 Industrial Arts Design or Approved Design Elective	3	IA 246 Graphic Technology	3
CH 111 Foundations of Chemistry	4	PY 221 College Physics	5
Literature Elective	3	PSY 304 Educational Psychology	3
Economics Elective	3	ED 242 Intro. to Teaching Ind. Arts	3
IA 233 Metal Technology II	3	Elective	3
Physical Education	1	Physical Education	1
	17		18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
IA 359 Electrical Technology I	3	ED 362 Phil. Curr. & Methods in Industrial Arts	4
PSY 376 Human Growth & Development	3	IA 368 Technical Drawing II	3
IA 351 General Ceramics	3	IA 364 Wood Technology II	3
ED 344 School and Society	3	IA 360 Electrical Technology II	3
Electives	6	Elective (Speech)	3
	18		16

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 473 Student Teaching in Ind. Arts	8	IA Elective	3
ED 479 Laboratory Planning & Mgmt.	3	Political Scence or History	3
IA 476 Power Technology	3	IA 480 Modern Industries	3
	14	Humanities or Soc. Sci.	6
			15

Hours Required for Graduation 128

Industrial and Technical Education

Poe Hall

Professor D. M. Hanson, *Coordinator of Advising*

Professor Emeritus: J. T. Nerden; *Associate Professor:* F. S. Smith; *Assistant Professor:* T. C. Shore Jr.; *Instructor:* W. M. Parker

The Industrial and Technical Education program offers curricula to prepare teachers, supervisors and administrators for the public schools, area vocational schools, community colleges and technical institutes. Complete four-year curricula in vocational industrial education and technical education lead to the Bachelor of Science in education. The curricula are planned to provide students with broad cultural and professional backgrounds to parallel occupational experience.

The program offers graduate degrees (see pages 12-13). For further information consult the Graduate Catalog.

VOCATIONAL INDUSTRIAL EDUCATION

The curriculum in vocational industrial education is designed to prepare vocational teachers for the secondary schools, area vocational schools and post-secondary school vocational programs. Upon satisfactory completion of the curriculum the graduate is qualified to teach in any of the aforementioned vocational areas.

OPPORTUNITIES

Graduates of the vocational industrial education curriculum have a wide selection of employment opportunities. The rapid growth of the vocational programs in the secondary schools in all fields has created an urgent demand for vocational teachers. A student may qualify for teaching positions in introduction to industrial education, trade preparatory training and industrial cooperative training in these fast-growing programs in the secondary schools. Other opportunities include teaching in the area vocational schools, in industry and in the post-secondary schools.

VOCATIONAL INDUSTRIAL EDUCATION CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 100 Introduction to Industrial Education	2	History Elective	3
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
MA 111 Algebra & Trigonometry	3-4	MA 122 Math of Finance or Mathematics Elective	3
or		Drafting Elective	3-4
MA 115 Introduction to Contemporary Mathematics		Physical Education	1
CH 111 Foundations of Chemistry or Elective	4	Elective	3
Physical Education	1		16-17
	13-14		

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Physics Elective	3-4	SOC 202 Principles of Sociology	3
Speech Elective	3	EB 201 Economics I	3
PS 201 The American Governmental System	3	ED 305 Analysis of Technical Education Programs & Course Construction	3
Physical Education	1	ED 327 History & Philosophy of Industrial & Technical Education	3
Electives	6	PE 280 Emergency Medical Care and First Aid	2
	16-17	Physical Education	1
		Elective	3
			18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 344 School & Society	3	PSY 376 Human Growth and Development	3
IE 355 Occupational Safety & Health	3	ED 428 Organization of Related Study Materials in Vocational Education	
ED 421 Principles & Practices in Industrial Cooperative Training		or	
or		ED 405 Industrial and Technical Education Shop & Laboratory Planning	3
ED 405 Industrial & Technical Education Shop & Laboratory Planning	3	ED 440 Vocational Education	2
PSY 304 Educational Psychology	3	ED 422 Methods of Teaching Vocational Industrial/Technical Education	3
ED 420 Principles of Guidance	3	ED 483 An Introduction to Instructional Media	3
Elective	3	Elective	3
	18		17

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 444 Student Teaching in Voc. Ind./Tech. Educ.	8	Economics Elective	3
ED 457 Organization & Management of Youth Club Activities	3	Sociology Elective	3
ED 496 Senior Seminar in Education	3	English Elective	3
	14	Elective	6
			15
		Hours Required for Graduation	127

Twelve hours of electives must be selected in accordance with the student's area of specialization and with the approval of the advisor. The remaining hours may be taken as free electives.

TECHNICAL EDUCATION

The curriculum in technical education is oriented toward preparing instructors within a wide range of teaching technologies and is closely coordinated with existing engineering curricula. A student enrolling in the technical education curriculum may specialize to some extent in areas related to interest and/or previous work experience. Admission to the technical education curriculum is limited to students demonstrating proficiency in a given applied technology, i.e., electrical, electronics, mechanical, etc.

OPPORTUNITIES

Employment opportunities for technical education graduates include teaching in the expanding community college complex, technical institutes, area vocational schools and within industry as instructors and coordinators of training programs. The growth of technical education in the nation and the large number of new technical education facilities being constructed will require an increasing number of instructors to staff teaching positions.

TECHNICAL EDUCATION CURRICULUM*

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry I	4	EB 201 Economics I	3
ED 100 Introduction to Industrial Education	2	ENG 112 Composition and Reading	3
ENG 111 Composition and Rhetoric	3	MA 102 Analytic Geometry and Calculus I	4
MA 111 Algebra and Trigonometry	4	PS 201 The American Governmental System	3
Physical Education	1	Physical Education	1
	14		14

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
E 101 Engineering Graphics I	2	PSY 200 Introduction to Psychology	3
English Elective	3	PY 208 General Physics or	
MA 201 Analytic Geometry & Calculus II	4	PY 212 General Physics	4
PY 205 General Physics or		Electives**	6
PY 211 General Physics	4	Physical Education	1
Physical Education	1		14
	14		

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 327 History & Philosophy of Industrial & Technical Education	3	ED 305 Analysis of Technical Education Programs & Course Construction	3
PSY 304 Educational Psychology	3	SOC 401 Human Relations in Industrial Society	3
SOC 202 Principles of Sociology	3	Electives**	9
Electives**	6		15
	15		

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 405 Industrial & Technical Education Shop and Laboratory Planning	3	ED 444 Student Teaching in Voc. Ind./Tech. Education	8
ED 422 Methods of Teaching Industrial Subjects	3	Electives**	7
Electives**	9		15
	15	Hours Required for Graduation	116

Mathematics and Science Education

Poe Hall

Professor H. E. Speece, *Head of the Department and Coordinator of Advising*

Professors: N. D. Anderson, L. M. Clark, J. R. Kolb; *Associate Professors:* R. D. Simpson, W. M. Waters Jr., L. W. Watson; *Associate Professor Emeritus:* H. A. Shannon; *Adjunct Assistant Professors:* E. G. Blakeway, R. R. Jones, C. M. Meek

* Students will be expected to demonstrate proficiency in the applied technology of his or her choice—may be fulfilled by technical institute training or selected courses in addition to those required for the degree.

** Minimum of 27 hours of elective courses must be selected from engineering, engineering sciences, physical sciences, etc., in accordance with the student's area of specialization and with the approval of the adviser. Remaining hours may be taken from free electives.

The Department of Mathematics and Science Education offers a program for preparing undergraduate students as teachers of mathematics and science. The programs are designed to provide a broad background in the natural sciences, social sciences and humanities; depth in mathematics or an area of science; and the development of professional competencies needed by teachers entering the schools of today. The depth of preparation will enable students to pursue programs of graduate studies. (See pages 12-13 and the Graduate Catalog.)

OPPORTUNITIES

The demand for qualified mathematics and science teachers in our schools and colleges provides opportunities for mathematics and science education graduates. Developments in the schools and in our society accentuate the importance of preparation and competence in teaching, and this is reflected in increased salaries, opportunities for graduate study and professional advancement.

MATHEMATICS EDUCATION CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Reading	3
PHI 201 Logic	3	MA 201 Analytic Geom. & Calc. II	4
MA 122 Math of Finance	3	History Elective	3
MA 102 Analytic Geom. & Calc. I	4	†Human/Soc. Sci. elective	3
Physical Education	1	Physical Education	1
ED 101 Orientation	0	CSC 111 Algroithmic Lang. I	2
		or	
		CSC 101 Intro to Programming	3
	14		16-17

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 202 Analaytic Geom. & Calc. III	4	Math elective	3
*Science	4	*Science	4
Literature elective	3	ST 372 Intro. to Stat. Inf. & Reg.	2
ST 371 Intro. Prob. & Dist. Theo.	2	ED 203 Intro. Teaching Ma./Sci.	3
†Human/Soc. Sci. elective	3	ED 203L Intro. Teaching Ma./Sci. Lab.	0
Physical Education	1	Speech elective	3
		Physical Education	1
	17		16

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 101J Orientation	0	ED 101J Orientation	0
MA 403 Intro. to Mod. Alg.	3	MA 408 Found. Euclidean Geom.	3
PSY 304 Educational Psychology	3	ED 344 School & Society	3
Math elective	3	MA 433 History of Mathematics	3
**Supporting elective	3	**Supporting elective	3
†Human/Soc. Sci. elective	3	†Human/Soc. Sci. elective	3
Elective	3	PSY 476 Psych. of Adoles. Dev.	3
	18		18

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
††ED 495 Sr. Seminar in Ma./Sci. Ed.	1-3	**Supporting elective	3
††ED 470 Methods of Teach. Math	3	Math elective	3
††ED 471 Stud. Teach. in Math	8	†Human/Soc. Sci. elective	3
††ED 472 Dev. & Sel. Tea. Mat. Ma.	2	Elective	3
		Elective	3
	15		15

Hours Required for Graduation 129

* Science must be 2-semester sequence in chemistry or physics.

** Supporting electives must be an approved sequence in science, math, computer science, statistics, economics, philosophy, history of science, sociology, psychology.

† The humanities/social sciences electives must be chosen so that 6 hours are in humanities and 9 hours are in the social sciences. Humanities include: philosophy, religion, literature, fine arts, history, or foreign languages. Social sciences include: economics, sociology, anthropology, political science, psychology and geography.

†† These courses are taken as a block in the professional semester.

SCIENCE EDUCATION CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Religion	3
AM 102 Analytic Geom. & Calc. I[1]	4	MA 201 Analytic Geom. & Calc. II[1]	4
or		or	
MA 112 Analytic Geom. & Calc. A	4	MA 212 Analytic Geom. & Calc. B	3
CH 101 Gen. Chemistry I	4	CH 103 Gen. Chemistry II	4
Humanities/Soc. Sciences[2]	3	or	
Physical Education	1	CH 107 Prin. Chem.	4
ED 101 Orientation	0	Biological Sci. elective	4
	15	Physical Education	1
			15-16

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 211 General Physics[3]	4	PY 212 General Physics[3]	4
Speech elective	3	ED 203 Intro. Teaching Math./Sci.	3
Required science	3	Humanities/Soc. Sci.[2]	3
Elective	3	Physical Education	1
Physical Education	1	Required science[4]	6
Humanities/Soc. Sci.[4]	3		17
	17		

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PSY 304 Educational Psychology	3	ED 344 School and Society	3
Humanities/Soc. Sci.[2]	3	Humanities/Soc. Sci.[2]	3
Required science[4]	7	Required science[4]	7
HI 321 Ancient & Med. Science	3	PSY 476 Psych. Adol. Development	3
or			16
HI 322 Rise of Modern Science	3		
or			
PHI 405 Philosophy of Science	3		
	16		

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ED 475 Methods of Teach. Sci.[5]	3	Humanities/Social Sci.[2]	6
ED 476 Student Teaching in Sci.[5]	8	Electives	6
ED 477 Instructional Materials In Science	2	Required science[4]	4
ED 495 Sr. Sem. in Math./Sci. Ed.[5]	2		16
	15		

Hours Required for Graduation 127

SCIENCE EDUCATION SPECIALIZATION REQUIREMENTS (27 hours)

BIOLOGY SPECIALIZATION:

Survey of Plant Life (BO 200)	4
Survey of Animal Life (ZO 201)	4
Introductory Organic Chemistry (CH 220)	4
Genetics (GN 301 or GN 411, 412)	3-4
Ecology (BO/ZO 360)	4
General Microbiology (MB 401)	4
Plant Physiology (BO 421)	
or	
Vertebrate Physiology (ZO 421)	3-4
or	
Cell Biology (ZO/BO 414)	

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[1] Required of those specializing in Chemistry or Physics.

[2] To be selected as follows from the Humanities and Social Sciences:

One course in history ..... 3 s.h.
One course in literature ..... 3 s.h.
Two additional courses from any of the following humanities:
Fine Arts, Foreign Language, History, Literature, Philosophy, Religion .... 6 s.h.
Three courses from any of the following social sciences:
Anthropology, Economics, Geography, Political Science, Scoiology, Psychology ..... 9 s.h.

[3] Students may elect to take PY 205 and PY 208 or PY 201, 202, and 203 in lieu of PY 211-212.

[4] Students are required to take a minimum of 27 semester hours in one of four areas of specialization (biology, chemistry, physics, or earth science).

[5] These courses are taken as a block in the professional semester (offered only during the fall semester for Science Education students).

CHEMISTRY SPECIALIZATION:

Organic Chemistry	4
Analytic Chemistry	4
Physical Chemistry	4
MA 202 Analytic Geometry & Calculus III	4
Earth Science Elective	3
Chemistry Electives	8

EARTH SCIENCE SPECIALIZATION:

GY 120 Physical Geology—GY 110 Physical Geology Laboratory	3
GY 222 Historical Geology	3
MY 201 Atmospheric Environment or MY 411 Introductory Meteorology	3
PY 223 Astronomy	3
OY (MAS) 200 Introduction to the Marine Environments	3
Earth Science Electives	12

PHYSICS SPECIALIZATION:

PY 223 Astronomy	3
PY 407 Introduction to Modern Physics or PY 203 General Physics	3-4
MA 202 Analytic Geometry & Calculus III	4
Earth Science Elective	3
Physics-Mathematics Electives	13-14

Occupational Education

Professor J. K. Coster, *Coordinator of Advising*

Professor: D. M. Hanson; *Professors Emeriti:* I. Hostetler, J. B. Kirkland, J. T. Nerden, D. W. Olson, C. C. Scarborough; *Adjunct Professor:* B. E. Childers; *Associate Professors:* G. E. Baker, C. D. Bryant, J. R. Clary, T. R. Miller, F. S. Smith, T. B. Young; *Adjunct Associate Professors:* W. J. Brown Jr., C. H. Rogers; *Assistant Professors:* W. L. Cox Jr., T. C. Shore Jr.; *Adjunct Assistant Professor:* W. R. Robinson.

Occupational education involves a study of the occupational structure of society, manpower requirements, and the functions of vocational education.

There is no undergraduate program in occupational education. However, undergraduate courses are offered which support vocational education programs. The Division of Occupational Education offers programs which lead to graduate degrees (see pages 12-13). For further information consult the Graduate Catalog.

Psychology

Poe Hall

Professor H. G. Miller, *Head of the Department and Coordinator of Advising*

Professors: H. M. Corter, J. W. Cunningham, D. W. Drewes, J. C. Johnson, S. E. Newman, R. G. Pearson; *Professor Emeritus:* K. L. Barkley; *Associate Professors:* J. L. Cole, T. E. LeVere, J. E. R. Luginbuhl, R. F. Rawls, J. L. Wasik, B. W. Westbrook; *Associate Professor Emeritus:* J. W. Magill; *Adjunct Associate Professors:* B. A. Norton, R. W. Oppenheim, M. N. Wiebe; *Assistant Professors:* D. L. Chmielewski, V. G. Cowgell, P. D. Green, K. W. Klein, D. H. Mershon, F. J. Smith, L. S. Taylor; *Adjunct Assistant Professors:* B. C. Ball, B. F. Corder, C. L. Kronberg, L. D. Silber

Psychology is one of the basic university disciplines. Mastery of some of the knowledge in psychology is necessary to practitioners in education, health, social service, social sciences and managerial professions.

The undergraduate program in psychology consists of a general major and two optional programs—human resource development and experimental psychology. The general option is flexible and may be chosen by students who wish to prepare for entry into professional and graduate study. The program flexibility enables them to choose elective courses which prepare them for the graduate program of their interest. Human resource development is designed to educate students in specific psychology and human interaction skills which will qualify them to enter human development occupations upon graduation. The occupations may include corrections, mental health, education, etc. The experimental option emphasizes the development of competence in the use of the experimental method in accumulating scientific knowledge. In this option substantial work in physical science, biological science and mathematics is required.

The Department of Psychology offers graduate programs (see pages 12-13). For further information see the Graduate Catalog.

OPPORTUNITY

Students holding the bachelor's degree in psychology and wishing to apply their psychological studies in a professional capacity generally continue their education in a graduate program such as clinical or experimental psychology, or in such fields as law, medicine, business, social work and a variety of other fields. Students in psychology may also choose to enter business or government, often without further training beyond the bachelor's degree.

EXPERIMENTAL OPTION

The Experimental Option is designed for those students who are interested in training in experimental psychology, either as preparation for graduate training in psychology or as preparation for other professional advanced training.

The Experimental Option differs from the other options open to majors in psychology both in courses in the major area and in the distribution of requirements. A strong background in mathematics and the physical and biological sciences is required of all students in the Experimental Option. In place of the Senior Seminar, currently required of other psychology majors, all students in the Experimental Option are required to take a sequence of laboratory courses in their junior and senior years to gain experience in the design and conduct of laboratory research in experimental psychology.

REQUIREMENTS

I. Major Area Courses:

PSY 200	Introduction to Psychology	3
PSY 300	Perception	3
PSY 310	Learning and Motivation	3
PSY 320	Cognitive Processes	3
PSY 400	Perception: Research Methods	3
PSY 410	Learning and Motivation: Research Methods	3
PSY 420	Cognitive Processes: Research Methods	3
PSY 430	Neuropsychology: Research Methods	3
PSY 505	History and Systems of Psychology	3
		27

II. Mathematics and Science Courses:

MA 112	Analytic Geometry and Calculus A (4) or MA 102 Analytic Geometry and Calculus I (4)	4
MA 212	Analytic Geometry and Calculus B (3) or MA 201 Analytic Geometry and Calculus II (4)	3
MA 114	Intro. to Finite Math. with Applications	3
ST 311	Introduction to Statistics	3
CSC 101	Introduction to Programming (3) or CSC 111 Algorithmic Languages I (2) or CSC 462 Computing for the Social Sciences (3)	2-3
BS 100	General Biology (4) or BS 105 Biology in the Modern World (4)	4
GN 411	The Principles of Genetics	3
	Chemistry or Physics (a two-semester sequence in either)	8
		30-31

III. Humanities and Social Sciences

Logic and Philosophy of Science (any two courses)	6
Philosophy (one advised elective in addition to above)	3
English Composition (normally ENG 111 and 112)	6
English, American, or other Literature (two courses)	6
History (two courses)	6
Social Science, not including Psychology (two courses)	6
	33

IV. Physical Education 4

V. Electives

Advised Electives	12
Free Electives	18
	30

Hours Required for Graduation 124

SAMPLE CURRICULUM: Experimental Option

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 112 Ana. Geom. Calc. A or MA 102 Ana. Geom. Calc. I	4	MA 212 Ana. Geom. Calc. B or MA 201 Ana. Geom. Calc. II	3-4
BS 100 General Biology or BS 105 Bio. Mod. World	4	PSY 200 Intro. to Psychology	3
ENG 111 Comp. and Rhetoric	3	ENG 112 Comp. and Reading	3
Elective	3	PHI Logic or Philosophy of Science	3
Physical Education	1	Elective	3
		Physical Education	1
	15		16-17

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 114 Intro. to Finite Math with Applications	3	Social Science*	3
Literature	3	Literature	3
History	3	History	3
PSY 300 Perception	3	PHI Logic or Philosophy of Science	3
Physical Science I	4	Physical Science II	4
Physical Education	1	Physical Education	1
	17		17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PSY 310 Learning and Motivation	3	PSY 320 Cognitive Processes	3
PSY 400 Perception: Res. Meth.	3	PSY 410 Learn and Motiv: Res. Meth.	3
GN 411 Princ. Genetics	3	Elective (Advised)	3
ST 311 Intro. to Stat.	3	Computer Science	2-3
Elective	3	Elective	3
	15		14-15

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PSY 420 Cognit. Proc.:Res. Meth.	3	PSY 430 Neuropsy: Res. Meth.	3
Philosophy elective	3	PSY 505 Hist. & Syst. of Psych.	3
Social Science*	3	Elective (Advised)	3
Elective (Advised)	3	Elective (Advised)	3
Elective	3	Elective	3
	15		15

Hours Required for Graduation 124

HUMAN RESOURCE DEVELOPMENT OPTION CURRICULUM

FRESHMAN YEAR

	Credits		
Mathematics	6	Biology	4
English Composition	6	Psychology 200	3
History	6	Physical Education	2
Sociology	3	Elective	3
			33

SOPHOMORE YEAR

	Credits		
Natural Science	6-8	English Literature	6
Statistics	3	Elective	3
Psychology & Social Science	9	Physical Education	2
Philosophy	3		32-34

* Not psychology

JUNIOR YEAR

	Credits
Speech 231	3
Psychology 350	4
Psychology 351	4
Psychology 352	4
	15
Psychology 493	4
Psychology 495	8
	12
	27

SENIOR YEAR

	Credits
Psychology 491	3
Psychology 492	3
Philosophy	3
Electives	24
	33
Hours Required for Graduation	125

PSYCHOLOGY: GENERAL CURRICULUM

FRESHMAN YEAR

Fall Semester	Credits	*Spring Semester*	Credits
Mathematics	3-4	Mathematics	3-4
English Composition	3	English Composition	3
Biological Science	4	PSY 200 Introduction to Psychology	3
Elective	3	Philosophy	3
Physical Education	1	Elective	3
	14-15	Physical Education	1
			16-17

SOPHOMORE YEAR

Fall Semester	Credits	*Spring Semester*	Credits
PSY 210 Psychological Analysis Applied to Current Problems	3	PSY 300 Perception	3
Natural Science	3-4	Natural Science	3-4
History	3	History	3
Sociology	3	Statistics	3
Psychology Elective	3	Psychology Elective	3
Physical Education	1	Physical Education	1
	16-17		16-17

JUNIOR YEAR

Fall Semester	Credits	*Spring Semester*	Credits
PSY 310 Learning & Motivation	3	PSY 320 Cognitive Processes	3
Literature	3	Literature	3
Social Science	3	Social Science	3
*Electives	6	*Electives	6
	15		15

SENIOR YEAR

Fall Semester	Credits	*Spring Semester*	Credits
PSY 491 Seminar in Psychology	3	PSY 492 Seminar in Psychology	3
Philosophy	3	Elective	3
Social Science	3	*Electives	9
*Electives	6		15
	15	Hours Required for Graduation	124

* Advised Electives

Special Education

(See Curriculum and Instruction, page 99.)

ENGINEERING

Riddick Hall

R. E. Fadum, *Dean*

J. F. Ely, *Associate Dean for Academic Affairs*

H. B. Smith, *Associate Dean for Research and Graduate Studies*

J. R. Hart, *Assistant Dean for Extension*

The engineer has the responsibility and obligation to use knowledge in his field for the benefit of mankind. Today, a new sense of responsibility has been imposed upon the engineer because of the impact of science and technology.

Engineering studies are important to those young men and women who look to industry, engineering education, or research and development for a career. These ambitions can well be furthered by the School of Engineering through its undergraduate or graduate programs, where students are offered technical instruction and leadership guidance by an experienced staff of qualified engineering educators.

The School of Engineering is organized into eight departments: biological and agricultural, chemical, civil, electrical, industrial, materials, mechanical and aerospace, and nuclear. Undergraduate degree programs are offered in all departments listed. In addition, a degree in engineering operations is offered through a curriculum coordinator. Most teaching departments offer advanced studies leading to the professional degree, the master's degree and the Doctor of Philosophy degree. See pages 12-13 for a complete list.

A career guidance and placement office is maintained by the University to assist graduating students and alumni.

The School of Engineering's curricula more than meet the standards of the Engineers' Council for Professional Development. It is the ambition of the school that these curricula and programs meet the needs of the people and industries of the state and region through effective instruction, competent research and development and worthwhile contributions to engineering knowledge.

CURRICULA AND DEGREES

The freshman year is the same in all engineering curricula. Entering students are assigned to the Freshman Engineering and Student Services Division where each student is given advice in planning an appropriate program of study. Although the entering student may indicate a curriculum choice, he or she may wait until the end of the first year when one is in a better position to judge which engineering branch of study is most suited to one's own interests and talents.

Bachelor of Science in Engineering—The four-year program provides preparation for graduate school or to meet the needs of young people who will go into industry in the fields of design, development, production, sales, application, and planning and operation of industrial units.

The four-year curricula offer programs of study leading to a bachelor's degree in aerospace, biological and agricultural, chemical, civil, electrical, engineering operations, industrial, materials, mechanical and nuclear engineering.* Construction engineering is an option in civil engineering. Graduation requirements are the satisfactory completion of the electives and required courses in any one curriculum which amount to 125 to 130 semester hours. University regulations allow a maximum of twelve hours of "D" grades to be counted towards graduation requirements. Of this number, a maximum of six hours may be in engineering courses.

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* ENGINEERING SCIENCE AND MECHANICS—Students enrolled in Engineering Science and Mechanics prior to July 1, 1976 should consult the 1975-77 Undergraduate Catalog for the curriculum requirements for a bachelor's degree in Engineering Science and Mechanics.

Specialized Degree—A specialized Bachelor of Science degree is offered through a program of study in furniture manufacturing and management. This four-year curriculum is offered through the Department of Industrial Engineering.

Joint Liberal Arts-Engineering Program—Students may wish to combine a Bachelor of Science in Engineering with either a Bachelor of Science or Bachelor of Arts in Liberal Arts. When the two are carried along together, the double degree program can be completed in five years. Those interested should contact the Freshman Engineering and Student Services Division and the Dean of Liberal Arts.

Professional Degree in Engineering—The School of Engineering offers professional curricula leading to the degrees Chemical Engineer, Civil Engineer, Electrical Engineer, Industrial Engineer, Materials Engineer, Mechanical Engineer and Nuclear Engineer. A program of study is designed to fit the needs of students desiring intensive specialization in a particular field or additional work not ordinarily covered in the normal four-year undergraduate curricula.

Professional course work is emphasized rather than research. The curriculum consists of a minimum of 30 credits making up a planned program designed to fit the student's objective. Typical programs are available in the various departmental offices.

ADMISSION

Applicants who hold the bachelor's degree in engineering 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 program requirements.

Application should be filed in the office of the dean of the School 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 University who plans to undertake a professional program and who has fulfilled all requirements for the bachelor's degree, except for a few courses, may be permitted to enroll in courses for credit toward the professional degree provided the student has given notice of his purpose to the dean of the School of Engineering.

2) A limited amount of credit to be applied toward the requirements for the professional degree may be transferred to N. C. State from other institutions offering advanced work in engineering. Transfer of credit must be recommended by the head of the department in which the student does his major work and approved by the Dean of Engineering.

3) Professional students are classified as post-baccalaureate students and are subject to rules and regulations established by the Dean of Engineering.

4) Grades for completed courses are reported to the Dean of Engineering and to Registration and Records. 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 Engineering.

6) Each professional student will be assigned an adviser in his or her major area. The adviser assists the student in preparing a program of study and counsels him or her in academic work. The student is required to prepare, with adviser's assistance, a complete plan of study before the end of the first semester in residence. This program of study is subject to approval by the Dean of Engineering.

HONORS PROGRAM

The Engineering Honors Program provides enriched educations for academically talented juniors and seniors. The opportunities which distinguish this program from standard programs of study are: 1) considerable flexibility in designing individual programs, 2) special courses for honors students, 3) special seminars, 4) individual study or research with a personally chosen professor. Each department has an honors adviser who can provide further information.

COOPERATIVE EDUCATION PROGRAM

A program of cooperative education began in 1968-69 in Engineering. The optional program is planned such that the student may alternate semesters of study with semesters of work during the sophomore and junior academic levels. The freshman and senior years are spent on campus while the sophomore and junior academic levels are spread over a three-year period to permit the interfacing of the academic semesters with practical work experience semesters. The co-op plan requires five years for completion during which time the student receives approximately 18 months of practical experience.

Students in all curricula in Engineering may participate if they have a grade-point average of 2.25 or better. After a student is accepted, he or she is expected to maintain at least a 2.00 grade-point average. Application for admission into the co-op program should be made early in the fall semester of the freshman year; however, later applications resulting in fewer work semesters prior to graduation will be considered during the sophomore year or the first semester of the junior year. Further information may be obtained from the Director of Cooperative Engineering Education, 236 Riddick Building.

STUDENT ACTIVITIES

Each curriculum in the School of Engineering has a technical society open to every student enrolled in the curriculum. In most cases, these are student chapters of national professional organizations. Each department also has one or more honor societies to give recognition to those with superior academic records. All students are encouraged to participate in these activities as part of their professional education. These organizations together form the Engineers' Council, the coordinating agency for students in their school-wide activities such as Open House and St. Patrick's Day Dance.

HUMANITIES AND SOCIAL SCIENCES

The educated engineer has a foundation in humanities and social sciences as well as in technical studies. Each student in Engineering is required to take a minimum of 18 hours of humanities and social sciences, approved by his or her adviser, and make up as follows:

One beginning course in economics (usually EB 201)
One beginning course in history
One beginning course in literature; suggested courses are:
- ENG 205 Studies in Great Works of Literature
- ENG 206 Studies in Drama
- ENG 207 Studies in Poetry
- ENG 208 Studies in Fiction

One course in the history or philosophy of science; suggested courses are:
- HI 321 Ancient and Medieval Science
- HI 322 Rise of Modern Science
- HI 341 Technology in History
- PHI 405 Philosophy of Science
- UNI 301 Science and Civilization
- UNI 302 Contemporary Science and Human Value

NOTE: The 18 hours humanities-social science series are *NOT FREE ELECTIVES*; therefore, by University rules, *CANNOT* be taken on a pass/fail basis. Free elective courses in the humanities and social sciences field, however, can be taken on a pass/fail basis.

Other courses may be chosen from the list below. Students are encouraged to combine courses into a two or three course set, thus providing depth in one area.

Consideration will be given to courses not on the list if a student has a special interest. In selecting courses the student should check carefully to be sure he or she has the appropriate prerequisites.

LIST OF COURSES

Anthropology Courses

ANT 252 Cultural Anthropology
ANT 305 Peoples of the World

Economics Courses

EB 201 Economics I
EB 301 Production and Prices
EB 302 Aggregate Economic Analysis: Theory & Policy
EB 304 Financial Institutions
EB (HI) 370 Rise of Industrialism
EB (HI) 371 Evolution of the American Economy
EB 410 Public Finance
EB 413 Competition, Monopoly, and Public Policy
EB 431 Labor Economics
EB 440 Economic Development
EB 442 Evolution of Economic Ideas
EB 448 International Economics
EB 475 Comparative Economic Systems

With consent of instructor, EB 201 may be accepted as a prerequisite for all courses now requiring EB 202.

Genetics Courses

GN 301 Genetics in Human Affairs
GN 504 Human Genetics

History Courses

All undergraduate history courses except HI 492 are appropriate.

Literature Courses

ENG 205 Studies in Great Works of Literature
ENG 206 Studies in Drama
ENG 207 Studies in Poetry
ENG 208 Studies in Fiction
ENG 261 English Literature I
ENG 262 English Literature II
ENG 265 American Literature I
ENG 266 American Literature II
ENG 346 Literature of the Western World I
ENG 347 Literature of the Western World II
ENG 371 The Modern Novel
ENG 372 Modern Poetry
ENG 398 Contemporary Literature I—1900-1940
ENG 399 Contemporary Literature II—1940 to present
ENG 453 The Romantic Period
ENG 468 American Romanticism
ENG 469 American Realism and Naturalism
ENG 485 Shakespeare

Foreign Languages and Literatures Courses

Any 201 or higher numbered courses, except 401-402, in any language or literature is appropriate.

Music Courses and Art Courses

MUS 200 Understanding Music
MUS 210 A Survey of Music in America
MUS 215 Music of the 17th and 18th Centuries
MUS 220 Music of the 19th Century
MUS 320 Music of the 20th Century
ART 200 The Visual Arts in Contemporary Life

Philosophy Courses

PHI 300 Early Western Philosophy
PHI 301 Modern Western Philosophy
PHI 305 Philosophy of Religion
PHI 306 Philosophy of Art
PHI 307 Morality and Human Happiness
PHI 308 Contemporary Moral Philosophy

PHI 309 Contemporary Political Philosophy
PHI 310 Existentialism
PHI 333 Theory of Knowledge
PHI 335 Symbolic Logic
PHI 402 Advanced Logic
PHI 405 Philosophy of Science

Political Science

All political science courses are appropriate.

Psychology Courses

PSY 200 Introduction to Psychology
PSY 210 Psychological Analysis Applied to Current Problems
PSY 370 Psychology of Personality and Adjustment
PSY 411 Social Psychology

Religion Courses

REL 300 Introduction to Religion
REL 311 The Hebrew Bible
REL 312 Christian Origins
REL 315 Western Religions of the Reformation
REL 316 Western Religions Since the Reformation
REL 321 Religion in American Life
REL (ENG) 325 Religion and the Modern Literary Imagination
REL 327 Contemporary Religious Thought
REL 331 Hinduism and Islam
REL 332 Buddism

Sociology Courses

SOC 202 Principles of Sociology
SOC 301 Human Behavior
SOC 302 Mass Communications and Modern Society
SOC 303 Current Social Problems
SOC 304 Contemporary Family Life
SOC 305 Race Relations
SOC 306 Criminology
SOC 401 Human Relations in Industrial Society
SOC 402 Urban Sociology
SOC 451 Population and Public Affairs

Speech-Communication Courses

SP 340 Play Production
SP 420 Development of Rhetorical Theory
SP 430 History and Criticism of American Public Address

University Studies Courses

UNI 301 Science and Civilization
UNI 302 Contemporary Science and Human Values
UNI 303 Man and His Environment
UNI 323 World Population and Food Prospects
UNI 401 The Urban Crisis
UNI 402 Peace and War in the Nuclear Age
UNI 495 Special Topics in University Studies
UNI 595 Special Topics in University Studies

Courses concerned with Man and with the Environment
(See also courses in anthropology, genetics and university studies.)

BO (ZO) 360	Introduction to Ecology
FOR 472	Renewable Resource Management
FOR 572	Conservation Policy Issues
NTR (FS, ANS) 301	Nutrition and Man
ZO 400	Biological Basis of Man's Environment

Freshman Engineering and Student Services Division

Associate Professor R. H. Hammond, *Director and Coordinator of Advising*

Assistant Professors: R. J. Leube, W. J. Vander Wall; *Senior Advisers:* G. K. Hilliard Jr., B. Houck Jr.; *Instructors:* J. L. Crow, G. A. Finley, J. F. Freeman, J. P. Newby, B. D. Webb

All students in their first year in the School of Engineering are required to take the same general program of courses. The Freshman Engineering and Student Services Division advises all freshman students on academic affairs and arranges

a program of courses which best suits one's individual background and talents and permits one the greatest probability of academic success. This division also offers general counseling service to all engineering students.

Although an entering student may designate the curriculum he or she proposes for a major, it is not necessary to decide upon a major until the end of the freshman year. As each student earns 28 or more credits, they are transferred to the department of his or her choice. This normally is achieved at the end of the spring semester.

The Freshman Engineering and Student Services Division offers assistance to high schools on questions involving engineering as a career. However, its major function is guiding and counseling each freshman engineering student.

TYPICAL FRESHMAN YEAR IN ALL ENGINEERING CURRICULA

	Credits
CH 101 General Chemistry I	4
CH 105 Chemistry—Principles and Applications*	3
E 101 Engineering Graphics I	2
E 120 Engineering Concepts	3
ENG 112 Composition and Reading**	3
Humanities—Social Science***	3
MA 102 Analytic Geometry and Calculus I	4
MA 201 Analytic Geometry and Calculus II	4
PY 205 General Physics	4
Physical Education	2
	32

The program above is typical. Other courses may be substituted, added, or deleted, dependent upon each student's individual background and talents. Individual programs might range from 28 to 35 credits.

Biological and Agricultural Engineering

(Also see Agriculture and Life Sciences.)

David S. Weaver Laboratories

Professor F. J. Hassler, *Head of the Department*

Professor G. B. Blum Jr., *Coordinator of Advising*

(For a list of faculty, see Agriculture and Life Science, page 58.)

Students in biological and agricultural engineering train to deal with problems of agriculture that are engineering in nature. Scientific and engineering principles are applied 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.

OPPORTUNITIES

Biological and agricultural engineers 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 provides

* Those students who intend to major in chemical engineering or who expect to take additional chemistry courses will take CH 107, Principles of Chemistry, instead of CH 105.

** Qualified students will be offered an advanced placement course, ENG 112H. If a grade of "C" or better is achieved, credit is also given for ENG 111. Qualified students will be notified by the Registrar and during freshman orientation. Other students will be required to take the ENG 111, 112 sequence. In neither case may credits for ENG 111 be used towards graduation requirements.

*** The humanities or social science courses usually suggested are HI 205, Western Civilization Since 1400, or EB 201, Economic Activity.

adequate training for postgraduate work leading to advanced degrees (see pages 12-13). Graduates receive the degree of Bachelor of Science in biological and agricultural engineering.

UNDERGRADUATE CURRICULUM

The science curriculum in biological and agricultural engineering develops young people 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 biological and agricultural engineering are directed to those methods of thought and techniques whereby science can be applied with understanding and judgment to engineering situations related to agricultural operations.

Since training in biological and agricultural engineering involves two distinct technical fields—agriculture and engineering—the science curriculum is a joint responsibility of the two schools and is so administered. Undergraduate students may officially enroll in either school; duplicate undergraduate records are maintained.

BIOLOGICAL AND AGRICULTURAL ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 202 Analytic Geometry and Calculus III	4	MA 301 Applied Differential Equations I	3
PY 208 General Physics	4	ESM 307 Solid Mechanics I	3
ESM 205 Principles of Engineering Mechanics	3	EE 331 Principles of Electrical Engineering	3
BAE 251 Elements of Biological & Agricultural Engineering	3	SSC 200 Soil Science	4
CSC 111 Algroithmic Languages I	2	Social Sciences & Humanities Elective	3
Physical Education	1	Physical Education	1
	17		17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ESM 305 Engineering Dynamics	3	BAE 342 Agricultural Processing	4
BAE 391 Electrotechnology in Biological & Agricultural Engineering	3	BAE 462 Functional Design of Field Machines	3
BAE 361 Analytical Methods	3	BAE 381 Agricultural Structures & Environment	3
MAE 301 Engineering Thermodynamics I	3	Social Sciences & Humanities Elective	3
BS 100 General Biology	4	Free Elective	3
	16		16

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
BAE 451 Agricultural Engineering Design I	3	BAE 452 Agricultural Engineering Design II	3
BAW (SSC) 471 Agricultural Water Management	4	Advised Technical Elective	3
Social Science & Humanities Elective	6	Free Elective	3
Free Elective	3	Social Science & Humanities Electives	6
	16		15

Hours Required for Graduation 129

The curricula above is for the science program in biological and agricultural engineering. For the technology curriculum, see Agriculture and Life Sciences.

Social Science and Humanities Electives will be selected from the standard engineering school listing.

Chemical Engineering

Riddick Hall

Professor J. K. Ferrell, *Head of the Department*

Professor J. F. Seely, *Coordinator of Advising*

Professors: K. O. Beatty Jr., R. P. Gardner, H. B. Hopfenberg, D. C. Martin, E. P. Stahel, V. T. Stannett; *Professors Emeriti:* R. Bright, W. L. McCabe, E. M. Schoenborn Jr.; *Adjunct Professors:* A. R. Berens, D. M. Preiss, D. R. Squire; *Associate Professors:* R. M. Felder, D. B. Marsland, R. W. Rousseau, M. R. Overcash; *Adjunct Associate Professor:* T. R. Hauser; *Assistant Professors:* J. E. Helt, H. M. Winston; *Adjunct Assistant Professor:* J. L. Williams

Chemical engineering is concerned with the design, optimization and control of processes, equipment and plants in which chemical and physical transformations of matter are carried out. Typical industries relying upon chemical engineering include those producing chemicals, polymers, synthetic fibers, metals, drugs, glass, food, gasoline, rocket fuels, paper, soap and cement; those producing energy from nuclear fuels; and those processing materials by methods involving chemical reactions.

Real progress in pollution abatement and control must come through the application of chemical engineering techniques. Chemical engineers are qualified to pursue careers in industries such as these in addition to traditional jobs. Biomedical engineering, pollution abatement and control, and engineering for the nation's energy requirements are other areas.

FACILITIES

Chemical engineering laboratories include pilot plant-type equipment for studying the principles of fluid flow, heat transfer, distillation, absorption, drying, crushing and grinding, filtration, chemical reaction kinetics, etc. Emphasis is placed on the use of both digital and analog computers in the solution of typical chemical engineering problems. Special equipment for research and instructional purposes is designed and built in the departmental laboratories.

OPPORTUNITIES

Graduates find employment in 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 advised to consider graduate training (see pages 12-13).

CURRICULUM

The chemical engineer's work is so diversified that one's education must be broad and basic. The spirit of research and experimentation is vital, so students need to acquire sound scientific backgrounds essential to original thought and independent accomplishment. The undergraduate curriculum emphasizes the engineering, chemical and 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 with the exception of a reduction of time devoted to laboratory work. Mathematics and science are also stressed.

CHEMICAL ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 221 Organic Chemistry I	4	EE 331 Principles of Elec. Engr.	3
MA 202 Analytic Geometry & Calculus III	4	Humanities & Soc. Sciences	3
PY 208 General Physics	4	CH 223 Organic Chemistry II	4
CHE 205 Chemical Process Principles	4	CHE 225 Chemical Process Systems	4
Physical Education	1	MA 301 Appl. Differential Eq. I	3
	17	Physical Education	1
			18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CHE 330 Chemical Engr. Lab I	2	CH 495 Speical Topics in Physical Chemistry	3
CHE 315 Chemical Process Thermodynamics	3	CHE 327 Separation Processes I	3
CHE 311 Transport Processes I	3	CHE 331 Chemical Engr. Lab II	2
Humanities & Soc. Sciences	3	Humanities & Soc. Sciences	3
MAT 201 Structure & Properties of Engr. Materials	3	CHE 316 Thermodynamics of Chemical & Phase Equilibria	3
Free Elective	3		
	17		14

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Free Elective	3	CHE 451 Chemical Engr. Design	3
CHE 432 Chemical Engr. Lab III	2	Approved Chem. Engr. Elective	3
CHE 495 Seminar	1	Humanities & Soc. Sciences	3
CHE 446 Chemical Process Kinetics	3	CH 315 Quantitative Analysis	4
CHE 425 Process Measurement & Control	3	Free Elective	3
Humanities & Soc. Sciences	3		16
	15	Hours Required for Graduation	130

Civil Engineering

Mann Hall

Professor D. L. Dean, *Head of the Department*

Professor P. Z. Zia, *Associate Head of the Department and Coordinator of Advising*

Professors: M. Amein, W. F. Babcock, T. S. Chang, P. D. Cribbins, R. A. Douglas, J. F. Ely, R. E. Fadum, W. S. Galler, K. S. Havner, C. L. Heimbach, A. I. Kashef, L. J. Langfelder, P. H. McDonald, W. G. Mullen, C. Smallwood Jr., C. C. Tung, M. E. Uyanik, H. E. Wahls; *Professor Emeritus:* C. R. Bramer; *Associate Professors:* G. H. Blessis, W. L. Bingham, E. D. Gurley, Y. Horie, J. L. Machemehl, J. F. Mirza, S. W. Nunnally, F. A. Rihani, J. C. Smith; *Adjunct Associate Professors:* C. P. Fisher, N. A. Jaworski, D. R. Johnston, S. D. Shearer; *Associate Professor Emeritus:* G. R. Taylor; *Assistant Professors:* J. L. Hulsey, H. R. Malcom Jr.; *Visiting Assistant Professor:* B. D. Barnes; *Adjunct Assistant Professor:* M. T. Mettrey; *Extension Specialist:* R. F. DeBruhl

Civil engineering is one of the broadest of the various fields of engineering. It is a discipline traditionally concerned with the improvement and control of environment and dealing with the planning, design and construction of buildings, dams, bridges, harbor works, water works, water and nuclear power facilities, sewage disposal works, nuclear waste facilities, and transportation systems including highways, railways, waterways, airports and pipe lines. Graduates in civil engineering are in demand by public agencies and by private industries. Employment varies from assignments in design offices or in the field, in small communities or large industrial centers.

The Department of Civil Engineering offers programs of study which provide adequate academic preparation to those contemplating a career in the civil engineering profession. The undergraduate program provides a sound general education and prepares the student for advanced study either by graduate study (see degrees offered, pages 12-13) or by self-study.

FACILITIES

Learning is facilitated by laboratories for testing structural materials, large models or full-scale structures, soils and bituminous products, for hydraulic experiments, for studies in airphoto interpretation and photogrammetry, for analysis of small structural models, for chemical and biological tests pertaining to sanitary engineering, and for the investigation of transportation problems.

UNDERGRADUATE CURRICULA

Two four-year undergraduate curricula are offered; one leads to a Bachelor of

Science in civil engineering; the other, to a Bachelor of Science in civil engineering, construction option.

The civil engineering curriculum is a balanced program 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.

The curriculum in the civil engineering construction option is designed for those interested in the construction phases of civil engineering. It includes the core course requirements in the physical sciences and the social sciences and humanities as established for all N. C. State engineering curricula. The curriculum includes a three semester sequence of courses in cost analysis and control, and construction methods and planning. The courses, unique to this curriculum, are designed to provide academic discipline in the engineering, planning and management aspects of construction.

CIVIL ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 202 Introduction to Civil Engineering+	3	GY 120 Elements of Physical Geology+	2
ESM 200 Introduction to Mechanics	3	GY 110 Physical Geology Laboratory*	1
MA 202 Geometry & Calculus III	4	MAT 200 Mechanical Properties of Structural Materials	2
PY 208 General Physics	4	E 301 Mechanics of Solids	3
Humanities & Social Science*	3	MA 301 Applied Differential Equations I	3
Physical Education	1	Humanities & Social Science*	3
	17	Free Elective	3
		Physical Education	1
			18

+ May be taken in reverse semesters.

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 301 Engineering Surveying	3	CE 305 Transportation Engineering I	4
CE 325 Structural Analysis	3	CE 326 Structural Engineering I	4
CE 332 Materials of Construction	3	CE 342 Soils Engineering I	4
CE 382 Hydraulics	4	CE 383 Water Resource Engineering I	4
IE 311 Engineering Project Analysis	3		16
	16		

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE Electives**	6	CE 450 Civil Engineering Design	3
Engineering Science Elective***	3	CE Elective	3
Free Elective	3	Free Elective	3
Humanities & Social Science*	3	Humanities & Social Science*	6
	15		15

Hours Required for Graduation 129

CONSTRUCTION OPTION CURRICULUM

For the freshman year see page 116.

* Humanities and social science courses to be selected from the standard school pattern.

** Two courses selected from: CE 406 Transportation Engineering II
CE 427 Structural Engineering II
CE 443 Soils Engineering II
CE 484 Water Resources Engineering II

*** Thermodynamics, engineering science and mechanics, electrical engineering or materials engineering.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 202 Introduction to Civil Engineering+	2	GY 120 Elements of Physical Geology+	2
MA 202 Analytic Geometry & Calculus III	4	GY 110 Physical Geology Laboratory	1
PY 208 General Physics	4	MAT 200 Mechanical Properties of Structural Materials	2
ESM 200 Introduction to Mechanics	3	ESM 301 Mechanics of Solids	3
Humanities & Social Science*	3	MA 301 Applied Differential Equations	3
Physical Education	1	Humanities & Social Science*	3
	17	Free Elective	3
		Physical Education	1
			18

+ May be taken in reverse semesters

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 301 Engineering Surveying	3	CE 305 Transportation Engineering I or	
CE 325 Structural Analysis	3	CE 383 Water Resource Engineering I	4
CE 332 Materials of Construction	3	CE 326 Structural Engineering I	4
CE 382 Hydraulics	4	CE 342 Soils Engineering I	4
IE 311 Engineering Economic Analysis	3	CE 365 Construction Engineer I	4
	16		16

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CE 463 Cost Analysis and Control	3	CE 460 Construction Engineering Project	3
CE 466 Construction Engineering II	3	CE 464 Legal Aspects of Contracting	3
Engineering Science Elective**	3	Free Elective	3
Free Elective	3	Humanities & Social Science*	6
Humanities & Social Science*	3		15
	15		

Hours Required for Graduation 129

POST-BACCALAUREATE STUDY IN CIVIL ENGINEERING RELATED TO OTHER FIELDS

Transportation Engineering or City and Regional Planning—There is a need for the coordination of transportation facilities and land planning. To fulfill this need, an advanced program leading to a post-baccalaureate degree in engineering with a major 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 University and the Department of City and Regional Planning at the University of North Carolina at Chapel Hill.

The minimum residence requirements include two academic years plus a summer internship. 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 may be obtained from the co-sponsoring departments.

Water Resources—To meet industry's need for personnel with training in water supply and the abatement of water pollution, students in the many curricula leading to positions in industry (food processing, textile chemistry, pulp and paper technology, chemical engineering, zoology and others) may consider courses in sanitary engineering for advanced undergraduate electives and for minor sequences for advanced degrees. Among appropriate courses are: CE 484, Water Resources Engineering II; CE 571, Theory of Water and Waste Treatment; CE 573, Unit

* Humanities and Social Science courses to be selected from standard school pattern.

** Thermodynamics, Engineering Science and Mechanics, Electrical Engineering or Materials Engineering.

Operations and Processes in Waste Treatment; CE 673, Industrial Water Supply and Waste Disposal; CE 674, Stream Sanitation.

In addition to programs in water supply and pollution control, students may major in hydraulics and hydrology. These programs are developed in conjunction with engineering science and mechanics and agricultural engineering. For further information write the Department of Civil Engineering.

Electrical Engineering

Daniels Hall

Professor L. K. Monteith, *Head of the Department*

Professor W. D. Stevenson Jr., *Associate Head of the Department*

Assistant Professor J. F. Kauffman, *Coordinator of Advising*

Professors: W. J. Barclay, W. Chou, A. R. Eckels, W. A. Flood, J. R. Hauser, N. F. J. Matthews, J. B. O'Neal Jr., D. R. Rhodes, J. Staudhammer, F. J. Tischer; *Adjunct Professor:* J. J. Wortman; *Professor Emeritus:* G. B. Hoadley; *Associate Professors:* N. R. Bell, W. T. Easter, J. W. Gault, T. H. Glisson, A. J. Goetze, M. A. Littlejohn, E. G. Manning, G. G. L. Meyer, W. C. Peterson, R. W. Stroh; *Adjunct Associate Professors:* E. Christian, M. G. Zaalouk; *Associate Professors Emeriti:* K. B. Glenn, W. P. Seagraves, E. W. Winkler; *Assistant Professors:* L. R. Herman, W. E. Snyder, G. G. Reeves; *Adjunct Assistant Professors:* J. W. Harrison, A. Jai, A. T. Shankle, J. R. Suttle, H. R. Whitman; *Adjunct Instructors:* G. F. Bland, J. L. White

Electrical engineering includes such specialized fields as communication, computer, electric power, electronic and microwave engineering. The student is prepared for any of these professional activities by starting with a thorough grounding in engineering science followed by fundamental electrical theory and advanced subject matter. The advanced subject matter is offered through elective courses which emphasize antennas, radio wave propagation, automatic control, micro computers, digital systems, communications, telemetering, electronics, the design of electrical and electronic systems, electrical power production, the utilization of electric power, electronics in medicine, instrumentation, semiconductor devices, integrated circuits, and other vital and rapidly developing concerns. By appropriate choice of elective courses a student may follow a suggested program in one of the specialized fields of electrical engineering or may choose electives to achieve an individualized program of study.

CURRICULUM

The curriculum in electrical engineering includes comprehensive training in mathematics and physics—fundamental sciences—and adequate training in allied branches of engineering. The electrical engineering courses specified in the curriculum during the sophomore and junior years provide the fundamental electrical theory for all EE majors. Specialization is achieved primarily during the senior year through appropriate choices of elective courses. Most courses are accompanied by coordinated work in the laboratory and by application of theory in the solutions to carefully planned problems. Laboratories are for the study of servomechanisms and control, electronic circuits, instrumentation, computers, communications, microwaves, antennas, electromagnetic fields and waves, electric filters and electrical machinery. Also there are a number of research laboratories, especially in solid-state electronics, computers, electromagnetics and communication systems.

Each student, with a faculty adviser's assistance, is required to plan a coordinated program which will meet the requirements for a Bachelor of Science in electrical engineering. Qualified students may coordinate their senior year with a plan for graduate study (see degrees, pages 12-13).

In addition to School of Engineering graduation requirements, attendance at two professional electrical engineering society meetings, one in the junior year and one in the senior year, is required.

Also a minimum of six continuous weeks of gainful employment is required. A wide variety of employment may be used, but technical work while in military service or for a school does not satisfy this requirement. Evidence of employment

will consist of a letter from the employer setting forth inclusive dates of employment, character of work performed and an evaluation of the student's work.

ELECTRICAL ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EE, 201 Electric Circuits I	4	EE 202 Electrical Circuits II	4
MA 202 Analytic Geom. & Calculus III	4	ESM 200 Intro. to Mechanics	3
PY 208 General Physics	4	MA 301 Applied Diff. Equations I	3
Humanities and Social Science	3	Humanities and Social Science	3
Physical Education	1	Free Elective	3
	16	Physical Education	1
			17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EE 302 Numerical Appl. in EE	3	EE 301 Linear Systems	3
EE 314 Electronic Circuits	4	EE 305 Electric Power Systems	4
EE 303 Electromagnetic Fields	4	EE 340 Fundamentals of Digital Systems	4
ENG 321 Comm. of Tech. Infor.	3	Approved Technical Elective***	3
Free Elective	3	Humanities and Social Science	3
	17		17

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EE 4-- Approved Dept. Elective**	3	EE 4-- Approved Dept. Elective**	3
EE 4-- Approved Dept. Elective**	3	EE 4-- Approved Dept. Elective**	3
Approved Technical Elective***	3	MAE 301 Thermodynamics	3
Humanities and Social Science	3	Humanities and Social Science	3
Approved Engr. Sci. Elective*	3	Free Elective	3
	15		15

Hours Required for Graduation 129

Engineering Operations

Riddick Hall

Associate Professor W. T. Easter, *Director and Coordinator of Advising*

Engineers not only design equipment and structures; they operate and control production systems, perform management and supervision at all levels, plan and maintain plant facilities, and market technical products. These latter functions may be grouped together under the general term "operations"—the ongoing tasks of providing needed goods and services in an economical, safe and healthful manner. Engineering careers in operations are well suited to persons who have interest in both technical and business matters and who find satisfaction in accomplishing objectives through working with people. This program provides educational background for such careers.

CURRICULUM

Engineering operations is an interdepartmental program of study leading to the Bachelor of Science degree. Starting with a foundation of basic arts and sciences, the curriculum builds a thorough grounding in engineering fundamentals and appli-

* Chosen from an approved list of Engineering School electives (non EE courses).
** Chosen from an approved list of 400 level EE courses. Students with B or better average in EE and Math may use 500 level courses.
*** Chosen from an approved list of Math, Physics, Statistics and Computer Science courses.

cations along with a strong introduction to the concepts and practices of business management. Additional depth in an area of the student's choice is provided by a technical elective sequence taken in the junior and senior years. Students may choose from three standard sequences—production control, industrial ceramics and electrical—or may design a special sequence related to individual interests.

The breadth and flexibility of this curriculum make it adaptable to a variety of individual educational needs ranging from general to specific interests. For example, several students currently are combining courses in music and instrument technology with the basic production sequence to prepare for careers in musical instrument manufacturing.

JOINT PROGRAMS

The School of Engineering operates joint programs in engineering operations (production sequence) with the Universities of North Carolina at Asheville and at Wilmington. A student at either school can complete up to 90 of the 128 credits before transferring to North Carolina State University. The remaining 38 credits can often be completed in one calendar year. Additional details are given in the UNC-A and UNC-W catalogs.

OPPORTUNITIES

Engineering operations graduates find careers not only in manufacturing companies, but also in the military services, governmental agencies and in service firms such as utilities, contractors, consultants, financial institutions and transportation companies.

Those who wish further education typically go into master's programs in management or business administration; some, however, enter related graduate engineering programs or other professional schools such as law and medicine.

ENGINEERING OPERATIONS CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 202 Analytic Geometry & Calculus III	4	MAT 201 Structure and Properties of Engineering Materials	3
PY 208 General Physics	4	ACC 260 Accounting I—Concepts of Financial Reporting	3
ESM 211 Introduction to Applied Mechanics	3	ESM 212 Mechanics of Engineering Materials	3
E 207 Engineering Graphics III	2	Humanities and Social Sciences*	3
Humanities and Social Sciences*	3	Free Elective	3
Physical Education	1	Physical Education	1
	17		16

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MAE 307 Energy and Energy Transformations	3	EE 350 Electric Power Utilization in Manufacturing Processes	3
ST 361 Introduction to Statistics for Engineers	3	IE 301 Engineering Economy	3
ACC 262 Managerial Uses of Cost Data	3	IE 328 Manufacturing Processes	3
CSC 111 Algorithmic Languages I	2	Technical Sequence**	3
Technical Sequence**	3	Free Elective	3
Humanities and Social Sciences*	3		15
	17		

SENIOR YEAR

Fall Semester	*Credits*
EB 202 Economics II or EB 326 Personnel Management	3
EO 491 Seminar in Engineering Operations	1
Technical Sequence**	6
Humanities and Social Sciences*	3
Free Elective	3
	16

Spring Semester	*Credits*
IE 420 Manufacturing Controls	3
Technical Sequence**	6
Humanities and Social Sciences*	3
Free Elective	3
	15

Hours Required for Graduation 128
(125 with the electrical sequence)

TECHNICAL ELECTIVE SEQUENCES

JUNIOR	F	S
1. *Production:* (total 19 credits)		
EB 332 Industrial Relations	3	
IE 443 Quality Control		3
	3	3
2 *Industrial Ceramics:* (total 19 credits)		
MAT 311 Ceramic Processing I	4	
MAT 312 Ceramic Processing II		3
	4	3
3. *Electrical:* (total 19 credits)		
EE 350 Electric Power Utilization in Manufacturing Processes (3) will not be taken.		
EE 201, 202 Electric Circuits I, II	4	4
	4	4

SENIOR	F	S
IE 332 Motion & Time Study	4	
IE 343 Plant Layout and Materials Handling		3
Technical Electives	3	3
	7	6
MAT 417 Ceramic Subsystem Design		3
Technical Electives	6	3
	6	6
EE 314 Electronic Circuits	4	
EE 340 Fundamentals of Digital Systems		4
EE Elective		3
	4	7

4. *Individualized:* (total 18 credits)

Tailored to the specific needs of individual students. See the program director for further information.

Industrial Engineering

Riddick Engineering Laboratories

Professor W. A. Smith Jr., *Head of the Department*

Professor S. E. Elmaghraby, *Associate Head of the Department*

Associate Professor H. L. W. Nuttle, *Coordinator of Advising*

Professors: J. R. Canada, S. E. Elmaghraby, R. W. Llewellyn, R. G. Pearson, A. L. Prak; *Associate Professors:* R. E. Alvarez, M. A. Ayoub, R. H. Bernhard, J. J. Harder, Shaler Stidham Jr.; *Assistant Professors:* E. L. Blair, J. A. Tompkins; *Instructor:* T. W. Myers; *Visiting Lecturers:* J. A. Ekwall, S. G. Isley; *Adjunct Professor:* A. L. Swan; *Adjunct Assistant Professors:* M. J. Goodman, D. J. Kulonda; *Professors Emeriti:* C. A. Anderson, R. G. Carson Jr.

The industrial engineer designs, improves and installs integrated systems of people, materials, equipment, and information. One draws upon specialized knowledge and skill in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from these systems. Productivity and effective

* Courses in the humanities and social sciences are to follow the standard plan for the School of Engineering. See pages 113-115.

** Students may follow a standard or an approved individualized technical elective sequence as outlined below.

utilization of resources, including energy conservation, are principle concerns of practitioners. The industrial engineer may develop operations, improvements for many diverse activities, such as a hostpial, a department store, a manufacturing enterprise, an insurance office or government functions. His or her position in an organization is usually as a management adviser in contact with every phase of the organization.

The curriculum blends a basic group of common engineering technical courses with specialized courses in the major areas of industrial engineering—design of human and machine systems, design of management control systems, and improvement of manufacturing operations. The course offerings stress mathematical and statistical techniques of industrial systems analysis; quantitative methodologies of operations research; computers as a tool for problem solving and simulation; economic considerations of alternatives; control of product or service quality and quantity; specifications of the manufacturing process including the equipment and tooling; and the utilization of safety and human factors engineering principles.

Industrial engineering's undergraduate program leads to a Bachelor of Science degree in industrial engineering. For graduate degrees, see pages 12-13. The department also offers a Bachelor of Science in furniture manufacturing and management which is described on pages 126-127.

INDUSTRIAL ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
IE 200 Introduction to IE	2	MAT 201 Struc. Prop. Engr. Mtl. I	3
MA 202 Anatlyic Geom. & Calc. III	4	IE 311 Engineering Econ. Analy.	3
PY 208 General Physics	4	MA 301 Appl. Diff. Equations I	3
ST 371 Intro. to Prob. & Distr. Theory	2	ST 372 Intro. to Stat. Inf. & Regr.	2
Humanities & Social Science	3	Humanities & Social Science	3
Physical Education	1	Physical Education	1
	16		15

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ACC 262 Mangr'l. Uses of Cost Data	3	IE 308 Con. of Prod. & Serv. Sys.	4
ESM 205 Principles of Eng. Mech.	3	IE 352 Work Analysis & Design	3
IE 321 Bus. Data Processing	3	IE 401 Stoch. Models in IE	3
IE 351 Manufacturing Eng.	3	Humanities & Social Science	3
IE 361 Det. Models in IE	3	Free Elective	3
	15		16

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EE 331 Principles of Elec. Eng.	3	Technical Elective	6
IE 452 Ergonomics	3	Engineering Science Elective	3
Technical Elective	3	Humanities & Social Science	3
Engineering Science Elective	3	Free Elective	3
Humanities & Social Science	3		15
Free Elective	3		
	18	Hours Required for Graduation	127

Furniture Manufacturing and Management

James T. Ryan Professor Anco L. Park, *In Charge*

Instructor: T. W. Myers; *Furniture Extension Specialist:* E. L. Clark; *Visiting Lecturer:* J. A. Ekwall

The furniture industry ranks second only to the automobile as a producer of consumer durable goods. The industry is the second largest industrial employer in

To be effective 1 July 1975 for Class of 1978.

North Carolina and produces over 25 per cent of the furniture made in the U.S.A. The industry is changing rapidly with the introduction of mechanization, new materials and sophisticated management controls.

The furniture manufacturing and management program is the only one of its kind in the country. It receives industry support and guidance. Plant and market field trips combined with project type instruction give students in-depth understanding of manufacturing. The faculty keeps abreast of industry problems through close contact with the Southern Furniture Manufacturers Association and by doing applied research and extension work.

The cooperative education program is well suited to the furniture manufacturing and management curriculum.

CURRICULUM

The degree of Bachelor of Science in furniture manufacturing and management prepares graduates for technical and managerial positions in the industry.

The curriculum stresses the application of engineering and technology to furniture manufacturing. Related subjects such as management, accounting and economic analysis cover the business side of modern furniture production systems.

In addition to academic course work, a minimum of six weeks of continuous, gainful employment in a furniture manufacturing plant is required. Usually, such employment is between the junior and senior years.

FURNITURE MANUFACTURING AND MANAGEMENT CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
SP 231 Expository Speaking	3	ACC 262 Managerial Uses Cost Data	3
E 240 Furniture Graphics	3	IE 241 Furn. Mfg. Processes I	3
PY 212 General Physics	4	ST 361 Intro. to Stat. for Engrs. I	3
IE 200 Intro. to Ind. Engineering	2	WPS 201 Elements of Wood	3
Humanities & Soc. Science	3	Humanities & Soc. Science	3
Physical Education	1	Physical Education	1
	16		16

WPS 205 Summer Practicum 5

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
IE 321 Business Data Processing	3	IE 301 Engineering Economy	3
IE 332 Motion & Time Study	4	IE 341 Furn. Plant Layout & Design	3
IE 340 Furn. Mfg. Processes II	4	IE 371 Furn. Quality & Prod. Control	4
IE 345 Principles of Upholstery	2	Free Elective	3
Humanities & Soc. Science	3	Aprpoved Elective	2
	16		15

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
IE 470 Furn. Mfg. Organization	2	EB 326 Personnel Management *or*	
Humanities & Soc. Science	3	EB 332 Industrial Relations	3
Free Elective	3	IE 440 Furn. Management Analysis	3
Approved Elective	4	Free Elective	3
		Approved Elective	2
	12	Humanities & Soc. Science	3
			14

Hours Required for Graduation 126

To be effective 1 July 1976 for class of 1978.

Materials Engineering

Page Hall

Professor W. W. Austin Jr., *Head of the Department and Coordinator of Advising*

Professors: J. R. Beeler Jr., R. B. Benson Jr., A. A. Fahmy, J. K. Magor, C. R. Manning Jr., K. L. Moazed, H. Palmour III, H. H. Stadelmaier, R. F. Stoops; *Adjunct Professors:* H. M. Davis, G. Mayer; *Associate Professors:* J. V. Hamme, G. O. Harrell; *Assistant Professors:* R. F. Davis, M. L. Fiedler, L. T. Jordan; *Adjunct Assistant Professor:* J. C. Hurt; *Special Lecturer:* K. R. Brose

The Department of Materials Engineering offers education, research and professional development which qualifies graduates as technical and administrative leaders for industries and government agencies involved with design, development, selection and processing of engineering materials. Typical industries served by materials engineers are: aerospace, electrical and electronics, construction, nuclear power and transportation.

OPPORTUNITIES

Materials engineers job opportunities include those in research and development of new materials needed in the rapidly expanding fields of chemical, mechanical, aerospace, electronic and nuclear technology. With the continued industrial development of the South and the State of North Carolina, opportunities are developing for materials engineers to play a vital role in maintaining state and regional progress.

Professional training in materials engineering provides opportunities for employment in industries producing or consuming essential products including metals and alloys, glass in all its forms, enamels and protective coatings for metals, structural clay products such as brick and tile, thermal insulators, electrical insulators, electronic devices, plastics, and composite materials.

CURRICULUM

The undergraduate curriculum is comprised of a three-year program of fundamental courses followed by a fourth year in which the student chooses a specialty area: ceramic engineering, metallurgical engineering, polymeric materials, materials processing, or materials engineering (general). A fifth year professional program is available for advanced work and further specialization in these fields.

Graduate degrees are available (see pages 12-13 and consult the Graduate Catalog).

Well-equipped laboratories aid research and instruction in: Aüger spectroscopy, x-ray diffraction, differential thermal analysis, thermogravimetric analysis, electron microprobe analysis, radiography, metallography, electron microscopy, mechanical behavior of materials, and nuclear fuel research.

PROFESSIONAL STUDY

In addition to the regular graduate program a fifth or professional year of postgraduate study is offered in materials engineering. This program of advanced course work leads to the degree of Materials Engineer. It is especially designed for students planning careers in consulting, production activities or in technical service and sales. Each program of study is individually designed. Regulations covering professional study are shown on pages 133-134.

MATERIALS ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 202 Analytic Geometry & Cal. III	4	MA 301 Differential Equations	3
PY 208 General Physics	4	Humanities & Social Sc.	3

Humanities & Social Sc.	3	ESM 205 Prin. of Engrg. Mechanics	3
CSC 111 Introd. to Computer Science	2	EE 331, 339 Electrical Engineering	4
Physical Education	1	MAE 301 Engr. Thermodynamics	3
Elective	3	Physical Education	1
	17		17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MAT 301 Equil. & Rate Processes in Materials Eng.	3	MAT 302 Materials Processing	3
MAT 320 Phys. Prin. In Matls. Sc. I	3	MAT 310 Physical Exam. of Matls.	2
Humanities & Social Sc.	3	MAT 321 Phys. Prin. in Matls. Sc. II	3
ESM 307 Solid Mechanics	3	MAT 322 Phase Diagrams	2
Technical Electives	3	Humanities & Social Sc.	3
	15	Technical Elective	3
			16

SENIOR YEAR

MAT 431 Physical Metallurgy I	3	MAT 423 Matls. Factors in Design I	3
MAT 435 Physical Ceramics I	3	Humanities & Social Science	3
MAT 450 Mechanical Properties of Matls.	3	Technical Elective	3
CHE 325 Introduction to Plastics	3	Electives	6
Technical Electives	3		15
	15		

Hours Required for Graduation 127

Mechanical and Aerospace Engineering

Broughton Hall

Professor C. F. Zorowski, *Head of Department*

Professor J. C. Williams III, *Associate Head of Department*

Professor B. H. Garcia Jr., *Coordinator of Advising*

Professors: J. A. Bailey, R. F. Barrett, M. H. Clayton, F. R. DeJarnette, J. A. Edwards, W. C. Griffith, F. J. Hale, F. D. Hart, H. A. Hassan, E. G. Humphries, R. B. Knight, M. N. Ozisik, J. N. Perkins, F. O. Smetana, F. Y. Sorrell, J. K. Whitfield, J. Woodburn; *Adjunct Professors:* J. J. Murray, E. A. Saibel; *Professors Emeriti:* H. B. Briggs, J. S. Doolittle, R. M. Pinkerton; *Associate Professors:* E. M. Afify, J. R. Bailey, T. H. Hodgson, C. J. Maday, C. J. Moore Jr., J. C. Mulligan, L. H. Royster; *Associate Professor and Extension Specialist:* H. M. Eckerlin; *Adjunct Associate Professors:* E. S. Armstrong Jr., R. E. Singleton; *Associate Professor Emeritus:* W. E. Adams; *Assistant Professors:* J. A. Daggerhart Jr., T. H. Pierce, W. F. Reiter Jr.; *Adjunct Assistant Professors:* G. Y. Anderson, F. O. Carta, D. P. Colvin, J. S. Stewart, J. R. Yow; *Assistant Professor Emeritus:* T. J. Martin Jr.; *Instructor:* G. O. Batton; *Visiting Instructor:* R. A. Howland; *Extension Specialist:* A. S. Boyers.

Mechanical engineers specialize in the generation of power and the design of machines and processes that apply mechanical and thermal energy to useful purposes. Example areas of specialization include conventional (fossil fuel) power generation; novel power sources (solar, wind, tides, etc.); internal combustion, diesel and turbine engines; heating, air conditioning and refrigeration; air, sea, and land vehicles; all types of mechanical devices, systems, and machinery; domestic and commercial appliances; instrumentation and industrial controls; and air, noise, and thermal pollution abatement systems.

Aerospace engineering shares responsibility for many of the areas listed above but is principally concerned with the design and the analysis of the performance, stability, and control of modern aircraft, both commercial and private, and space vehicles; all types of mechanical devices, systems, and machinery; domestic and and electric propulsion systems; and aerodynamics—the interaction between the vehicle and the atmosphere.

CURRICULA

Because of the close relationship between mechanical and aerospace engineering, both curricula are administered by one department. There is cooperation between

the two disciplines in which responsibility for subject areas such as thermodynamics, heat and mass transfer, vibrations, acoustics, fluid mechanics, propulsion and control theory is shared.

Each program is designed to provide the student with an understanding of both the science on which the discipline is founded and the applied science and technology which characterizes its specific personality. In addition the programs provide the student with an opportunity to begin developing the skills of applying his or her acquired knowledge and specializing in a specific area of discipline interest. The Bachelor of Science degree is available in both aerospace engineering and mechanical engineering. Graduate degrees are also offered (see pages 12-13 and consult the Graduate Catalog).

FACILITIES

The academic programs in Mechanical or Aerospace Engineering are augmented by extensive laboratory facilities available for practical experience in engineering systems. Mechanical Engineering facilities include instrumentation, acoustic and vibration, photoelasticity, stress analysis, dynamomentry, heat transfer, materials processing and design laboratories. Aerospace engineering facilities include subsonic, transonic, and supersonic wind tunnels, aerospace structures and propulsion laboratories.

OPPORTUNITIES

Since all industry uses machinery and power, and mechanization is expanding the world over, mechanical engineering provides career and employment opportunities which are virtually limitless. Mechanical engineers are needed in every technology-oriented industry as well as in such fields as law and medicine.

The aerospace industry is one of the largest employers of engineers in the United States. Career and employment opportunities are available in the areas of aerodynamics, propulsion, structures and stability and control in both commercial and private aviation and in related aerospace industries.

Mechanical engineers and aerospace engineers find opportunities in design, production, testing, operation and maintenance, research and development, marketing and sales, management and teaching. Opportunities are limited only by the capabilities and professional training of the individual.

MECHANICAL ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 202 Analytic Geometry and Calculus III	4	MAE 216 Elements of Mechanical Engineering	3
PY 208 General Physics	4	MA 301 Applied Differential Equations I	3
ESM 205 Principles of Engineering Mechanics	3	ESM 305 Engineering Dynamics	3
Humanities, Social Sciences* or		CSC 111 Algorithmic Languages I	2
Free Elective	3	Humanities, Social Sciences* or	
Physical Education	1	Free Elective	3
	15	Physical Education	1
			15

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MAE 301 Engineering Thermodynamics I	3	MAE 302 Engineering Thermodynamics II	3
MAE 305 Mechanical Engineering Laboratory I	1	MAE 306 Mechanical Engineering Laboratory II	1
MAE 316 Strength of Mechanical Components	3	MAE 315 Dynamics of Machines	3
EE 331 Principles of Electrical Engineering	3	EE 332 Principles of Electrical Engineering	3
		ESM 303 Fluid Mechanics I	3

MAT 201 Structure and Properties of Engineering Materials	3
Humanities, Social Sciences* or Free Elective	3
	16

Humanities, Social Sciences* or Free Elective	3
	16

SENIOR YEAR

Fall Semester	*Credits*
MAE 401 Energy Conversion or MAE 402 Heat & Mass Transfer	3
MAE 405 Mechanical Engineering Laboratory III	1
MAE 415 Mechanical Engineering Analysis	3
Departmental Elective	3
Humanities, Social Sciences* or Free Elective	6
	16

Spring Semester	*Credits*
MAE 402 Heat & Mass Transfer or MAE 401 Energy Conversion	3
MAE 416 Mechanical Engineering Design	4
Departmental Elective	3
Humanities, Social Sciences* or Free Elective	6
	16
Hours Required for Graduation	126

Students may elect to take PY 201, 202 and 203 in place of PY 205, 208. Rearrangement of the schedule of courses to accomplish this will be worked out in consultation with the student's adviser.

* See pages 113-115 for information concerning the humanities, social science sequence.

AEROSPACE ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*
MA 202 Analytic Geom. & Cal. III	4
PY 208 General Physics	4
ESM 205 Prin. of Engr. Mech.	3
Humanities, Social Sci. or Free Elective	3*
Physical Education	1
	15

Spring Semester	*Credits*
MAE 261 Aero. Vehicle Performance	3
MA 301 Applied Differen. Equations	3
ESM 305 Engineering Dymanics	3
CSC 111 Algorithmic Languages I	2
MAT 201 Struc. & Prop. of Engr. Mat. I	3
Physical Education	1
	15

JUNIOR YEAR

Fall Semester	*Credits*
MAE 301 Engr. Thermodynamics I	3
MAE 355 Aerodynamics I	4
MAE 371 Aero. Vehicle Struct. I	3
EE 331 Prin. of Elec. Engr.	3
EE 339 Prin. of Elec. Engr. Lab	1
Humanities, Social Sciences or Free Elective	3*
	17

Spring Semester	*Credits*
MAE 356 Aerodynamics II	4
MAE 365 Propulsion I	3
MAE 435 Principles of Auto Control	3
MAE 472 Aero. Vehicle Struct. II	4
Humanities, Social Sciences or Free Elective	3*
	17

SENIOR YEAR

Fall Semester	*Credits*
MAE 478 Aero. Vehicle Design I	2
MAE 462 Flight Veh. Stab. & Con.	3
MAE 465 Propulsion II	4
MAE 455 Boundary Layer Theory	3
Humanities, Social Sciences or Free Electives	6*
	18

Spring Semester	*Credits*
MAE 479 Aero. Vehicle Design II	3
Departmental Elective	3
Humanities, Social Sciences or Free Electives	9*
	15
Hours Required for Graduation	129

* 27 credit hours of Humanities, Social Sciences and free electives of which 9 credit hours are free electives and 18 credit hours are Humanities and Social Sciences which must be taken from an approved list.

Nuclear Engineering

Burlington Engineering Laboratories

Professor T. S. Elleman, *Head of the Department*

Associate Professor E. Stam, *Coordinator of Advising*

Professors: R. P. Gardner, R. L. Murray, R. F. Saxe, K. Verghese, L. R. Zumwalt; *Associate Professors:* J. R. Bohannon Jr., C. E. Siewert; *Extension Specialist:* J. Kohl; *Health Physicist:* R. D. Cross; *Reactor Engineer:* F. J. Steinkruger

Nuclear engineering is concerned with the engineering aspects of the control, release and utilization of nuclear energy. Nuclear reactors serve many functions—they serve as heat sources for economical electric power plants, are the basis of modern propulsion systems for ships and submarines, and produce fissionable and radioactive isotopes for a variety of peaceful applications. Nuclear methods are applied in medical diagnosis and treatment, scientific research, and the search for new resources. The nuclear engineering program educates individuals in scientific and engineering principles essential for effective and productive contributions in industrial, university and government service.

OPPORTUNITIES

Although the nuclear industry is relatively young, it already represents a major national effort. Reactor development and construction will continue to grow as we become increasingly reliant upon nuclear energy as a substitute for energy from fossil fuels. Industrial applications of radiation will accelerate as the economic potential of such methods becomes even more firmly established. There continues to be a substantial need for nuclear engineers, especially by electric utilities, reactor manufacturers, and regulatory agencies.

CURRICULUM

Nuclear engineers work in nuclear systems research, design, development, testing, operation, environmental protection, and marketing. The Bachelor of Science program prepares graduates for positions in industry or government laboratories or for graduate study (see pages 12-13). The curriculum incorporates basic sciences and engineering, with emphasis on mathematics and physics, followed by coursework in nuclear science and technology. Attention is given to the engineering design of nuclear reactors and nuclear radiation systems and to energy resources and environmental aspects of nuclear energy.

Facilities for nuclear education include: a one-megawatt pulsing reactor (PULSTAR), which can be operated at a steady state of 1 MW or pulsed to 2200 MW; a cobalt-60 gamma source, 20,000 curies; solid state detectors and multi-channel analyzers for gamma-ray analysis; analog computers; digital computer, IBM System/360, Model 75; activation analysis laboratory; and high- and low-level radiochemistry laboratories.

NUCLEAR ENGINEERING CURRICULUM

For the freshman year see page 116.

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 202 Analytic Geometry and Cal. III	4	MA 301 Appl. Diff. Equations I	3
PY 208 General Physics	4	PY 410 Introductory Nuclear Physics	4
MAT 201 Struc. and Prop. Eng. Mtls.	3	ESM 200 Introduction to Mechanics	3
CSC 111 Algorithmic Languages I	2	NE 201 Appl. of Nuclear Energy	3
Humanities and Social Sciences	3	Humanities and Social Sciences	3
Physical Education	1	Physical Education	1
	17		17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MAE 301 Engr. Thermodynamics I	3	MA 401 Appl. Dif. Equations II	3

EE 331	Principles of Electrical Engr.	3	
ESM 303	Fluid Mechanics I	3	
NE 302	Fundamentals of Nucl. Engr.	4	
	Humanities and Social Sciences	3	
		16	
EE 332	Principles of Electrical Engr.	3	
MAE 303	Engr. Thermodynamics III	3	
NE 401	Reactor Analysis and Design	4	
	Free Elective	3	
		16	

SENIOR YEAR

Fall Semester		*Credits*	*Spring Semester*		*Credits*
NE 402	Reactor Engineering	4	NE 403	Nucl. Engr. Design Proj.	3
NE 404	Rad. and Reactor Safety	3	NE 405	Reactor Systems and Economics	3
	Technical Elective	3		NE Elective	3
	Humanities and Social Sciences	3		Humanities and Social Sciences	3
	Free Elective	3		Free Elective	3
		16			15

Hours Required for Graduation 129

Professional Program in Engineering

The School of Engineering offers professional curricula leading to the degrees Chemical Engineer, Civil Engineer, Electrical Engineer, Industrial Engineer, Materials Engineer, Mechanical Engineer and Nuclear Engineer. A program of study is designed to fit the particular needs of each student.

Professional course work is emphasized rather than research. The curriculum consists of a minimum of 30 credits making up a planned program designed to fit the student's objective.

ADMISSION

Applicants who hold the bachelor's degree in engineering 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 program requirements.

Application should be filed in the office of the dean of the School 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 University who plans to undertake a professional program and who has fulfilled all requirements for the bachelor's degree except for a few courses, may be permitted to enroll in courses for credit toward the professional degree provided the student has given notice of his purpose to the dean of the School of Engineering.

2) A limited amount of credit to be applied toward the requirements for the professional degree may be transferred to N. C. State from other institutions offering advanced work in engineering. Transfer of credit must be recommended by the head of the department in which the student does his major work and approved by the Dean of Engineering.

3) Professional students are classified as post-baccalaureate students and are subject to rules and regulations established by the Dean of Engineering.

4) Grades for completed courses are reported to the Dean of Engineering and to Registration and Records. 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 Engineering.

6) Each professional student will be assigned an adviser in his or her major area. The adviser assists the student in preparing a program of study and counsels him or her in academic work. The student is required to prepare with the adviser's assistance, a complete plan of study before the end of the first semester in residence. This program of study is subject to approval by the Dean of Engineering.

Forestry students gain valuable experience through a lecture in the natural setting of Schenck Forest.

FOREST RESOURCES

Biltmore Hall

E. L. Ellwood, *Dean*

L. C. Saylor, *Associate Dean and Coordinator of Advising*

The management and utilization of the South's forest resources and products provide opportunities for challenging professional careers. Forests provide a variety of goods—timber, water, wildlife and recreation environments—vital to the economy and well being of North Carolina. Graduates of the School are qualified for professional positions managing forest lands, or producing the products or managing the services developed from these lands. Emphasis is placed on natural renewable resource management because the wise use of the products and amenities that can be derived from forest lands is central to preserving environmental quality and the quality of life.

North Carolina is an important forest state. Its 20 million acres of commercial forest land, comprising two-thirds of the State's land area, form the base for goods and services valued at approximately five billion dollars annually. Nearly 20 percent of the state's industrial labor force is associated with forest based organizations; forests support the southern region's largest industry. New wood-using industries continue to move into the South, creating multi-billion dollar outputs. Similarly, recreational activities continue to expand as a result of growing population, affluence, mobility and leisure time.

As a result of this growth, forest based industries and governmental agencies need well-educated, technically competent personnel.

Some of the programs in the School of Forest Resources are not duplicated in other Southern Universities, so the Trustees of the University and the Southern Regional Education Board have designated them as regional in nature. As a result no limit is set for enrollments of qualified out-of-state students.

DEGREES

The Bachelor of Science degree is conferred upon the satisfactory completion of any of the four-year undergraduate curricula listed below.

Graduate degrees offered include: Master of Science, Master of Forestry, Master of Recreation Resources, Master of Wood and Paper Science and the Doctor of Philosophy. Applicants should consult the Graduate Catalog for additional information.

FIELD INSTRUCTION AND EXPERIENCE

All students (except those in conservation) are required to present an equivalent of one summer of acceptable work experience. Students consult with their advisers as to what constitutes acceptable employment.

A summer camp is required of all forestry students. This camp follows the sophomore year for resident students. Transfer students attend the camp after completing the junior year at North Carolina State University.

Undergraduates enrolled in recreation resources administration complete a nine-weeks internship immediately following the completion of the junior year.

All pulp and paper majors spend at least one summer working in a pulp and paper mill designated by the University.

Wood science and technology students attend a summer practicum following the sophomore year; transfer students attend following the junior year.

Additional field instruction and scheduled trips to representative industries and agencies are required frequently as a part of regular class assignments.

HONORS PROGRAM

Students making exceptional academic records during their freshman year may, with faculty approval, follow an honors program. Honors students develop more

rigorous programs of study, frequently taking advanced courses in mathematics, chemistry, statistics and economics. With the adviser's consent honors students may substitute preferred courses for normally required courses in order to develop strength in special interest areas. Honors students are required to undertake a program of independent study which can involve a research problem or special project during their junior or senior year.

EXTENSION

The Forestry Extension program, a part of the Agricultural Extension Service, is the largest program of its type in the United States. It serves landowners, industries and public agencies in the areas of forestry, recreation, wildlife and wood and paper. Its primary responsibility is promoting the application of new ideas developed through research and experience.

In cooperation with the Continuing Education Division, short courses are offered in a number of fields to provide industry and government employees an opportunity to keep abreast of modern developments in techniques and equipment.

FACILITIES AND LABORATORIES

A school library and most classrooms are housed in Biltmore Hall. Among special education facilities in Forest Resources are: 80,000 acres in forests including the Hofmann forest on the coastal plain; the Hill, Schenck, Hope Valley and Goodwin Forests in the Piedmont; and the Slocum summer camp for sophomores in Hill Forest, Durham county. Specialized laboratories unique to the South are the Hodges Wood Products Laboratory housing machining, gluing, finishing, preserving, testing and research laboratories, a sawmill, a dry kiln and a veneer lathe; and the Robertson Laboratory with wood preparation, chemistry, pulping, testing and coloring laboratories, digesters and a small paper machine.

CURRICULA

Five curricula are administered in the School through its Departments of Forestry, Recreation Resources Administration and Wood and Paper Science. These programs provide a broad education in the biological and physical sciences as well as a sound cultural background. Students are prepared for careers in the professional fields of conservation, forestry, recreation resources administration, pulp and paper science and technology, and wood science and technology.

Freshmen have a nearly common core of courses during the first semester allowing deferment of the final selection of a curriculum for two or three semesters. To assist students with a better understanding of their major area of study, introductory courses are given in each curriculum.

Conservation

(Also see Agriculture and Life Sciences.)

M. G. Cook, *Major Adviser, School of Agriculture and Life Sciences*

L. C. Saylor, *Major Adviser, School of Forest Resources*

Conservation is wise use, perpetuation, or improvement of natural resources for the long-term benefit of society. Rapid urbanization and industrialization, and increasing population, are increasing pressures on the use of land areas for food and fiber, for wood and water and for recreation. These trends require trained people to make sound judgments in natural resources management and use.

The Schools of Forest Resources and Agriculture and Life Sciences—with strong programs in forestry, recreation, wood and paper science, ecology, soils, wildlife and the basic biological sciences—jointly offer a baccalaureate program in conservation. Conservation graduates are trained in the basic concepts of several disciplines to apply a conservation philosophy to problem-solving in a modern society.

CURRICULUM

Depending upon interests, students enroll in either Forest Resources or Agriculture and Life Sciences. All programs in conservation have common core courses; specialty areas or minors are developed through elective courses.

Conservation provides a broad general education in natural resource management leading to a Bachelor of Science degree, rather than emphasizing technological aspects. Students desiring a more professional emphasis frequently combine the conservation program with a second degree. By the proper choice of electives, one may obtain a dual degree in fields such as botany, forestry, liberal arts, recreation, soil science, wildlife management and zoology.

CONSERVATION CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ALS 103 Introductory Topics in ALS or FOR 101 Introduction to Forestry	1	CH 101 General Chemistry I	4
BO 200 Plant Life or BS 100 General Biology	4	ENG 112 Composition & Reading	3
ENG 111 Composition & Rhetoric	3	Humanity-Social Science Elective	3
Humanity-Social Science Elective	3	MA 112 Analytic Geometry & Calculus A	4
MA 111 Algebra & Trigonometry	4	Physical Education	1
Physical Education	1		15
	16		

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 103 General Chemistry II or CH 107 Principles of Chemistry	4	BO 200 Plant Life or ZO 201 Animal Life	4
GY 120 Elements of Physical Geology	2	English Elective	3
GY 110 Physical Geology Laboratory	1	Free Elective	4
Humanity-Social Science Electives	6	SSC 200 Soil Science*	4
ZO 221 Conservation of Natural Resources	3	Physical Education	1
Physical Education	1		16
	17		

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
BO (ZO) 360 Introduction to Ecology	4	Biological Science Elective	3
Conservation Elective	3	Conservation Elective	3
RRA 241 Recreation Resource Relationships	3	Humanity-Social Science Elective	3
Humanity-Social Science Elective	3	PY 221 College Physics	5
ST 311 Introduction to Statistics	3	FOR 472 Renewable Resource Management	3
	16		17

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Biological Science Elective	3	Biological Science Elective	3
Conservation Elective	3	Conservation Elective	3
English Elective	3	Humanity-Social Science Elective	3
ZO 353 Wildlife Management	3	Free Electives	6
Free Electives	4		15
	16		

Hours Required for Graduation 128

* Students with non-technical interests may substitute SSC 205 for SSC 200.

Elective courses may be used for emphasizing subject areas in communication, soils, wildlife biology, education and other areas.

Forestry

Biltmore Hall

Professor C. B. Davey, *Head of Department*

TEACHING AND RESEARCH

Professors: F. S. Barkalow Jr., R. C. Bryant, A. W. Cooper, E. B. Cowling, M. H. Farrier, L. F. Grand, W. L. Hafley, J. W. Johnson, J. O. Lammi, D. E. Moreland (USDA), G. Namkoong (USFS), T. O. Perry, L. C. Saylor, R. R. Wilkinson, B. J. Zobel; *Adjunct Professors:* G. H. Hepting, J. W. Koenigs, E. G. Kuhlman, L. J. Metz, C. G. Wells, R. C. Winkworth; *Professors Emeriti:* T. E. Maki, W. D. Miller, R. J. Preston; *Associate Professors:* A. E. Hassan, D. L. Holley, R. C. Kellison, D. H. J. Steensen, A. L. Sullivan, A. G. Wollum II; *Adjunct Associate Professors:* W. T. Gladstone, H. T. Schreuder, R. Stonecypher, H. A. Thomas; *Assistant Professors:* F. P. Hain, L. G. Jervis; *Adjunct Assistant Professor:* J. A. Barker; *Liaison Geneticists:* J. B. Jett Jr., E. C. Sossaman Jr., R. J. Weir; *Teaching Technician:* T. V. Gemmer; *Research Associates:* J. M. Cheeseman, L. W. Haines; *Research Assistants:* D. W. Hazel, J. R. Sprague

EXTENSION

Professors: W. T. Huxter—Leader Forestry Section, J. C. Jones; *Professors Emeriti:* W. M. Keller, F. E. Whitfield; *Associate Professors:* R. S. Douglass, E. M. Jones; *Assistant Professors:* J. R. McGraw, W. M. Stanton, A. J. Weber; *Specialist:* L. H. Harkins

CURRICULUM

The forestry curriculum provides students a basic educational background of biological, physical, and social sciences, humanities, mathematics and communication skills. Interspersed throughout the curriculum are forestry courses that deal with a wide variety of professional activities.

The goal of the program is a good education in the management and protection of rural and urban forest lands and resources, and the environment which they influence. Academic studies on campus are supplemented by practical laboratory exercises in forest areas, and the sophomore year is followed by an intensive 10-week summer camp experience in the Coastal Plain, Piedmont and Mountain regions of North Carolina.

Three months of acceptable work experience are required for graduation with a Bachelor of Science degree in forestry.

FORESTRY FIELDS OF SPECIALIZATION

The concentrations in forestry include a) general forestry, b) business operations, c) forestry biometry, d) watershed management, e) forest biology, f) wildlife management, g) harvesting operations, h) recreation, i) conservation and j) wood technology. A student selects a concentration and schedules appropriate approved courses.

DUAL DEGREE PROGRAMS

Programs have been arranged with economics and business, entomology, recreation resources administration, soil science, and zoology, whereby students can obtain, in addition to the Bachelor of Science degree in forestry, a second Bachelor of Science degree in agricultural economics, conservation, entomology, natural resource recreation management, soil science or wildlife management. These joint programs usually require additional credits above the forestry concentration and free elective credits. Depending upon ability, students may carry additional credits in their four-year program or by enrolling for an extra semester or equivalent summer session.

OPPORTUNITIES

Graduates are in demand by state and federal land-managing agencies, by industrial concerns growing wood as a raw material, and by other organizations and agencies such as the agricultural extension service. Some graduates, after acquiring professional forestry experience, are self-employed as consultants and as operators or owners of forest-related businesses.

FORESTRY CURRICULUM

FRESHMAN YEAR[1]

Fall Semester	*Credits*	*Spring Semester*	*Credits*
BO 200 Plant Life	4	CH 103 (107) General Chemistry	4
MA 112 Analytic Geom. Calc. A	4	MA 212 Analytic Geom. Calc. B	3
CH 101 General Chemistry	4	ENG 112 Composition & Reading	3
ENG 111 Composition & Rhetoric	3	FOR 210 Dendrology (Gymnosperms)	2
FOR 101 Introduction to Forestry	1	Humanity-Social Science Elec.	3
Physical Education	1	Physical Education	1
	17		16

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 221 College Physics	5	EB 212 Economics of Agriculture	3
WPS 202 Wood Struc. Prop.	3	FOR 272 Forest Mensuration	3
FOR 211 Dendrology (Angiosperms)	2	SSC 200 Soil Science	4
FOR 201 Intro. to For. Mensuration	2	Humanity-Social Science Elec.	3
English-Speech Elec.	3	Free Elective	3
Physical Education	1	Physical Education	1
	16		17

SUMMER CAMP

FOR 204	Silviculture	2
FOR 263	Dendrology	1
FOR 264	Forest Protection	2
FOR 274	Map. & Mensuration	4
FOR 284	Utilization	1
		10

All students select an option by the beginning of the junior year at the latest.

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 301 Intro. to Forest Insects	3	FOR 452 Silvics	4
ST 311F Intro. to Statistics	3	PP (FOR) 318 Forest Pathology	4
FOR 219 Forest Econ. & Oper.	3	Humanity-Social Science Elec.	3
Humanity-Social Science Elec.	3	Option Requirement	3
Option Requirement	3	Free Elective	3
	15		17

WORK EXPERIENCE*

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
FOR 405 Forest Land Management	5	FOR 406 Forest Land Inventory and Planning	6
Option Requirements	8	Option Requirements	9
Free Elective	3		
	16		15

[1] The Freshman year course offerings as shown here assume that entrance test scores suggest readiness for MA 112 and CH 101. Appropriate substitutions will be made where test scores indicate the need to start at a different level.

**Three months of acceptable work experience are required for graduation.*

Hours Required for Graduation 139

Recreation Resources Administration

Biltmore Hall

Professor T. I. Hines, *Head of the Department*

Professors: W. E. Smith, R. E. Sternloff; *Associate Professor:* M. R. Warren Jr.; *Adjunct Associate Professor:* J. S. Stevens Jr.; *Associate Professors Emeriti:* G. A. Hammon, L. L. Miller, C. C. Stott; *Assistant Professors:* D. L. Erickson, P. K. McKnelly, C. D. Siderelis; *Adjunct Assistant Professors:* J. H. Brendle Jr., H. K. Cordell, J. H. Moses; *Teaching Technicians:* B. E. Clapp, B. E. Wilson; *Adjunct Instructors:* R. L. Buckner, W. C. Singletary Jr.

Standards adopted by the recreation profession make college graduation a requirement for professional recreation employment. North Carolina State University has facilities, staff, curriculum, program and an established reputation for comprehensive professional education in recreation and parks.

The curriculum of Recreation Resources Administration offers a broad general educational background, basic professional and technical courses, and the opportunity to specialize in a particular field of recreation.

RECREATION RESOURCES ADMINISTRATION CURRICULUM

The recreation resources administration curriculum fulfills the needs of the graduate who will be employed by federal, state and local governmental agencies, private enterprises, industry and business, voluntary and quasi-public agencies and other private groups. General education courses are in biology, psychology, history and political science, English, mathematics, chemistry and economics. Specialized courses are in statistics, research methods, computer science, and landscape horticulture. Professional courses, applying directly to the needs of the recreator and his profession, cover recreation philosophy, management techniques and skills, fiscal operation, supervision, comprehensive and site planning, programming, administration, etc.

CONCENTRATIONS

A student may study the application of recreation management to a particular environment by following one of these concentrations:

Commercial Recreation—A background in economics, personnel management, accounting, marketing and business is necessary.

Institutional Recreation—Youth service agencies, corrective institutions and private agencies require that a graduate have emphasis in sociology and psychology.

Urban Park Management—Additional courses in applied biology, horticulture, soils, municipal government and community organization are required.

Natural Resource Recreation Management—Requires professional competence in natural resource management where there is a major concern with the preservation, wise use and improvement of recreation resources and opportunities as they occur in the forest environment.

Recreation Planning—A background is required in air photo interpretation, economics, governmental planning and community organization in addition to the core curriculum courses.

Recreation Program Management—A broad knowledge in face-to-face leadership techniques and skills involving the promotion and management of athletics, arts and crafts, music, dramatics and other recreation activities.

Natural Resource Interpretive—The management and promotion of the natural resource interpretive program requires a background in communication skills and an emphasis in the biological sciences.

Historical Resources Interpretive—The promotion, operation and management of the interpretive program provided for historical buildings and sites require the use of communicative knowledge and skills and a background in anthropology and history.

RECREATION RESOURCES ADMINISTRATION CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
BS 100 General Biology	4	EB 201 Economics I *or*	
ENG 111 Composition & Rhetoric	3	EB 212 Economics of Agriculture	3
FOR 101 Introduction to Forestry	1	ENG 112 Composition & Reading	3
MA 112 Analytic Geometry & Calculus A *or*		BO 200 Plant Life *or*	
MA 122 Mathematics of Finance	3-4	ZO 201 Animal Life	4
RRA 152 Introduction to Recreation	3	RRA 241 Recreation Resource Relat.	3
Physical Education	1	Social Science-Humanity Elective	3
		Physical Education	1
	15-16		17

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry I *or*		RRA 216 Maintenance & Operations II	3
CH 111 Foundations of Chemistry	4	FOR (WPS) 273 Quantitative Methods in Forest Resources *or*	
RRA 215 Maintenance & Operations I	3	CSC 200 Introduction to Computers & Their Uses	3
SOC 202 Principles of Sociology *or*		PS 201 American Govt. System *or*	
SOC 301 Human Behavior	3	PS 206 Local Governmental Systems	3
Elective	3	ST 311 Introduction to Statistics	3
Writing Elective	3	[1]Concentration	3
Physical Education	1	Physical Education	1
	17		16

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
BO (ZO) 360 Introduction to Ecology	4	RRA 359 Recreation & Park Supervision	3
RRA 341 Prin. of Recreation Palnning	3	RRA 451 Facility & Site Planning	3
RRA 358 The Recreation Program	4	[1]Concentration	6
[1]Concentration	6	Free Elective	3
	17		15

SUMMER SESSION
(9 weeks)

RRA 475 Recreation and Park Internship 9

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
HS 201 Principles of Horticulture *or*		RRA 454 Recreation & Park Finance	3
[2]HS 342 Landscape Horticulture	3	RRA 491 Spec. Prob. in Recreation *or*	
RRA 453 Admin. Policies & Procedures	3	SOC 416 Research Methods	3
Social Science-Humanity Elective	3	[1]Concentration	6
[1]Concentration	3	Free Elective	3
Free Elective	3		15
	15		

Hours Required for Graduation 136

Wood and Paper Science

Biltmore Hall

Professor I. S. Goldstein, *Head of the Department*

TEACHING AND RESEARCH

Professors: A. C. Barefoot, R. M. Carter, E. B. Cowling, E. L. Ellwood, J. S. Gratzl, C. A. Hart, R. G. Hitchings, R. G. Pearson, R. J. Thomas; *Adjunct Professors:* P. Koch, W. T. McKean, R. F. Vokes; *Professor Emeritus:* A. J. Stamm; *Associate Professors:* H. Chang, R. C. Gilmore, R. H. Reeves, C. N. Rogers, D. H. J. Steensen; *Adjunct Associate Professors:* W. T. Gladstone, T. K. Kirk, K. P. Kringstad; *Associate Professor Emeritus:* C. G. Landes; *Assistant Professor:* M. W. Kelly; *Adjunct Assistant Professor:* A. G. Mullin; *Assistant Professor Emeritus:* H. D. Cook; *Teaching Technician:* T. Gemmer; *Associate Members of the Faculty:* A. Prak (Industrial Engineering), V. T. Stannett (Chemical Engineering)

EXTENSION

Professor: M. P. Levi, Leader, Wood Products Section; *Associate Professor Emeritus:* L. H. Hobbs; *Assistant Professor:* S. J. Hanover; *Instructor:* E. L. Dean; *Specialists:* R. C. Allison, L. G. Jahn

[1] Of the 24 hours in the various concentration areas, 9 to 16 hours are required specifically for the selected concentration and 8 to 15 hours are elected from controlled areas.

[2] Required for Urban Park Management Concentration.

The wood industries have been a vital part of North Carolina's economy for over 300 years. North Carolina ranks high in the manufacture of hardwood, plywood, and wooden furniture, rough lumber and railroad tie production and the manufacture of pulp and paper. The value of forest products produced annually in the state exceeds three billion dollars. Seventeen percent of the state's labor force is employed in the wood industries.

The Department of Wood and Paper Science offers two curricula leading to Bachelor of Science degrees—wood science and technology and pulp and paper science and technology—to educate persons for careers in the wood based and allied industries or in government agencies concerned with wood resources. Wood science and technology is concerned with the technical aspects of wood and its processing into reconstituted and manufactured products. Pulp and paper science and technology deals specifically with wood fibers and their processing for paper and wood based chemicals.

PULP AND PAPER SCIENCE AND TECHNOLOGY

Robertson Laboratory

Professor R. G. Hitchings, *In Charge*

This curriculum prepares people for technical work in the rapidly growing pulp and paper industry which ranks fifth among all American industries. This is primarily a Southern industry with over 60 percent of the nation's pulpwood produced in the South. Careers include process engineers, product development engineers, technical service engineers, quality control supervisors, process control chemists and production supervisors. After basic science courses, the students study in the specialized Robertson Pulp and Paper Laboratory in wood pulp processes, chemical and by-products recovery, pulp bleaching, and in the various papermaking operations, such as refining, sizing, filling, dyeing, formation, coating and the converting of paper.

Pulp and paper is a regional program approved by the Southern Regional Education Board as the undergraduate program to serve the Southeast in this field. Approximately 70 undergraduate scholarships are granted annually to students by more than 100 company members composing the Pulp and Paper Foundation.

All pulp and paper majors spend at least one summer working in a pulp or paper mill designated by the University. One hour of academic credit is granted after completion of 12 weeks of mill work and presentation of a satisfactory report. In addition to this minimum summer work requirement, students are urged to work in mills the two other summers between academic years to gain valuable practical experience.

This curriculum leads to a Bachelor of Science in pulp and paper science and technology. Three programs are available emphasizing the technological, engineering or scientific aspects of pulping and papermaking. The technology program provides a broad background for those students anticipating careers in mill operations or with paper industry supplier organizations. Greater depth in the underlying scientific principles or their applications can be obtained from the science and engineering programs, which also provide a good foundation for graduate study. A fifth year program leading to a second degree, a Bachelor of Science in chemical engineering, is available.

PULP AND PAPER SCIENCE AND TECHNOLOGY CURRICULUM

TECHNOLOGY PROGRAM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry I	4	CH 107 Principles of Chemistry	4
ENG 111 Composition and Rhetoric	3	ENG 112 Composition & Reading	3
MA 112 Analytic Geometry & Calculus A*	4	WPS 242 Fiber Analysis	3
		MA 212 Analytic Geometry &	

WPS 101 Intro. to Wood and Paper Science	1
Social Science-Humanity Elective**	3
Physical Education	1
	16

Calculus B*	3
E 101 Engineering Graphics I	2
Physical Education	1
	16

* Honors students take MA 102, 201 and 202
** Basic economics course recommended

SOPHOMORE YEAR

Fall Semester	*Credits*
CH 220 Introductory Organic Chemistry	4
PY 211 General Physics*	4
ST 361 Introduction to Statistics for Engineers	3
Physical Education	1
Social Science-Humanity Elective	3
Free Elective	3
	18

Spring Semester	*Credits*
CH 315 Quantitative Analysis	4
PY 212 General Physics*	4
WPS (FOR) 273 Quantitative Methods in Forest Resources	3
Social Science-Humanity Elective	3
Physical Education	1
	15

* Honors students take PY 205, 208

JUNIOR YEAR

Fall Semester	*Credits*
CH 331 Introductory Physical Chemistry	4
CHE 301 Elements of Chemical Engineering	3
WPS 211 Pulp & Paper Internship	1
WPS 321 Pulp & Paper Technology I	3
WPS 331 Introduction to Wood and Pulping Chemistry	1
MAE 307 Energy & Energy Transformations	3
Social Science-Humanity Elective	3
	18

Spring Semester	*Credits*
Engineering Elective*	3
CHE 302 Elements of Chemical Engineering	3
WPS 322 Pulp & Paper Technology II	3
WPS 332 Wood & Pulping Chemistry	4
Free Elective	3
	16

* EE 331, 350, IE 301 or CHE 225

SENIOR YEAR

Fall Semester	*Credits*
WPS 471 Pulping Process Analysis	3
WPS 411 Pulp/Paper Unit Processes	3
WPS 491 Senior Problems in Wood & Paper Science	1
Social Science-Humanity Elective	3
WPS 413 Paper Properties & Additives	3
Technical Elective	3
	16

Spring Semester	*Credits*
WPS 403 Paper Process Analysis	3
WPS 412 Pulp & Paper Unit Processes II	3
WPS 463 Plant Inspections	1
Social Science-Humanity Elective	3
Free Elective	3
Technical Elective	3
	16

Hours Required for Graduation 131

PULP AND PAPER SCIENCE AND TECHNOLOGY CURRICULUM

SCIENCE PROGRAM

FRESHMAN YEAR

Fall Semester	*Credits*
ENG 111 Composition & Rhetoric	3
CH 101 General Chemistry I	4
MA 102 Analytic Geometry & Calculus I	4
WPS 101 Intro. to Wood and Paper Science	1
Social Science-Humanity Elective*	3
Physical Education	1
	16

Spring Semester	*Credits*
ENG 112 Composition & Reading	3
CH 107 Principles of Chemistry	4
MA 201 Analytic Geometry & Calculus II	4
E 101 Engineering Graphics I	2
WPS 242 Fiber Analysis	3
Physical Education	1
	17

* Basic economics course recommended

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
MA 202 Analytic Geometry & Calculus III	4	MA 301 Applied Differential Equations I	3
PY 205 General Physics	4	PY 208 General Physics	4
Social Science-Humanity Elective	3	Free Elective	3
Physical Education	1	Physical Education	1
	16		15

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 431 Physical Chemistry I	3	CH 433 Physical Chemistry II	3
CH 432 Physical Chemistry I Laboratory	1	WPS 322 Pulp and Paper Technology II	3
WPS 211 Pulp and Paper Internship	1	WPS 332 Wood & Pulping Chemistry	4
WPS 321. Pulp and Paper Technology I	3	Social Science-Humanity Elective	3
ST 361 Introduction to Statistics for Engineers	3	Technical Electives	4
CH 315 Quantitative Analysis	4		17
Free Elective	3		
	18		

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
WPS 471 Pulping Process Analysis	3	WPS 403 Paper Process Analysis	3
WPS 491 Senior Problems in Wood & Paper Science	1	WPS 463 Plant Inspections	1
WPS 413 Paper Properties and Additives	3	Free Elective	3
Social Science-Humanity Electives	6	Social Science-Humanity Elective	3
Technical Elective	3	Technical Electives	6
	16		16
		Hours Required for Graduation	131

PULP AND PAPER SCIENCE AND TECHNOLOGY CURRICULUM
CHEMICAL ENGINEERING PROGRAM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 112H Composition and Reading*	3	E 101 Engineering Graphics I	2
CH 101 General Chemistry I	4	CH 107 Principles of Chemistry	4
WPS 101 Intro. to Wood and Paper Science	1	WPS 242 Fiber Analysis	3
MA 102 Analytic Geometry & Calculus I	4	MA 201 Analytic Geometry & Calculus II	4
Social Science-Humanity Elective	3	CSC 111 Algorithmic Languages I	2
Physical Education	1	Physical Education	1
	16		16

* If not qualified, take ENG 111 and 112

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
PY 205 General Physics	4	MA 301 Applied Differential Equations I	3
MA 202 Analytic Geometry & Calculus III	4	CHE 225 Chemical Process Systems	3
CHE 205 Chemical Processes Principles	3	PY 208 General Physics	4
Physical Education	1	Free Elective	3
	16	Physical Education	1
			18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
WPS 211 Pulp & Paper Internship	1	WPS 322 Pulp and Paper Technology II	3
WPS 321 Pulp & Paper Technology I	3	CHE 315 Chemical Process Thermodynamics	3
CH 431 Physical Chemistry I	3	CHE 327 Separation Processes I	3
CH 432 Physical Chemistry I Laboratory	1		

CHE 311	Transport Processes I	3
Social Science-Humanity Elective		3
Free Elective		3
		17

WPS 332	Wood and Pulping Chemistry	4
Social Science-Humanity Elective		3
		16

SENIOR YEAR

Fall Semester		*Credits*
WPS 471	Pulping Process Analysis	3
WPS 411	Pulp & Paper Unit Processes I	3
WPS 491	Senior Problems in Wood & Paper Science	1
WPS 413	Paper Properties and Additives	3
Social Science-Humanity Electives		6
		16

Spring Semester		*Credits*
WPS 403	Paper Process Analysis	3
WPS 412	Pulp & Paper Unit Processes II	3
WPS 463	Plant Inspections	1
Technical Elective		3
Social Science-Humanity Elective		3
Free Elective		3
		16
Hours Required for Graduation		131

WOOD SCIENCE AND TECHNOLOGY

Professor R. M. Carter, *In Charge*

Wood science and technology is an applied science of an inter-disciplinary nature utilizing the natural sciences, mathematics, engineering and economics to understand wood and its processing. It is a materials science, but also involves industrial manufacturing and management. The wood technologist's job is related to engineering; but, unlike the engineer, one's educational exposure to wood science makes one capable of applying knowledge in such wood processes as machining, seasoning, gluing and finishing.

OPPORTUNITIES

The wood technologist's scientific engineering, industrial knowledge and specialty in the properties and behavior of wood qualify him or her for positions in today's modern wood manufacturing industries.

Careers include industrial positions with companies manufacturing lumber, veneer, plywood, particle and fiber boards and consumer wood products such as furniture. Wood technologists are also in demand by suppliers to wood manufacturing industries, such as chemical and machinery companies. Policy making opportunities are available with state and federal government in research, marketing or extension activities.

Wood is a renewable biological resource requiring less energy for processing than other materials. Therefore, the wood technologist can help improve the environment by developing cleaner processes, working with a renewable resource and creating policies governing environmental development.

FIELDS OF SPECIALIZATION

The program provides the opportunity to follow concentrations in a discipline outside the department to the extent of a minimum of 21 credit hours. The student may develop a second area of concentration which can be applied to the field of wood science and technology and which can also provide a base for subsequent graduate work in wood science and technology or in the concentration. Concentrations are available in: a) economics, b) quantitative analysis, c) biology and biochemistry, d) chemistry, e) harvesting operations and f) political science. Concentrations other than those listed may be arranged through the department.

DUAL DEGREE PROGRAM

A dual degree program is available with the Department of Economics and Business whereby students can obtain, in addition to a Bachelor of Science in wood science and technology, a second Bachelor of Science in economics.

Additional credits beyond those required for the single degree program are necessary. Capable students can usually obtain additional credits within the four years of the regular undergraduate program.

CURRICULUM

Students study nature of wood as a natural resource and its processing by means of a systematic study of the properties of wood and the processes involved in its utilization and manufacture.

The curriculum's flexibility enables students to specialize in areas of interest as they apply to the wood science and technology field. Sound mathematics and natural science background allows a materials science approach to wood to develop concurrently with training in the processing technology of wood and wood based products and in decision making applied to wood product manufacturing.

After the sophomore year students attend a six-week wood process laboratory practicum in the Brandon P. Hodges Wood Products Laboratory. Students then intern in industry or in institutional research.

During the program's final two years, students choose a concentration in another discipline outside of the department.

WOOD SCIENCE AND TECHNOLOGY CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 112 Analytic Geometry & Calculus A*	4	MA 212 Analytic Geometry & Calculus B*	3
CH 101 General Chemistry I	4	CH 103 General Chemistry II	4
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Reading	3
WPS 101 Intro. to Wood and Paper Science	1	BS 100 General Biology or BO 200 Plant Life	4
Social Science-Humanity Elective	3	Physical Education	1
Physical Education	1		
	16		15

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
EB 201 Economics I or EB 212 Economics of Agriculture	3	Social Science-Humanity Elective	3
PY 221 College Physics	5	WPS 203 Wood Structure & Properties II	4
Social Science-Humanity Elective	3	WPS 220 Wood Protection	3
WPS 202 Wood Structure & Properties	3	Concentration Elective	3
Physical Education	1	Free Elective	3
		Physical Education	1
	15		16

SUMMER PRACTICUM

	Credits
WPS 205 Wood Products Practicum	5
WPS 210 Forest Products Internship	1
	6

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Social Science-Humanity Elective	3	Social Science-Humanity Elective	3
ST 361 Introduction to Statistics for Engineers I	3	WPS 302 Wood Processing II	3
WPS 301 Wood Processing I	3	WPS 316 Wood-Polymer Principles	3
WPS 315 Introduction to Wood-Polymer Principles	2	WPS 344 Introduction to Quality Control	3
Concentration Elective	3	WPS 491 Senior Problems in Wood & Paper Science	1
		Concentration Elective	3
	14		16

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Social Science-Humanity Elective	3	WPS 442 Wood Mechanics & Design	3
WPS 434 Wood Operations	3	Concentration Electives	6
WPS 441 Introduction to Wood Mechanics	2	Free Electives	6
WPS 491 Senior Problems in Wood & Paper Science	2		15
Concentration Electives	6	Hours Required for Graduation	129
	16		

* Students with mathematical aptitude and interest are encouraged to substitute MA 102, MA 201 and MA 202 for the mathematical sequence listed.

LIBERAL ARTS

R. O. Tilman, *Dean*

W. B. Toole III, *Associate Dean*

The School of Liberal Arts offers programs of study which lead to baccalaureate and advanced degrees in the disciplines comprising the humanities and social sciences, and also offers courses in these areas which are part of the programs of all undergraduate students in the University. In this way the University provides an opportunity for its students to prepare for a full life in professions and occupations that require intellectual flexibility, broad knowledge, and a basic comprehension of human beings and their problems.

Nine departments are included in the School of Liberal Arts: economics and business (also a department in the School of Agriculture and Life Sciences), English, history, foreign languages and literatures, philosophy and religion, physical education, political science, sociology and anthropology (also a department in the School of Agriculture and Life Sciences) and speech-communication. Undergraduate majors are offered in economics, accounting, business management, English, history, French, Spanish, philosophy, political science, sociology, speech-communication, and multi-disciplinary studies. In some departments special concentrations are available within the major programs: e.g., writing and editing (English), criminal justice (political science or sociology), and social work (sociology). A teacher education option is available in English, speech-communication, French, Spanish, and social studies (history, economics, political science, sociology). Degrees granted include the Bachelor of Arts, the Bachelor of Science, the Master of Arts, and the Doctor of Philosophy, as well as professional degrees in economics, political science, and sociology.

BACHELOR OF ARTS PROGRAM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Reading	3
History*	3	History	3
Mathematics**	3-4	Mathematics	3-4
Foreign Laguage 201 (Intermediate)***	3	Philosophy*****	3
Social Science****	3	Social Science	3
Physical Education	1	Physical Education	1
	16-17		16-17

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Literature******	3	Literature	3
Natural Science*******	3-4	Natural Science	3-4
Elective	3	Social Science	3
Social Science	3	Elective	3
Elective	3	Area Elective********	3
Physical Education	1	Physical Education	1
	16-17		16-17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Major*********	6	Major	9
Electives	9	Electives	6
	15		15

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Major	9	Major	6
Electives	6	Electives	9
	15		15
		Hours Required for Graduation	124

* A two-semester program including a course concerned with pre-industrial Western or non-Western societies (HI 204, 207, 208, 209, 215, 216, 263, 264, 265, or 266), and another dealing with the United States or post-industrial Western societies (HI 205, 210, 211, 233, 241, 242, 243, 244, or 272).

** Two semesters required for economics and business or sociology majors (MA 111-112 or the equivalent required for economics and business; the same recommended for sociology but any two mathematics courses other than MA 115 allowed). For all other liberal arts majors the requirement may be satisfied with any two mathematics courses other than MA 115 or one course other than MA 115 plus a course in computer science, statistics, or logic.

*** Proficiency required at the first-semester intermediate level in French, Spanish, German, Russian, Italian, Latin, Greek, or Portuguese. Proficiency at the second-semester intermediate level in one of these languages is required for English, speech-communication, and foreign language majors.

**** The requirements call for twelve hours of social science representing at least three of the following disciplines: anthropology, economics, political science, psychology, sociology. At least nine of these hours must be outside the student's major field.

***** Three hours of philosophy, exclusive of logic (PHI 201 and 335), are required.

****** This requirement calls for *any two* of the following survey courses in British literature, American literature, and foreign language literature: Eng 261, Eng 262, Eng 265, Eng 266, FLG 301, FLG 302, FLS 301, FLS 302, FLF 301, FLF 302, FLS 303, FLS 304.

******* This requirement calls for a minimum of eight credit hours including one basic introductory course from physics, chemistry, or the biological sciences [CH 101, CH 103, CH 105 (with CH 104 lab), CH 107, CH 111; PY 205, PY 208, PY 211, PY 212, PY 231, PY 232; BS 100 *or* BS 105; BO 200]. The remaining hours may be completed through other courses chosen from the preceding list or through any of the following courses: PY 221, PY 223, ZO 221, ZO 400, ZO 490; BO (ZO) 360; GN 301; NTR 301, GY 101, GY 120, GY 208; MAS 200; MY 201.

******** One of the following courses in fine arts, literature in translation, religion, or speech-communication is required: ENG 290, ENG 325, ENG 346, ENG 347, ENG 397; FLR 303, FLR 304; GRK 320; FLF 491, FLG 498, FLS 491; all FL 250 courses; Art 200; Art History; DN 441; MUS 200, MUS 210, MUS 215, MUS 220, MUS 301, MUS 302, MUS 320; any course in religion; SP 340, SP 361, SP 420, SP 430.

********* Major requirements for the Bachelor of Arts range from 30-42 hours. Most of the major programs call for 30 hours of work above the basic courses in a discipline.

BACHELOR OF SCIENCE PROGRAM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry I	4	CH 107 Principles of Chemistry or CH 103 General Chemistry II	4
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Reading	3
Mathematics*	4	Mathematics	3-4
Physical Education	1	Physical Education	1
Humanities/Social Science Elective**	3	Humanities/Social Science Elective	3
	15		14-15

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PHI 205 Problems & Types of Philosophy	3	Humanities/Social Science Elective	3
Mathematics	3-4	Course I—Major****	3
PY 205 or 211 General Physics	4	Mathematics	3
Physical Education	1	PY 208 or 212 General Physics	4
Foreign Language/English Literature***	3	Physical Education	1
	14-15	Foreign Languages/English Literature	3
			17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
BS 100 General Biology	4	Humanities/Social Science Elective	3
History or Philosophy of Science*****	3	Course IV—Major	3
Course II—Major	3	Course V—Major	3
Course III—Major	3	Advanced Technology or Science Course II	3-4
Advanced Technology or Science Course I******	3-4	Zoology 201 Animal Life or Botany 200 Plant Life	4
	16-17		16-17

SENIOR YEAR

Fall Semester	*Credits*
Course VI—Major	3
Course VII—Major	3
Advanced Technology or Science Course II	3-4
Electives	6
	15-16

Spring Semester	*Credits*
Course VIII—Major	3
Course IX (Seminar in Major)	3
Advanced Technology or Science Course IV	3-4
Electives	6
	15-16

Total Hours Required for Graduation 127

* One of the following four-course sequences: 1) MA 102, 201, 202 and 231, 301, 312, 405; 2) MA 112, 212, 114, 214.
** Twelve hours in humanities and/or social sciences in areas outside major discipline.
*** Six hours of foreign language and/or English literature at 200 level or above.
**** Twenty-seven hours are required in economics, English, history, philosophy, or political science.
***** One of the following: HI 322, HI 321, PHI 405, HI 341, or MA 433.
****** A 15-hour concentration is required in some area of science or technology.

COOPERATIVE EDUCATION IN THE B.A. AND B.S. PROGRAMS

Cooperative Education in Liberal Arts seeks to broaden the student's intellectual horizons and at the same time provide an introduction to the world of business, industry, government, or finance in preparation for a career after graduation. The freshman and senior years are usually spent on campus while the sophomore and junior years are devoted to alternate periods of on-campus study and off-campus work. The student is paid by the employer for work experiences. Ordinarily the program takes five years to complete, but students who are willing to take an average of 18 hours a semester and attend summer school can finish in four years.

Further information can be obtained from the Director of Cooperative Education in Liberal Arts (124-D Tompkins Hall).

JOINT LIBERAL ARTS-ENGINEERING PROGRAM

Some students may want to combine a Bachelor of Science in engineering with either a Bachelor of Science or Bachelor of Arts in liberal arts. When the two are carried along together, the double degree program can be completed in five years. Those interested should contact the Director of the Freshman Engineering Division and the Associate Dean of Liberal Arts.

Economics and Business

Patterson Hall

Professor W. D. Toussaint, *Head of the Department*

Professor B. M. Olsen, *Assistant Head of the Department and Coordinator of Advising*

Professor F. D. Sobering, *Assistant Head of the Department, In Charge of Extension*

H. T. Daniel, *Scheduling Officer*

TEACHING, RESEARCH AND EXTENSION

Professors: R. C. Brooks, A. J. Coutu, E. W. Erickson, R. M. Fearn, D. G. Harwood, D. M. Hoover, L. A. Ihnen, P. R. Johnson, R. A. King, H. L. Liner, G. A. Mathia, T. E. Nichols Jr., E. C. Pasour Jr., E. A. Proctor, C. R. Pugh, R. A. Schrimper, J. A. Seagraves, R. L. Simmons, C. B. Turner, W. L. Turner, C. R. Weathers, R. C. Wells, J. C. Williamson Jr.; *Professors Emeriti:* A. J. Bartley, D. R. Dixon, J. G. Sutherland (USDA), E. W. Swanson; *Associate Professors:* J. G. Allgood, D. S. Ball, G. A. Carlson, J. S. Chappell, R. D. Dahle, M. M. El-Kammash, R. S. Fenwick, B. L. Gardner, H. C. Gilliam Jr. (USDA), L. H. Hammond, C. W. Harrell Jr., D. M. Holthausen, H. A. Homme, D. N. Hyman, Thomas Johnson, C. P. Jones, E. W. Jones, F. A. Mangum Jr., C. J. Messere, D. F. Neuman, R. J. Peeler Jr., R. K. Perrin, J. C. Poindexter Jr., P. S. Stone, R. E. Sylla, J. W. Wilson; *Associate Professor Emeritus:* R. S. Boal; *Assistant Professors:* R. L. Clark, L. E. Danielson, D. B. Diamond, J. E. Easley Jr., D. J. Flath, A. R. Gallant, T. J. Grennes, C. R. Knoeber, J. S. Lapp, M. P. Loeb, R. B. McBurney Jr., M. B. McElroy, L. B. Perkinson (USDA), W. P. Pinna, T. M. Reynolds, W. J. Wessels; *Visiting Assistant Professors:* G. M. Scobie, R. B. Vernon; *Assistant*

Professors Emeriti: J. C. Matthews Jr., E. M. Stallings, O. G. Thompson, Ruby P. Uzzle; *Instructors:* A. M. Beals Jr., W. P. Brown, M. R. Hilliard, M. T. Holcomb, D. M. Holmes, J. M. Jefferys, E. W. Leonard, T. N. Taylor; *Special Lecturers:* C. L. Bergold, G. A. Gunderson, W. P. Windham; *Extension Specialists:* C. E. Hammond, S. C. Riddick, S. R. Sutter; *Associate Members of the Faculty:* R. H. Berhard (Industrial Engineering), W. D. Cooper (Textile Technology), D. L. Holley (Forestry)

The economics and business program develops in the student critical and analytical skills which underlie the ability to understand contemporary problems and institutions, both in their historical setting and under conditions of change. The curriculum furnishes the academic background necessary for positions in industry, government service and graduate work (see pages 12-13 and consult the Graduate Catalog) in economics, business and the social sciences.

The Department of Economics and Business offers degrees in several undergraduate fields of study. These include the Bachelor of Arts degrees in accounting, business management, economics and the Bachelor of Science degree in economics. In addition, the department offers the social studies teacher education option to prepare the student for "A" certification in North Carolina secondary schools.

The department is administered jointly by the Schools of Agriculture and Life Sciences and Liberal Arts. For information on agricultural economics, see pages 66-67.

The department also provides service courses for the various technical schools and the Division of Continuing Education. An increasing number of curricula now offer a minor program in economics or business.

The department maintains a library including technical reference books, major professional journals and government publications. Research publications from other institutions throughout the United States are on file. Computational facilities are available for students whose research problems involve extensive analysis of data, as well as for those students who want to learn to use computer facilities. The department has a specially-trained clerical and programming staff and has access to an IBM System/370 Model 165 operated by the Triangle University Computational Center. Access is also available to other medium speed terminals and an IBM System/360 Model 40 located on the University campus.

BACHELOR OF ARTS IN ECONOMICS

The Bachelor of Arts degree in economics consists of 27 hours in prescribed and elected courses. Of these, 12 hours are required in the core. The remaining 15 hours are economics electives which are primarily society oriented.

		Credits
EB 301	Production and Prices	3
EB 302	Aggregate Economic Analysis: Theory and Policy	3
EB 350	Economics and Business Statistics	3
EB 490	Senior Seminar in Economics	3
	Restrictive Electives in Economics	15
		27

BACHELOR OF ARTS IN ACCOUNTING

The Bachelor of Arts degree in accounting consists of 39 hours in prescribed and elected courses. Of these, 12 hours are required in the core. The remaining 27 hours are divided among six hours of electives in economics and 21 hours in accounting courses.

		Credits
EB 301	Production and Prices	3
EB 302	Aggregate Economic Analysis: Theory and Policy	3
EB 350	Economics and Business Statistics*	3
ACC 468	Professional Accountancy Resumé	3
	Restricted Electives in Economics	6
	Accounting Concentration	21
		39

* ST 311, 361, or 371 may be substituted for EB 350.

BACHELOR OF ARTS IN BUSINESS MANAGEMENT

The Bachelor of Arts degree in business management consists of 33 hours in prescribed and elected courses. Of these, 18 hours are required as the core. The

remaining 15 hours are divided among six hours of electives in economics and nine hours from three of the five areas of business concentration.

		Credits
ACC 260	Accounting I—Concepts of Financial Reporting	3
EB 301	Production and Prices	3
EB 302	Aggregate Economic Analysis: Theory and Policy	3
EB 350	Introduction to Methods of Economic Analysis*	3
EB 307	Business Law I	3
EB 490	Senior Seminar in Economics	3
	Restricted Electives in Economics	6
	Electives from Areas of Business Concentration	9
		33

* ST 311, 361, or 371 may be substituted for EB 350.

SOCIAL STUDIES TEACHER EDUCATION OPTION

The Bachelor of Arts degree with a major in economics, social studies teacher education option, consists of a modified economics major plus 24 hours of complementary courses in history, sociology, anthropology and political science. Additional courses in psychology and education (including student teaching) in the 129 hour program complete the requirements for "A" certification. The social studies teacher education program is open to majors in economics, history, political science, and sociology and anthropology. Admission to the program, however, is limited to approximately 15 students per semester. Applicants are selected on the basis of academic competition and dedication to teaching.

		Credits
EB 301	Production and Prices	3
EB 302	Aggregate Economic Analysis: Theory and Policy	3
EB 350	Economics and Business Statistics*	3
	Restricted Electives in Economics	15
	Total Economics Courses	24
	Complementary Courses in History and Social Sciences	24

* ST 311, 361, or 371 may be substituted for EB 350.

BACHELOR OF SCIENCE DEGREE

The Bachelor of Science degree with a major in economics consists of 27 hours in prescribed and elected courses. Of these, 15 or 18 hours are required as the core. Nine of the remaining hours must consist of economics electives.

		Credits
EB 201	Economics I	3
EB 202	Economics II*	3
EB 301	Production and Prices	3
EB 302	Aggregate Economic Analysis: Theory and Policy	3
EB 350	Economics and Business Statistics**	3
EB 490	Senior Seminar in Economics	3
	Restricted Electives in Economics	9
		27

* EB 202 may be waived subject to the approval of the student's faculty adviser.
** ST 311, 361, or 371 may be substituted for EB 350.

Elective Courses

Students must complete at least two courses selected from the specified list of economics electives, the two intermediate theory courses (EB 301 and EB 302) and one of the basic statistics courses before enrolling in Senior Seminar (EB 490 or EB 468).

These electives, primarily society oriented are: EB 304, EB 370 (HI 370), EB 371 (HI 371), 410, 413, 422, 430, 431, 435, 436, 442, 448, 451, 475, 491, 501, 502, 515, 521, 533, 540, 550, 551, 555, 561 (ST 561), 570, and 574 (SOC 574).

Additional firm-oriented economics electives are available. These courses are often considered business courses and are intended to provide skills for dealing with problems at firm level. The areas of business concentration are:

Finance: EB 304, 415, 420
Business Management: EB 310, 525, 535
Marketing: EB 311, 313, 430, 521
Personnel: EB 326, 332, 431
Production: EB 303, 325, 523, 551

Courses from other departments may be used to fulfill business concentration requirements upon approval of the Department of Economics and Business.

English

Winston Hall

Professor L. S. Champion, *Head of the Department*

Professor R. B. White Jr., *Assistant Head of the Department*

Professor P. E. Blank, *Coordinator of Advising*

Professors: J. D. Durant, M. Halperen, A. S. Knowles, B. G. Koonce Jr., F. H. Moore Jr., G. Owen Jr., W. B. Toole III, P. Williams Jr.; *Professors Emeriti:* L. C. Hartley, H. G. Kincheloe, R. G. Walser; *Associate Professors:* L. J. Betts Jr., P. E. Blank Jr., J. W. Clark Jr., E. P. Dandridge Jr., J. B. Easley, H. A. Hargrave, L. F. Jeffers, D. M. Lucas, W. E. Meyers, C. E. Moore, M. S. Reynolds, D. D. Short, N. G. Smith, J. J. Smoot, H. C. West, M. C. Williams; *Assistant Professors:* J. S. Anhorn, B. J. Baines, M. M. Brandt, E. D. Clark, V. C. Downs, E. D. Engel, J. M. Grimwood, A. H. Harrison, W. E. Haskin, M. T. Hester, L. T. Holley, J. A. Kilby Jr., M. F. King, V. B. Lentz, L. H. MacKethan, N. B. Rich, K. L. Seidel, J. N. Wall Jr., R. V. Young Jr.; *Instructors:* G. W. Barrax, C. M. Blackman, G. B. Blank, J. H. Bolch, A. E. Brown, D. P. Ewing, J. S. Griffin, J. H. Hobbs, C. R. Horner, M. B. Jones, S. B. Jordan, H. J. Joseph, A. H. McDonald, G. I. Matthews, T. J. O'Sullivan, K. S. Spears, G. L. Stephenson, T. Toher, J. P. Williams; *Part-Time Instructor:* S. Y. Graham

The Department of English offers basic and advanced courses in composition, language, and literature. The freshman courses, common to all curricula and prerequisite to all advanced courses in English, are designed to give intensive training and practice in written communication, in addition to an introduction to literary types. Courses in communication of technical information and in creative and advanced expository writing are offered to meet requirements in special curricula and to provide elective credits. Advanced courses are available for a major in literature (Bachelor of Arts program), majors in English—writing and editing option (Bachelor of Arts program) or teacher certification option (Bachelor of Arts program), and a concentration in literature (Bachelor of Science program), as well as for general electives.

For graduate degrees, see pages 12-13.

B.A. PROGRAM, MAJORS IN ENGLISH

Bachelor of Arts Degree Program—The student must schedule 36 semester hours beyond the usual six hours in freshman composition. Basic requirements include the sophomore survey of English literature, a course in Shakespeare, and at least one course in American writers. Beyond these courses, the student may pursue special interests within the limits of two recommended categories. In the final semester, a special seminar (ENG 496) will serve as a capstone to one's study.

Bachelor of Arts in English—Writing and Editing Option—The student must schedule 36 semester hours beyond the usual six hours in freshman composition. Courses are included in journalism, technical writing, public speaking, radio, television and literature. In the final semester, a special seminar (ENG 496) will serve as a capstone to one's study. Additionally the student must schedule 15-18 semester hours in a track or discipline in which one wishes to apply communication skills.

B.A. PROGRAM, TEACHER EDUCATION OPTION IN ENGLISH

English majors may enroll in the teacher education option offered by the School of Liberal Arts in cooperation with the School of Education. Students who complete this program are eligible to apply for certification to teach English in secondary schools in North Carolina. The requirements of the program include 28 semester hours in professional courses and 36 semester hours in English beyond the usual six hours in freshman composition. Students desiring to enter this program should declare their intention before the spring of the sophomore year and are required to file a formal application for admission which must be approved in order for them to participate.

B.S. PROGRAM, CONCENTRATION IN ENGLISH

Bachelor of Science Program—The student, in consultation with his or her department adviser, must schedule 27 semester hours beyond the usual six hours in freshman composition, including the senior seminar.

Foreign Languages and Literatures

Harrelson Hall

Professor A. A. Gonzalez, *Head of the Department*

Associate Professor Gilbert G. Smith, *Assistant Head of the Department and Coordinator of Advising*

Professor: E. M. Stack; *Professor Emeritus:* G. W. Poland; *Associate Professors:* T. P. Feeny, G. Gonzalez, J. R. Kelly, M. Paschal, E. W. Rollins Jr., S. E. Simonsen, H. Tucker Jr.; *Associate Professor Emeritus:* F. J. Allred; *Assistant Professors:* S. T. Alonso, L. L. Cofresi, T. N. Hammond, W. M. Holler, B. Nogara, V. M. Prichard, C. E. Sorum, J. H. Stewart; *Assistant Professor Emeritus:* R. B. Hall; *Instructors:* S. de la Queriere, D. D. Girardi, E. M. Jezierski, L. K. Stillman

MAJORS IN FRENCH OR SPANISH

All the general requirements for the Bachelor of Arts degree must be met, including six hours of literature survey outside the major field. Degree designations are: B.A. in French Language and Literature, B.A. in Spanish Language and Literature, French Language and Literature Teacher Education option and Spanish Language and Literature Teacher Education option.

Bachelor of Arts degree—Students must complete 36 hours beyond the elementary courses (101-102), including a senior seminar. Majors must take 12 additional hours of related studies in a second foreign language or in British and American literature. Spanish majors have the additional option of 12 hours in Hispanic studies.

B.A. Program with Teacher Education Option—In collaboration with the School of Education, the department offers a program upon completion of which graduates may be certified as secondary school foreign language teachers in the North Carolina public school system. Candidates should advise their academic counsellor as early as possible for the proper planning of their curriculum. They should formally declare their intention by the spring semester of the sophomore year.

No graduate degrees are given in foreign languages, but special courses and certification examinations are offered for advanced degree students.

History

Harrelson Hall

Professor B. W. Wishy, *Head of the Department*

Assistant Professor J. A. Mulholland, *Coordinator of Advising*

Professors: B. F. Beers, M. L. Brown Jr., M. S. Downs, R. W. Greenlaw, W. C. Harris, D. E. King, J. M. Riddle, S. Suval; *Professors Emeriti:* S. M. Noblin, L. W. Seegars; *Associate Professors:* J. R. Banker, W. H. Beezley, C. H. Carlton, R. N. Elliott, J. P. Hobbs, G. D. Newby, R. H. Sack, E. D. Sylla, M. E. Wheeler; *Associate Professor Emeritus:* L. W. Barnhardt; *Adjunct Associate Professor:* T. W. Mitchell; *Assistant Professors:* R. M. Collins, C. J. Constantin, J. E. Crisp, C. W. Harper, C. F. Kolb, A. J. LaVopa, J. A. Mulholland, R. G. O'Brien, D. M. Scott

An understanding of the historical background of our times is expected of the educated person. The Department of History makes it possible for students to gain this understanding through a wide range and variety of courses at all levels from introductory through graduate.

A wide range of introductory courses is available to satisfy the history requirement or part of the humanities and social sciences requirement in most University curricula. Students in the School of Liberal Arts are required to take two courses in history—one dealing with a culture significantly different from our own in preindustrial Western or non-Western societies and the other dealing with our own

culture in the United States or post-industrial Western societies.

The Department of History in cooperation with the Division of Continuing Education makes available a variety of introductory courses by correspondence. Some introductory courses and most graduates courses are offered in the evening.

For graduate degrees offered, see pages 12-13.

BACHELOR OF ARTS DEGREE PROGRAM

A history major must take 30 hours of course work in history in addition to the six hours required of all students in the School of Liberal Arts. These 30 hours must include a senior seminar. At least 24 hours of the 30 must be at the 300 level or above.

BACHELOR OF ARTS PROGRAM WITH TEACHER EDUCATION OPTION

History majors may enroll in the teacher education program offered by the School of Liberal Arts in cooperation with the School of Education. Students who complete this program are eligible for certification to teach social studies in secondary schools in North Carolina. In addition to Bachelor of Arts degree requirements, students are required to take professional courses in education and psychology and additional social sciences courses. Students desiring to enter this program should declare their intention during their sophomore year. They are required to file an application for formal admission during their junior year. Admission is competitive and the criteria include an overall grade point average of 2.5 or better.

BACHELOR OF SCIENCE PROGRAM

A concentration in history involves 18 hours of course work beyond the six hours required of all students in the School of Liberal Arts, plus a senior seminar. Of the 18 hours, at least 12 must be at the 300 level or above.

Multi-Disciplinary Studies

Multi-Disciplinary Studies Committee

Professor R. S. Bryan (Philosophy and Religion), *Chairman*

Professor W. B. Toole (English)

Associate Professor W. C. Harris (History)

Associate Professor M. M. Sawhney (Sociology and Anthropology)

Associate Professor J. W. Wilson (Economics and Business)

Professor Paul A. Bredenburg *and Associate Professor* W. Curtis Fitzgerald, *Coordinators of Advising*

The multi-disciplinary studies program allows a student to design his or her own academic major. Instead of following the requirements for a major in *one* of the traditional disciplines, the candidate for the Bachelor of Arts degree in multi-disciplinary studies has the responsibility of organizing a concentration or field of specialization from *two or more* disciplines. A concentration in Latin American studies might, for example, combine related courses in language, literature, history, economics, sociology and political science.

The freshman and sophomore basic requirements for the multi-disciplinary studies program are the same as for the other Bachelor of Arts programs in Liberal Arts. In satisfying basic requirements in language, humanities, social science, mathematics and natural science, the student should, whenever possible, choose those courses that are most appropriate as background for the courses in his or her major concentration.

ADMISSION TO THE PROGRAM

To become a candidate for a major in multi-disciplinary studies, a student first secures application forms and information from the office of the dean of the School of Liberal Arts (Tompkins Hall, Room 118) or from the office of the chairman of the Multi-Disciplinary Studies Committee (Harrelson Hall, Room 122), then prepares a tentative proposal which includes a list of courses comprising 30 credit hours and an essay of 300-500 words explaining one's reasons for desiring to make this set of courses the field of specialization. The student's proposal is reviewed by a faculty sponsor and submitted to the Multi-Disciplinary Committee for consideration. After a thorough examination to determine whether the set of courses proposed as a multi-disciplinary major is academically sound and coherent, the committee will recommend that the Dean of Liberal Arts accept or reject the proposal; or it will be sent back to the student and his or her sponsor with suggestions for modification and resubmission.

Philosophy and Religion

Harrelson Hall

Professor R. S. Bryan, *Head of the Department*

Associate Professor W. C. Fitzgerald Jr., *Coordinator of Advising and Assistant Head of the Department*

Professor: P. A. Bredenberg; *Associate Professors:* W. R. Carter, W. L. Highfill, R. S. Metzger, T. H. Regan, A. D. VanDeVeer; *Associate Professor Emeritus:* J. L. Middleton; *Assistant Professors:* H. D. Levin, J. H. Moorhead, A. W. Sparer, J. C. VanderKam; *Instructors:* D. D. Auerbach, R. I. Nagel, C. L. Stalnaker

The Department of Philosophy and Religion at North Carolina State University: 1) serves the needs of the University at large by providing courses devoted to the discussion of the great philosophic ideas of western civilization and of the religious notions which have had an impact on all of civilization, and 2) provides an opportunity for extensive technical study in philosophy for those students who wish to concentrate in this field either for its own sake or as an ideal intellectual foundation for subsequent graduate or professional study.

Programs lead to two degrees in philosophy, the Bachelor of Arts and the Bachelor of Science. Candidates for the Bachelor of Arts degree in philosophy must complete 30 hours in philosophy not including the introductory course, Problems and Types of Philosophy (PHI 205). These must include either Logic (PHI 201) or Symbolic Logic (PHI 335); courses in the development of western philosophic thought (PHI 300, 317, 318, and 319); and a seminar (PHI 490). Candidates for the Bachelor of Science degree in philosophy must complete 27 hours in philosophy. These must include PHI 300, PHI 317, PHI 318, PHI 319, PHI 335, PHI 490 and PHI 405, Philosophy of Science.

Physical Education

Carmichael Gymnasium

Professor F. R. Drews, *Head of the Department*

Associate Professors: J. B. Edwards Jr., A. M. Hoch, H. Keating, W. R. Leonhardt, W. H. Sonner; *Assistant Professors:* A. L. Berle, J. V. Brothers, R. C. Combs, N. E. Cooper, J. M. Daniels, R. G. Gwyn, J. W. Isenhour Jr., M. S. Rhodes, J. L. Shannon, W. M. Shea, E. A. Smaltz; *Instructors:* W. A. Cheek, T. W. Evans, V. M. Leath, R. H. Nicholson, C. E. Patch, T. C. Winslow, G. E. Wall

North Carolina State University requires from two to four semesters in physical education to be taken consecutively during the freshman and sophomore years. The specific number of semesters of required physical education is determined for each student by the Department of Physical Education. Insofar as faculty, facilities and allotment of time permits, each student is guided into courses which will best meet individual needs.

Prescribed Courses—Prescribed courses are designed to meet the specific student needs as determined by tests. Prescribed courses are: Health and Physical Fitness, Beginning Swimming I, Beginning Swimming II, Restricted Activity I and Restricted Activity II. The Health and Physical Fitness course is required of all new freshmen. The Department of Physical Education also requires a demonstrated survival swimming ability or placement in the appropriate beginning swimming course.

Controlled Elective Courses—Elective courses are grouped under one of these areas: aquactics, combatives, developmental activities, individual sports and team sports. Students are encouraged to develop proficiency in at least two vigorous lifetime sports.

The courses PE 280, Emergency Medical Care and First Aid, and PE 285, Personal Health, are offered as electives but do not constitute credit towards meeting physical education requirements.

Political Science

Tompkins Hall

Professor W. J. Block, *Head of the Department*

Associate Professor K. S. Petersen, *Coordinator of Advising*

Professors: F. V. Cahill, J. T. Caldwell, A. Holtzman, R. O. Tilman; *Associate Professors:* J. H. Gilbert, H. G. Kebschull, J. P. Mastro, J. M. McClain, K. S. Petersen, M. S. Soroos, J. O. Williams; *Assistant Professors:* B. B. Clary, E. S. Fairchild, J. A. Hurwitz, T. E. Marshall, G. R. Rassel, E. R. Rubin, D. W. Stewart, J. E. Swiss; *Visiting Instructors:* S. H. Kessler, M. L. Vasu

The Department of Political Science offers basic and advanced courses in all major fields of the discipline: American government and politics (local, state and national), comparative government and politics, international relations and organizations, political theory, public administration and methodology of political science. The department provides an area in which students may concentrate their major efforts, and it affords opportunities for the study of government and administration to students in other curricula and schools.

Graduate courses in political science are available at N. C. State and at Fort Bragg. For graduate degrees see pages 12-13 and consult the Graduate Catalog.

The department conducts a State Legislative Internship Program in alternate years. It also participates in the State Government Internship program, which functions under the sponsorship of the Institute of Government at Chapel Hill.

MAJOR IN POLITICAL SCIENCE

Bachelor of Arts Program—Major requirements are: 30 hours (in addition to any political science course which may be taken to satisfy the 12-hour social science requirement), 21 of which must be at the 300-level or above; PS 201 or equivalent; at least six hours in each of three pairs of deciles (Pair A: American Politics/Policy and Administration; Pair B: International or Comparative Politics; Pair C: Political Theory/Scope and Methods) and a Political Science Seminar (indicated by its PS course number: any number whose first digit is 4 and whose last digit is 5 or higher or any number in the 560's).

The department recommends that its majors, whenever practicable, take MA 111 and MA 112 in fulfillment of the School of Liberal Arts mathematics requirement.

CONCENTRATION IN POLITICAL SCIENCE

Bachelor of Science Program—A concentration in political science requires 27 hours of course work in the discipline, including PS 202, PS 391 and a subsequent seminar in political science.

Criminal Justice (either B.A. or B.S.)—The Departments of Political Science and Sociology and Anthropology offer undergraduate majors a concentration in criminal justice. This concentration includes 24 semester hours of specialized study. The program develops students who may move into middle management and policy

making positions in agencies such as police, court, correctional, probation and parole agencies.

Students interested in criminal justice should contact Dr. Erika Fairchild, 221 Tompkins Hall, Political Science, or Dr. Elizabeth Suval, 230 1911 Building, Sociology and Anthropology.

Teacher Education Option—A major in political science may also choose a teacher education option. This is a 130-credit hour degree program which includes the normal 30-hour major plus the required professional education courses. Successful completion of the program leads to certification to teach social studies in the secondary schools.

Sociology and Anthropology

(Also see Agriculture and Life Sciences)

1911 Building

Professor S. C. Mayo, *Head of the Department*

Associate Professor E. M. Suval, *Assistant Head of the Department*

Professor J. N. Young, *Coordinator of Advising*

TEACHING AND RESEARCH

Professors: L. W. Drabick, C. P. Marsh, G. C. McCann, H. D. Rawls, M. M. Sawhney, J. N. Young; *Professor Emeritus:* C. H. Hamilton; *Associate Professors:* R. C. Brisson, W. B. Clifford II, A. C. Davis, C. V. Mercer, R. L. Moxley, R. D. Mustian, G. S. Nickerson, I. E. Russell, O. Uzzell, R. C. Wimberley; *Visiting Associate Professor:* K. D. Kim; *Assistant Professors:* W. T. Austin, C. G. Dawson, R. S. Ellovich, L. R. Della Fave, V. A. Hiday, T. M. Hyman, P. T. McFarlane, J. G. Peck, L. J. Rhoades, J. O. Shurling, P. L. Tobin, M. L. Walek, J. M. Wallace, M. T. Zingraff; *Visiting Assistant Professors:* H. L. Adkins, J. F. Denny, R. L. Gilmore

EXTENSION

Professor: J. N. Collins, *In Charge of Community Development*

Professors: J. D. George, M. E. Voland; *Professor Emeritus:* J. W. Crawford; *Associate Professors:* V. E. Hamilton, T. N. Hobgood Jr., C. E. Lewis, P. P. Thompson; *Assistant Professor:* C. W. Moody

This department teaches students the principles and techniques for understanding human group behavior. The department seeks: 1) to train students to become leaders in organizing groups and communities and in administering programs; 2) to qualify exceptional students on the undergraduate and graduate levels for 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.

BACHELOR OF ARTS DEGREE

The following departmental requirements must be met by all students majoring in sociology: A minimum of 30 hours in the major field including SOC 202, Principles of Sociology; SOC 301, Human Behavior; SOC 415, Introduction to Sociological Theory; SOC 416, Research Methods; a minimum of five electives, at least two at the 400 or higher level in sociology; and SOC 490, Senior Seminar in Sociology. The department also requires 15 additional hours of social science including one course in psychology; ANT 252, Cultural Anthropology, and an additional ANT course are strongly recommended. One course in statistics is also required.

Social Work—The curriculum prepares students for a professional career in a variety of agency and program settings designed to enrich the quality of life for persons served and to enable individuals, families, groups and communities to improve social functioning. The program combines 30-36 hours of classroom and field placement instruction which helps students to incorporate and use the values, knowledge, methods and techniques of social work practice. Graduates have full professional status and may be granted advanced standing in a two-year Master's

degree program in social work. The curriculum is accredited by the Council on Social Work Education.

Criminal Justice—The criminal justice option seeks to develop a professional orientation that will be relevant both to occupational goals and participation as a citizen in community affairs. Courses in both political science and sociology are included in a 28-hour block that provides a general background in crime causation and agencies of criminal justice plus the opportunity to select from more specific courses dealing with deviance, juvenile delinquency, the court system, correctional facilities, and the like, including field placement in an agency of the criminal justice system.

Social Studies Teacher Education Option—This curriculum prepares the student for state certification in social studies in the secondary school system. The inclusion of a professional semester with practice teaching and the need for a broad base in the social sciences makes this a comparatively demanding program with somewhat less opportunity for free electives. Courses in education and psychology are taken beginning in the sophomore year in preparation for the teaching experience. In addition, the student learns the basic concepts of economics, political science, anthropology and history, as well as sociology.

Speech-Communication

Tompkins Hall

Professor W. G. Franklin, *Head of the Department*

Assistant Professor T. L. Attaway, *Coordinator of Advising*

Professor: C. A. Parker; *Associate Professor Emeritus:* L. H. Swain; *Associate Professors:* L. R. Camp, H. E. Munn Jr.; *Assistant Professor:* T. L. Attaway, R. A. Francesconi, R. A. Leonard, B. L. Russell; *Instructors:* J. C. Schnur, G. P. Schumacher, N. H. Snow

Speech-Communication is conceived as: (1) a humanistic study; (2) a social and behavioral science, and (3) a natural science. Characteristically, humanistic study of speech and its consequences employs historical, critical, philosophical, esthetic, and literal analyses of the intentions, actions, and effects of oral communication. Scientifically viewed as a symbolic interaction, speech is an object of empirical inquiry in laboratory and field. Conceived as physiological, acoustic, and learned behavior, speech-communication receives the rigorous experimental analyses of the biological and physical sciences. Such multiple approaches are requisite to comprehending the complexity of the speech act.

MAJOR IN SPEECH-COMMUNICATION

Bachelor of Arts Degree Program—The major in speech-communication includes 30 semester hours. The curriculum in speech-communication requires five prescribed courses in speech. The student may elect courses within the field from among offerings in broadcast communication, organizational communication, public communication, speech science communication and theatre communication to complete the 30-hour requirement.

PHYSICAL AND MATHEMATICAL SCIENCES

Cox Hall

A. C. Menius Jr., *Dean*

J. D. Memory, *Associate Dean*

The School of Physical and Mathematical Sciences trains potential scientists and mathematicians; gives technical support to curricula in North Carolina State's other seven schools; and does research in physical sciences and mathematics. These activities are carried out by seven academic departments: biochemistry, chemistry, computer science, statistics, geosciences, mathematics and physics. The Institute of Statistics (Raleigh section) and the Department of Physical Sciences Research are also associated with the School of Physical and Mathematical Sciences.

Graduates of the school are recruited for technical and administrative positions in industrial research and development laboratories, universities and colleges, nonprofit research organizations and government agencies. A large percentage of the graduates undertake advanced study leading to the Master of Science and Doctor of Philosophy degrees.

The high school student with an above-average performance in mathematics, chemistry or physics, and a basic interest in natural phenomena and their mathematical descriptions, should consider a career in physical sciences or mathematics. The school consistently attracts outstanding students; approximately one-third of its students graduate with honors or high honors.

FACILITIES

Classrooms and school offices in the campus' center are listed under each department. In addition, physics research laboratories are located in Daniels Hall and the Nuclear Science Building and at the Triangle Universities Nuclear Laboratory in Durham. Biochemistry research is underway in Polk and Withers Halls.

Special equipment and laboratories include a plasma physics laboratory supported by a research tube-making facility; a radio-chemistry laboratory; a one-million volt Van de Graaff accelerator; analog and ambilog computers; an IBM 1130 digital; a laser research laboratory; a Varian Associates HA-100 high resolution nuclear magnetic resonance spectrometer; an upper atmosphere laboratory; a biomathematics and biophysics laboratory; undergraduate and graduate desk computing laboratories; biochemical research and teaching laboratories; and an ultraviolet-infrared-visible spectroscopic laboratory. Other campus facilities for teaching and research are electron microscopes, a heterogeneous nuclear reactor designed for operation at 100 kilowatts, complete x-ray laboratories with diffraction and radiographic equipment, a Beckman Model E analytical ultracentrifuge, precision instrument shops, and an IBM 360 Model 40 digital computer connected by telecommunication lines to the Model 75 at the Triangle Universities Computation Center. N. C. State also participates in the Triangle Universities Nuclear Laboratory which has a 0-35 Mev. cyclo-graaff accelerator.

CURRICULA

The school offers undergraduate programs of study leading to the Bachelor of Science degree with a major in chemistry, computer science, geology, mathematics, meteorology, physics or statistics. These curricula have similar freshman years, enabling a freshman to change, without loss of time, from one department to another in the school.

SHORT COURSES AND INSTITUTES

Several short courses and specialized institutes are offered throughout the academic year and during the summer months in chemistry, computer science, geology, mathematics, physics, and statistics for high school teachers and college professors. For information, write the school dean.

In addition, certain regular courses may be taken for credit through correspondence or evening classes through the Division of Continuing Education in Raleigh, Charlotte or in the Greensboro-Burlington-Winston-Salem area. For information write North Carolina State University Division of Continuing Education, Raleigh.

SUPERIOR STUDENT AND HONOR PROGRAMS

Exceptional students may be selected to participate in the Superior Student Program during their freshman and sophomore years. Enriched courses in chemistry, English, mathematics, and physics have been developed specifically for program participants. At the beginning of the junior year, promising students may select special courses, participate in undergraduate research, and receive some graduate credit toward the Master of Science degree during the senior year.

Well-prepared students entering the school may seek advanced placement in chemistry, history, mathematics, or physics by passing qualifying examinations.

STUDENT ACTIVITIES

In addition to University-wide extracurricular activities and honor organizations, the School of Physical and Mathematical Sciences has student chapters of the following professional and honor organizations: Society of Physics Students, Pi Mu Epsilon, the American Chemical Society, and the Association for Computing Machinery.

The Science Council, composed of elected students from the school, sponsors and participates in a wide variety of technical and social activities.

GRADUATE STUDY

The Master of Science degree is available with a major in biochemistry, biomathematics, chemistry, geology, marine sciences, statistics, mathematics, applied mathematics and physics. The Master of Biomathematics is offered. The Doctor of Philosophy degree is available in biochemistry, biomathematics, chemistry, marine sciences, statistics, mathematics, applied mathematics and physics.

Chemistry

Dabney Hall and Withers Hall

Professor C. L. Bumgardner, *Head of the Department*

Professor R. H. Loeppert, *Assistant Professor* W. P. Ingram Jr., *Assistant Heads of the Department*

Professor R. H. Loeppert, *Coordinator of Advising*

Professors: H. A. Bent, J. Bordner, L. H. Bowen, M. K. DeArmond, F. W. Getzen, F. C. Hentz Jr. (Director of General Chemistry), Z. Z. Hugus Jr., S. G. Levine, G. G. Long, C. G. Moreland, A. F. Schreiner (Graduate Administrator), W. P. Tucker, G. H. Wahl Jr., R. C. White; *Adjunct Professor:* M. E. Wall; *Professors Emeriti:* G. O. Doak, W. J. Peterson, W. A. Reid, P. P. Sutton; *Associate Professors:* H. H. Carmichael, T. C. Caves, A. F. Coots, C. E. Gleit, K. W. Hanck, L. A. Jones, M. L. Miles (Director of Organic Laboratories), D. W. Wertz; *Associate Professor Emeritus:* W. E. Jordan; *Assistant Professors:* Y. Ebisuzaki, W. R. Johnston, W. L. Switzer, T. M. Ward; *Assistant Professor Emeritus:* T. J. Blalock; *Instructors:* E. H. Manning, G. J. Shaw; *Instructors Emeriti:* J. W. Morgan, G. M. Oliver; *Teaching and Research Technicians:* M. C. Bundy, D. E. Knight; *Teaching Technician and General Laboratory Coordinator:* R. L. McClean

Chemistry is the science dealing with the composition of all substances and changes in their composition. Chemists have contributed to the synthetic fiber

DN 212 Basic Photography 3(1-4) 9-18-78 eff 1/79
DN 217 Typography II 3(2-2) 9-13-78 eff 1/79
DN 312 Intermediate Photography 3(1-4) 9-18-78 eff 1/79

DN 317 Typography II 3(1-4) 9-18-78 eff 1/79

DN 318 Ideation I 3(2-2) 9-18-78 eff 8/79

DN 412 Advanced Photography 3(1-4) 9-18-78 eff 1/79

DN 418 Ideation II 3(2-2) 9-18-78 eff 1/79

DN 449 Urban Form and Structure 3(3-0) 9-18-78 eff 1/79

industry, petroleum products and fuels, plastics, the food processing industry, nuclear energy, modern drugs and medicine. Today's chemists are concerned with the fundamental building blocks of all materials—atoms and molecules—leading to improvement of old materials, development of new ones and control of our environment.

OPPORTUNITIES

The chemical industry is the nation's largest manufacturing industry. Chemists comprise the largest proportion of scientists in the United States, and future demand for chemists should continue to grow. A variety of jobs is open to the chemist: biochemistry, metallurgy, space science, oceanography, sales or management, pure research. Chemists are employed in almost every field based on modern technology and opportunities in the field of education are many and varied. The Bachelor of Science program in chemistry provides an excellent premedical curriculum.

UNDERGRADUATE CURRICULA

BACHELOR OF SCIENCE IN CHEMISTRY

The Bachelor of Science curriculum (shown below), accredited by the American Chemical Society, includes a strong, broad background in mathematics, physics and the liberal arts. The basic areas of organic, physical, inorganic and analytical chemistry are stressed. Laboratory and classroom work develop the skills, knowledge and inquiring spirit necessary for a successful career in chemistry. The minor field and elective credits allow individual diversity at the junior and senior levels. Many undergraduates participate in current departmental research through part-time employment or a senior research project. The curriculum prepares the student for jobs open to the Bachelor of Science chemist or for advanced graduate work. For graduate degrees, see pages 12-13 and consult the Graduate Catalog.

BACHELOR OF SCIENCE, CHEMICAL SCIENCES OPTION

The chemical sciences option is a more flexible program for students who do not wish to become professional chemists but who wish to pursue interdisciplinary studies with an emphasis on chemistry. This program has less stringent requirements in mathematics, physics and chemistry than does the accredited Bachelor of Science program, thus permitting greater latitude in selection of courses from other disciplines. A student desiring this option should enroll initially in the standard Bachelor of Science curriculum. Near the end of the first year, one may transfer to the option after receiving departmental advisory committee approval for one's goals and program.

B.S. CHEMISTRY CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry I	4	CH 107 Principles of Chemistry	4
CH 106 Laboratory Techniques I	1	CH 108 Laboratory Techniques II	1
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
MA 102 Analytic Geometry and Calculus I	4	MA 201 Analytic Geometry and Calculus II	4
Social Science	3	PY 201 General Physics*	4
Physical Education	1	Physical Education	1
	16		17

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
English Elective	3	English Elective	3
MA 202 Analytic Geometry and Calculus III	4	MA 301 Applied Differential Equations I	3
PY 202 General Physics*	4	PY 203 General Physics*	4
Physical Education	1	Free Electives	3
		Physical Education	1
	16		18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 428 Qualitative Organic Analysis	3	CH 401 Systematic Inorganic Chemistry	3
CH 431 Physical Chemistry I	3	CH 433 Physical Chemistry II	3
Humanities—Social Sciences	3	CH 434 Physical Chemistry II Laboratory	2
FLG 101 Elementary German I	3	Humanities—Social Sciences	3
Minor**	3	FLG 102 Elementary German II	3
	15	Minor	3
			17

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 411 Analytical Chemistry I	4	CH 413 Analytical Chemistry II	4
Chemistry Elective	2	Humanities—Social Sciences	3
Humanities—Social Sciences	3	Minor	3
Minor	3	Free Electives	6
Free Electives	4		16
	16		

Hours Required for Graduation 131

Computer Science

Dabney Hall

Professor D. C. Martin, *Head of the Department*

Associate Professor T. L. Honeycutt, *Associate Department Head and Coordinator of Advising*

Professors: W. Chou, P. E. Lewis, D. A. Link, L. B. Martin; *Associate Professors:* D. R. Deuel, R. J. Fornaro, D. F. McAllister, J. D. Powell, W. E. Robbins, A. L. Tharp; *Adjunct Associate Professor:* L. H. Williams; *Assistant Professors:* S. D. Danielopoulos, L. E. Deimel Jr., J. W. Hanson, M. J. Lee, K. Tai, N. F. Williamson; *Instructors:* M. R. Austin, A. B. Finger; *Visiting Instructor:* J. Hatch; *Special Lecturer:* F. W. Houghtaling

The discipline of computer science has developed during the past 25 years as a direct consequence of rapid growth of the electronic computer. This technological development has great impact on man and the way he lives. Almost all areas of industry, the military establishment, government agencies, education and business use computers and new applications continue to arise. Computers are used to help make and operate our automobiles, airplanes and space ships; to help design our highways, bridges and buildings; to handle banking transactions and to assist in management decisions; to analyze farm production; as a research tool for the scientist; to monitor manufacturing processes, utilities and communication; and to provide a multitude of other services.

OPPORTUNITIES

A wide range of jobs exist for computer scientists since computers have diverse applications. Salaries are good for both men and women. There is a need for basic research into the principles of computer system design and the analysis of computational algorithms and students may choose to continue their training with graduate study.

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* The sequence PY 205, 208, 407 may be substituted for PY 201, 202, 203, with approval of the adviser.

** The minor may be in any field closely related to chemistry, such as mathematics, physics, computer science, geoscience, statistics, biological sciences, engineering or science education. A total of four courses in two such areas may constitute a "split" minor. The minor field should be chosen in consultation with the faculty adviser prior to or during the junior year.

CURRICULUM

This undergraduate curriculum leads to a degree of Bachelor of Science in computer science. Core courses provide foundations in programming and computer languages, the structure of data, computer architecture, solution methods including numerical analysis and simulation, and the theory of computation. The restricted electives chosen in consultation with one's adviser during the junior year allow exploration of specific computer science areas or fields such as information science, operating systems, computer architecture, and analysis of algorithms. One may study fields in which there are significant computer applications like management, physical, biological and social sciences, numerical analysis and statistics.

Students in other departments may select courses in computer science as electives to broaden their programs of study and to learn how to use the computer for solving problems.

COMPUTER SCIENCE CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CSC 101 Introduction to Programming	3	CSC 102 Programming Concepts	3
MA 102 Analytic Geometry and Calculus I	4	MA 201 Analytic Geometry and Calculus II	4
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
Basic Science	3	Basic Science	3
PE 100 Health and Physical Fitness	1	Physical Education	1
	14		14

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CSC 112 Basic Computer Organization and Assembly Language	3	CSC 311 Data Structures	3
MA 405 Introduction to Matrices and Linear Transformations	3	MA 312 Introduction to Differential Equations	3
PY 205 General Physics	4	PY 208 General Physics	4
Humanities-Social Sciences	3	Humanities-Social Sciences	3
Literature	3	Restricted Elective	3
Physical Education	1	Physical Education	1
	17		17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CSC 302 Introduction to Numerical Methods	3	CSC 312 Computer Organization and Logic	3
CSC 322 Applied Algebraic Structures	3	CSC 412 Introduction to Computability Language and Automata	3
ST 371 Introduction to Probability and Distribution Theory	2	ST 372 Introduction to Statistical Inference and Regression	2
Humanities-Social Sciences	3	Humanities-Social Sciences	3
Restrictive Elective	3	Restricted Elective	3
Free Elective	3	Free Elective	3
	17		17

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CSC 411 Introduction to Simulation	3	Restricted Elective	3
Restricted Elective	3	Restricted Elective	3
Restricted Elective	3	Restricted Elective	3
Humanities-Social Sciences	3	Humanities-Social Sciences	3
Free Elective	3	Free Elective	3
	15		15

Hours Required for Graduation 126

Geosciences

Withers Hall

Professor C. J. Leith, *Head of the Department and Coordinator of Advising*

Professors: H. S. Brown, E. G. Droessler, W. J. Saucier; *Professors Emeriti:* J. M. Parker III, J. L. Stuckey; *Associate Professors:* S. P. S. Arya, V. V. Cavaroc Jr., C. D. Harrington, G. S. Janowitz, C. E. Knowles, L. J. Pietrafesa, A. H. Weber, C. W. Welby; *Adjunct Associate Professors:* F. S. Binkowski, J. T. Peterson, J. R. Smith, W. H. Spence; *Associate Professor Emeritus:* E. L. Miller Jr.; *Assistant Professors:* M. J. Aldrich, E. F. Stoddard, T. L. Tsui, G. F. Watson, R. H. Weisberg, I. J. Won; *Adjunct Assistant Professors:* W. D. Bach Jr., J. K. Ching, R. E. Eskeridge; *Instructors:* T. B. Curtin, D. T. Long

The geosciences include the overlapping divisions of the physical, chemical and biological earth sciences, such as geology, geophysics, geochemistry, hydrology, meteorology, oceanography and paleontology. The Department of Geosciences offers courses in these disciplines and awards the B.A. and B.S. degrees in geology and the B.S. degree in meteorology. Degree programs in oceanography are at the graduate level only. (For graduate degrees offered see pages 12-13 and consult the Graduate Catalog.)

Geology is the professional field in which geological knowledge and techniques are focused on the solution of problems concerned with the environment, with the occurrence, origin, distribution and behavior of rocks, with mineral deposits, with raw material supplies and with a variety of engineering projects. Many engineering undertakings—siting and construction of dams and reservoirs, tunnels, buildings and highways—depend on geological setting knowledge. Discovery, evaluation, development and conservation of mineral resources (including fossil fuels and ground water) and the disposal of liquid and solid wastes require quantitative and analytical application of geologic principles.

Meteorology is the science of the atmosphere, including the processes and the phenomena within the atmosphere, the interactions with earth's land and sea surface below and with the solar atmosphere above. Its objectives are to apply understanding of the atmosphere and the processes within to benefit mankind in his welfare and endeavors. The meteorology curriculum provides basic training for roles in both theory and application. The student is prepared for research or professional applications.

No activity on earth is unaffected by the natural conditions and processes of our atmospheric environment. A familiar purpose of meteorology is to provide weather forecasts so man may protect himself intelligently from damages by weather and plan beneficially his individual activities for the immediate future. In addition to weather information reports to the public, meteorology reaches into broader aspects of environmental technology. Increasing concern about "environmental quality," in relation to operations and welfare, and to the impacts on air quality by commerce and industry have led to expanded concepts of atmospheric monitoring and the need for research and services applied to industrial operations, environmental planning and government regulation. Among meteorology fields are atmospheric pollution, weather modification and control, and interrelations with agriculture, industry and marine science.

The oceans are the subject of major research programs worldwide. The Department of Geosciences offers undergraduate and graduate courses in geological, meteorological and physical oceanography.

Remote sensing imagery provides a new dimension to geosciences. These data are utilized for teaching and research.

OPPORTUNITIES

Geologists are employed by oil companies, quarrying concerns, exploration companies, construction firms, railroads, public utilities, banks and insurance companies; iron, steel and other metal producers, manufacturers using nonmetallic raw materials such as ceramics, cement and abrasives; municipal, state and federal government agencies, schools, colleges, museums and research institutes. There is a growing need for the application of geological science to engineering construction

in connection with highways, foundations, excavations, beach erosion control and water supply problems. The mineral industry of the Southeast has expanded substantially in the last decade.

Basic meteorological services are provided by federal government agencies, primarily the National Oceanic and Atmospheric Administration and components of the Department of Defense; these agencies are the principal employers of meteorologists. This work may involve atmospheric sensing and measurement, including the use of meteorological satellites and space probes; data analysis and computation; weather forecasting, and guidance services to aeronautics, agriculture, forestry, hydrology, and recreation and public health. Meteorologists are used in environmental planning and regulation at the state and local levels. Power generating and fuel transmission industries, engineering firms, weather consulting firms, insurance companies, major retailing businesses, and schools and colleges and research institutions are employing meteorologists because of recognition of the involvement of the atmosphere on their activities.

GEOSCIENCES CURRICULUM

LEADING TO B.A. DEGREE IN GEOLOGY

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
MA 122 Analytic Geom. and Cal. I	4	MA 212 Analytic Geom. and Cal. II	3
Social Science-Humanities*	3	GY 222 Historical Geology	3
GY 101 General Physical Geology	3	Social Sciences-Humanities*	3
GY 110 Physical Geology Laboratory	1	Physical Education	1
Physical Education	1		13
	15		

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry	4	CH 103 General Chemistry II	4
Social Science-Humanities*	3	Social Science-Humanities*	3
GY 330 Crystallography & Mineralogy	3	GY 331 Optical Micros. & X-ray Diff.	4
Elective	3	Physical Education	1
Physical Education	1	Elective	3
SP 231 Expository Speaking	3		15
	17		

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 211 General Physics	4	GY 351 Structural Geology	3
Social Sciences-Humanities*	3	Social Science-Humanities*	3
GY 440 Igneous and Met. Petrology	4	GY 452 Sedimentary Petrology	4
ST 311 Intro. to Statistics	3	PY 212 General Physics II	4
CSC 200 Intro. to Computers & Their Uses	3	Elective	3
	17		17

SUMMER SESSION

GY 465 Geological Field Camp (OPTIONAL)

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
GY 462 Field Geology***	3	Geology Elective**	3
Social Science-Humanities*	3	Electives	6
Electives	3	Social Science-Humanities*	6
Geology Elective**	3		15
ENG 321 The Comm. of Tech. Info.	3		
	15	Hours Required for Graduation	124

* Social Science-Humanities requirements shall contain courses in at least three Humanities (Fine Arts, History, Literature, Language, Philosophy, Religion) and three Social Sciences (Anthropology, Economics, Political Science, Psychology, Sociology).

** Geology electives must include either Paleontology or Mineral Exploration and Evaluation.

*** GY 465 Geological Field Camp (or equivalent field camp) may be substituted for GY 462.

GEOSCIENCES CURRICULUM

LEADING TO B.S. DEGREE IN METEOROLOGY

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry I	4	CH 105† Chemistry—Principles & Applications	3
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
MA 102 Analytic Geometry and Calculus I	4	MA 201 Analytic Geometry and Calculus II	4
Humanities-Social Sciences	3	PY 205 General Physics	4
Physical Education	1	Physical Education	1
	15		15

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 202 Analytic Geometry and Calculus II	4	MA 301 Applied Differential Equations I	3
PY 208 General Physics	4	Geophysical Sciences Elective**	3
Communicative Arts*	3	Communicative Arts*	3
Humanities-Social Sciences	3	Technical Elective A***	3
Physical Education	1	Humanities-Social Sciences	3
	15	Physical Education	1
			16

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MY 411 Introductory Meteorology	3	MY 422 Atmospheric Kinematics & Dynamics	3
MY 421 Atmospheric Statics & Thermodynamics	3	MY 435 Measurements and Data Systems	3
ST 371 Introduction to Probability and Statistics	4	Technical Elective A***	3
Humanities-Social Sciences	3	Technical Elective B****	3
Free Elective	3	Free Elective	3
	16		15

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MY 441 Meteorology Analysis I	3	MY 412 Atmospheric Physics	3
MY 443 Meteorological Laboratory I	4	MY 444 Meteorological Laboratory II	4
Technical Elective B****	3	Technical Elective B****	3
Humanities-Social Sciences	3	Technical Elective A***	3
Free Elective	3	Free Elective	3
	16		16

Hours Required for Graduation 124

† Students who intend to take additional chemistry courses, or who plan technical electives which require additional chemistry, should add CH 104 or replace CH 105 with CH 103 or CH 107. Advanced tranafer students are permitted to substitute mathematics, science, or engineering credits for CH 105.

* Modern language or speech and technical writing.

** Geophysical science elective is selected from among GY 101, GY 120, MAS 200, PY 223, SSC 200, CE 201 or 370, FOR 272.

*** Technical elective A includes courses in the sciences, agriculture, and engineering, chosen from lists approved by the major department and school, but excluding more than one advanced course in meteorology. It must include at least one course in computer programming.

**** Technical elective B constitutes a minor field of emphasis, consisting of at least eight credits in that subject. Among those available, but not limited to them, are: chemistry, computer science, geology (physical geology, geophysics), mathematics (to include MA 511), physics (senior courses), statistics (to include a 500-level course), chemical engineering (heat transfer, fluid mechanics, air pollution), civil engineering (hydrology, sanitation, geodetics), electrical engineering (field theory, wave propagation, instrumentation), engineering science and mechanics (fluid mechanics), mechanical-aerospace engineering (heat transfer, fluid mechanics), forestry (protection, mensuration, management), health science (significantly involving atmospheric environment), marine science (upper division and graduate), plant science (significantly involving atmospheric environment), soil science (to include SSC 511).

Mathematics

Harrelson Hall

Professor N. J. Rose, *Head of the Department*

Professor H. V. Park, *Associate Head of the Department*

Professor W. J. Harrington, *Assistant Head of the Department and Coordinator of Advising*

Professors: J. W. Bishir, E. E. Burniston, R. E. Chandler, J. M. A. Danby, R. O. Fulp, W. J. Harrington, K. Koh, J. R. Kolb, J. Levine, P. E. Lewis, J. Luh, R. H. Martin Jr., P. A. Nickel, H. Sagan, H. E. Speece, R. A. Struble, H. R. van der Vaart, O. Wesler; *Associate Professors:* S. L. Campbell, H. C. Cooke, W. G. Dotson Jr., J. C. Dunn, R. Gellar, R. E. Hartwig, J. E. Huneycutt Jr., D. M. Latch, C. H. Little Jr., A. Maltbie, J. A. Martin, C. D. Meyer Jr., A. R. Nolstad, L. B. Page, C. V. Pao, D. M. Peterson, H. A. Petrea, J. A. Roulier, E. L. Stitzinger, W. M. Waters, J. B. Wilson; *Assistant Professors:* C. N. Anderson, H. J. Charlton, L. O. Chung, J. E. Franke, M. L. Gardner, D. E. Garoutte, D. J. Hansen, T. Lada, C. F. Lewis, J. Nelson, S. O. Paur, M. S. Putcha, R. T. Ramsay, R. G. Savage, S. Schecter, J. F. Selgrade, R. Silber, J. L. Sox Jr., D. F. Ullrich, R. E. White; *Instructors:* D. L. Brant, H. L. Crouch Jr., H. L. Davison, T. F. Gordon

The undergraduate major in mathematics provides a core of basic mathematics courses with a program of electives sufficiently flexible to prepare a student for graduate study in pure or applied mathematics (for graduate degrees, see pages 12-13), for careers in industry, business or government, or for teaching. A carefully selected set of required courses and electives in science, humanities and modern language provides a program well adapted to the demands of modern day life.

Students with a special interest may take the applied mathematics option.

REQUIREMENTS FOR BACHELOR OF SCIENCE IN MATHEMATICS

Required Mathematics Courses (30 credits)
- MA 102-201-202 Analytic Geometry and Calculus I, II, III
- MA 114 Introduction to Finite Mathematics with Applications
- MA 312 Introduction to Differential Equations
- MA 403M Introduction to Modern Algebra
- MA 405M Introduction to Linear Algebra and Matrices
- MA 425 Mathematical Analysis I
- MA 426 Mathematical Analysis II or MA 512 Advanced Calculus II

Mathematics Electives (12 credits)
- Twelve (12) credits of Mathematics courses at 400-500 levels.

Science and Mathematics-related Requirements (17-19 credits)
- CH 101
- CSC 101 or CSC 111
- MA 421 or ST 371-372
- PY 205-208 (or PY 201-202)

Science and Math-related Electives (12 credits)*
- (1) At least 6 additional credits of physical science, engineering science, or life science (6-12 credits)
- (2) Additional courses in Computer Science and/or Statistics (0-6 credits)

Required Humanities (15 credits)
- English 111, 112
- English or American Literature—one semester
- Introductory History—one semester
- Foreign Language—completion of the intermediate course no. 201

Humanities/Social Sciences Electives (18 credits)
- At least six (6) of the eighteen credits must be at the 300 or 400 level.

Physical Education (4 credits)

Free Electives (16-18 credits)

Hours Required for Graduation 126

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* These elective courses require the approval of the student's advisor.

REQUIREMENTS FOR APPLIED MATHEMATICS OPTION

Required Mathematics Courses (33 credits)
- MA 102-201-202 Analytic Geometry and Calculus I, II, III
- MA 114 Introduction to Finite Mathematics with Applications
- MA 312 Introduction to Differential Equations
- MA 403M Introduction to Modern Algebra
- MA 405M Introduction to Linear Algebra and Matrices
- MA 425 Mathematical Analysis I
- MA 426 Mathematical Analysis II or MA 512 Advanced Calculus II

MA 430 Introduction to Applied Mathematics

Mathematics Electives (6 credits)

Six (6) credits of Mathematics courses at 400-500 levels.

Science and Mathematics-related requirements (17-19 credits)

CH 101

CSC 101 or CSC 111

MA 421 or ST 371-372

PY 205-208 (or PY 201-202)

Applied/Career-oriented electives (15 credits)

(1) Twelve (12) credits* (in depth) in one Math-related or career-oriented area;

(2) Three (3) additional credits in science. (This may be replaced by a 400-500 Math elective if the 12 credits in (1) are all in science.)

Required Humanities (15 credits)

English 111, 112

English or American Literature—one semester

Introductory History—one semester

Foreign Language—completion of the intermediate course no. 201

Humanities/Social Sciences Electives (18 credits)

At least six (6) of the eighteen credits must be at the 300 or 400 level.

Physical Education (4 credits)

Free Electives (16-18 credits)

Hours Required for Graduation 126

* These elective courses require the approval of student's advisor.

SAMPLE PROGRAM IN Mathematics
(Includes the Applied Mathematics Option)

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 102M Analytic Geometry and Calculus I	4	MA 201M Analytic Geometry and Calculus II	4
CH 101 General Chemistry I	4	MA 114 Introd. to Finite Mathematics with Applications	3
ENG 111 Composition and Rhetoric	3	ENG 112 Composition & Reading	3
Introductory History	3	Science Elective	3-4
Physical Education	1	CSC 101 Intro. to Programming	3
	15	Physical Education	1
			17-18

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 202M Analytic Geometry and Calculus III	4	MA 312 Introd. to Differential Equations	3
PY 205 General Physics	4	MA 403M Intro. to Modern Algebra	3
English or American Literature	3	PY 208 General Physics	4
Foreign Language	3	Humanities/Social Science Elective	3
Science/Math-related Elective	3	Free Elective	3
Physical Education	1	Physical Education	1
	18		17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
MA 405M Introd. to Linear Algebra and Matrices	3	MA 421 Introd. to Probability	3
MA 425 Mathematical Analysis I	3	MA 426 Mathematical Analysis II	3
Science/Math-related Elective	3	Science/Math-related Elective	3
Humanities/Social Sciences Elective	3	Humanities/Social Science Elective	3
Free Elective	3	Free Elective	3
	15		15

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Mathematics Elective	3	Mathematics Elective*	3
Mathematics Elective	3	Mathematics Elective	3
Humanities/Social Sciences Electives	6	Humanities/Social Science Elective	3
Free Elective	3	Free Electives	6
	15		15

Hours Required for Graduation 126

* Replace by MA 430 for the Applied Mathematics Option.

Physics

Cox Hall

Professor A. W. Jenkins Jr., *Head of the Department*

Professor R. R. Patty, *Associate Head of the Department and Coordinator of Advising*

Professors: W. R. Davis, W. O. Doggett, G. L. Hall, G. H. Katzin, E. R. Manring, J. D. Memory, A. C. Menius Jr., G. E. Mitchell, M. K. Moss, J. Y. Park, L. W. Seagondollar, D. R. Tilley, A. W. Waltner; *Professors Emeriti:* W. H. Bennett, F. W. Lancaster, J. T. Lynn, L. H. Thomas; *Associate Professors:* K. T. Chung, G. C. Cobb, C. R. Gould, C. E. Johnson, Fred Lado, D. H. Martin, G. W. Parker, J. F. Schetzina; *Assistant Professors:* D. G. Haase, Jim Kim, J. R. Mowat, H. L. Owen, J. S. Risley, D. E. Sayers; *Associate Members of the Department:* J. M. A. Danby (Mathematics), R. E. Fornes (Textiles), R. L. Murray (Nuclear Engineering), D. L. Ridgeway (Statistics)

Physics is the fundamental science of observation, measurement and the mathematical description of the particles and processes of nature. In addition to extending our basic knowledge of the universe, physics provides the means for attacking problems of importance in modern technology. The variety of the contributions made by physicists is indicated by activities such as the discovery of new basic particles of nature, the invention and use of new instruments to probe interplanetary space, the study of processes fundamental to the release of thermonuclear energy, the development of lasers and solid state devices, the research on the structure and interaction of nuclei, atoms, molecules and ions.

PROGRAMS

The Physics Department offers a program of study at the undergraduate level which provides the student with a strong fundamental background and with course options allowing deeper study of selected areas of particular individual interest. At the graduate level, a comprehensive fundamental preparation is followed by specialization and research in one of the following areas: atmospheric, atomic, nuclear, nuclear magnetic resonance, plasma, relativity and solid state physics. (See pages 12-13 for graduate degrees and consult the Graduate Catalog.)

GRADUATE STUDY

The undergraduate curriculum in physics provides the basic training for a career in physics or for graduate study. The curriculum leads to a Bachelor of Science in Physics.

PHYSICS CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry I	4	PY 201 General Physics	4
ENG 111 Composition & Rhetoric	3	MA 201 Analytic Geometry & Calculus II	4
MA 102 Analytic Geometry & Calculus I	4	CH 107 Principles of Chemistry	4
Humanities-Social Sciences	3	ENG 112 Composition & Reading	3
Physical Education	1	Physical Education	1
	15		16

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 202 General Physics	4	PY 203 General Physics	4
MA 202 Analytic Geometry & Calculus III	4	PY 413 Thermal Physics	3
Free Elective	3	MA 301 Applied Differential Equations I	3
Humanities-Social Sciences	3	Free Elective	3
English Elective	3	Humanities-Social Sciences	3
Physical Education	1	Physical Education	1
	18		17

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 411 Mechanics I	3	PY 412 Mechanics II	3
PY 414 Electricity & Magnetism I	3	PY 415 Electricity & Magnetism II	3
PY 451 Intermediate Experiments in Physics I	2	PY 452 Intermediate Experiments in Physics II	2
MA 401 Applied Differential Equations II	3	Mathematics Elective	3
Free Elective	3	Humanities-Social Sciences	3
	14	Free Elective	3
			17

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
PY 401 Modern & Quantum Physics I	3	PY 402 Modern & Quantum Physics II	3
Technical Elective*	3	Technical Electives*	6
Mathematics Elective	3	Humanities-Social Sciences	3
Humanities-Social Sciences	3	Free Electives	3
Free Elective	3		15
	15		

Hours Required for Graduation 127

* Technical or Sciences Electives (above 200 level)

Statistics

Cox Hall

Professor D. D. Mason, *Head of the Department*

Professor F. E. McVay, *Coordinator of Advising*

Professors: B. B. Bhattacharyya, C. C. Cockerham, H. J. Gold, M. M. Goodman, A. H. E. Grandage, R. J. Hader, W. L. Hafley, D. W. Hayne, H. L. Lucas, R. J. Monroe, L. A. Nelson, C. H. Proctor, C. P. Quesenberry, J. O. Rawlings, D. L. Ridgeway, J. A. Rigney, R. G. D. Steel, H. R. van der Vaart, O. Wesler; *Adjunct Professor:* J. T. Wakeley; *Professor Emeritus:* G. M. Cox; *Associate Professors:* A. R. Gallant, T. M. Gerig, F. G. Giesbrecht, Thomas Johnson, A. C. Linnerud, A. R. Manson, J. L. Wasik; *Visiting Associate Professor:* B. S. Weir; *Adjunct Associate Professors:* D. L. Bayless, J. R. Chromy; *Assistant Professors:* D. A. Dickey, B. J. Stines; *Visiting Assistant Professor:* D. J. Drummond; *Adjunct Assistant Professors:* A. J. Barr, J. H. Goodnight, H. T. Schreuder; *Visiting Instructor:* John Warren; *Senior Research Technologist:* F. J. Verlinden; *Associate Statistician:* H. K. Hamann; *Assisatnt Statisticians:* P. H. Geissler, H. J. Kirk, D. W. Turner, F. T. Wang

Statistics is the body of scientific methodology which deals with the logic of experiment and survey design, the efficient collection and presentation of quantitative information, and the formulation of valid and reliable inferences from sample data.

The Department of Statistics is part of the Institute of Statistics, which includes Departments of Biostatistics and Statistics at Chapel Hill. The Department of Statistics provides instruction, consultation and computational services on research projects for other departments of all schools at North Carolina State University including the Agricultural Experiment Station. Department staff are engaged in research in statistical theory and methodology. This range of activities furnishes a professional environment for training students in the use of statistical procedures in such fields as the physical, biological and social sciences, and in industrial research and development.

The undergraduate program leads to a bachelor of science in statistics. For graduate degrees see pages 12-13 and consult the Graduate Catalog.

OPPORTUNITIES

The importance of sound statistical thinking in the design and analysis of quantitative studies is generally recognized. Industry relies on statistical methods to control the quality of goods in the process of manufacture and to determine the acceptability of goods produced. Statistical procedures based on scientific sampling have become basic tools in such diverse fields as weather forecasting, opinion

polling, crop and livestock estimation, and business trend prediction. Because one can improve the efficiency of use of increasingly complex and expensive experimental and survey data, the statistician is in demand wherever quantitative studies are conducted.

TYPICAL STATISTICS CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
CH 101 General Chemistry I	4	CH 103 General Chemistry II	4
MA 102 Analytic Geometry and Calculus I	4	MA 201 Analytic Geometry and Calculus II	4
CSC 101 Introduction to Programming	3	BS 100 General Biology	4
Physical Education	1	Physical Education	1
	15		16

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ST 371 Intro. to Probability and Distribution Theory	2	ST 372 Intro. to Statistical Inference and Regression	2
MA 202 Analytic Geometry and Calculus III	4	MA 405 Introduction to Linear Algebra and Matrices	3
PY 205 General Physics	4	PSY 200 Introduction to Psychology	3
EB 201 Economics I	3	PY 208 General Physics	4
Humanities or Social Science Elective	3	EB 202 Economics II	3
Physical Education	1	Physical Education	1
	17		16

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ST 421 Introduction to Mathematical Statistics	3	ST 422 Introduction to Mathematical Statistics	3
Major Elective	3	Major Elective	6
Foreign Language	3	Foreign Language	3
Humanities or Social Science Elective	3	Free Elective	3
Biological Science Elective	3		15
Free Elective	3		
	18		

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
ST 501 Basic Statistical Analysis	3	ST 502 Basic Statistical Analysis	3
Major Elective	3	Major Elective	3
ENG 321 Communication of Technical Information	3	SP 231 Expository Speaking	3
Humanities or Social Science Elective	3	Humanities or Social Science Elective	3
Free Elective	3	Free Elective	3
	15		15
		Hours Required for Graduation	127

Research in the textile chemistry laboratory is constantly monitored.

TEXTILES

Nelson Textile Building and David Clark Laboratories

D. W. Chaney, *Dean*

D. S. Hamby, *Associate Dean, Textiles Extension and Continuing Education*; M. R. Shaw, *Assistant Dean, Textiles Research;* P. D. Emerson, *Head, Textile Machine Design and Development*; W. E. Smith, *Assistant to the Dean, Student Services*; E. E. Hutchison, *Academic Coordinator*; G. Rodeffer, *Librarian, Burlington Textiles Library*

The field of textiles is broad. It covers almost every aspect of our daily lives—with applications in medicine, space, recreation and sports, personal safety, environmental improvement and control, transportation and in household and apparel uses. These versatile materials—textiles—are made to exacting design specifications by a variety of modern high-speed processes, utilizing tools such as lasers, electronics and computers. Textiles begins with the synthesis of fibers by man or by nature; it carries through a myriad selection of processes for fabric formation, including the steps necessary to make fabrics useful, such as the manufacture of dyestuffs and coloring, chemical auxiliaries and finishes, cutting and fashioning into end-use products.

The approximately 5,000 graduates of the School of Textiles hold diverse positions, mostly in North Carolina. In the textile and related industries, occupations range from manufacturing management, sales, corporate management, designing and styling, research development and technical service to quality control and personnel management. These textile graduates are in the creative and management decision-making aspects of the industry. They plan the flow of materials and machines. They create new products and processes. They solve product and process problems. They create styles, designs, patterns, colors, textures, and structures for apparel, home and industrial uses. They engineer the systems and products required of industrial, space, medical, apparel and other uses of textile products. They deal with computers, automation, product quality, plant performance and environmental problems. They manage large and small companies, personnel, and systems.

The School of Textiles prepares young people for careers in the above occupations. A broad background is stressed; two-thirds of the educational program can come from the resources of the University outside the School. Opportunities remain excellent, with the School maintaining one of the University's best placement records. Demand for textile graduates from North Carolina State University is particularly strong, due in part to the strength of the academic programs. These programs are organized in two departments: textile technology and textile chemistry.

CURRICULA

The School of Textiles offers a broad choice of curricula depending upon individual interests. Terminal Bachelor of Science programs in textile technology or in textile chemistry permit a broad choice of courses in addition to required core courses. For example, a student may specialize in yarn or fabric structures, in textile economics and marketing or in fabric styling and design. The student's curriculum includes humanities, social sciences and basic sciences and may result in a concentration in business economics, industrial engineering, languages, mathematics, physics, chemistry, political science, statistics or textile chemistry (or technology). The structure of the course sequence may allow graduate study in either the field of concentration or in textile chemistry or technology. It is possible, with one summer of extra work, to obtain a double degree, for example in textile technology and chemistry.

Curricula leading to graduate study, particularly to Doctor of Philosophy programs, such as in fiber and polymer science, differ from terminal Bachelor of Science programs primarily in the junior and senior year. While considerable

latitude is still possible, there are a number of prescribed courses, the nature of which depends upon the type of graduate study anticipated.

Textile chemistry gives the student fundamental education in chemistry emphasizing the application of this science to textiles. Emphasis on chemical fundamentals adequately prepares exceptional textile chemistry students for graduate study either in pure or applied chemistry. Similarly, students who complete the program in any of the concentrations in textile technology with a high degree of excellence may do graduate study in numerous areas.

Inasmuch as professional textiles work is concentrated in the last two years of the student's program, it is possible for students from junior or community colleges, or other institutions of higher learning, to transfer to the School of Textiles with a minimum loss of time.

INSPECTION TRIPS

For certain textile courses, it is desirable for the student to see the manufacturing process under actual operating conditions. When possible, student groups visit outstanding manufacturing plants. Trip participation is required; transportation costs and other travel expenses, while held to a minimum, are paid by the student.

SUMMER EMPLOYMENT

Job opportunities for summer employment are available for textile students. Placement assistance is available through the school placement office and frequently can be arranged in the student's home community. Qualified students may arrange to receive academic credit of up to three hours per summer not to exceed six hours for faculty-approved summer jobs.

DEGREES

Upon completion of programs in either textile technology or textile chemistry, the degree of Bachelor of Science is conferred.

The School of Textiles offers the following graduate degrees: Master of Textile Technology; Master of Science in textile technology or in textile chemistry; and Doctor of Philosophy in fiber and polymer science. For general requirements consult the Graduate Catalog.

By faculty agreement candidates for the Doctor of Philosophy degree in other schools of this institution may specialize in essentially textile-related subjects. In such cases, research is usually done in textiles.

THE FOUR-ONE PROGRAM

The School of Textiles has a program which permits a student with a baccalaureate degree from an accredited college or university to complete the requirements for a Bachelor of Science degree in textile technology or textile chemistry after the satisfactory completion of one year of study.

Applicants should have completed mathematics, physics and chemistry comparable to that required in the basic textile technology or chemistry curricula. Under these conditions, the student can complete the degree requirements in two regular semesters and summer school. Students not meeting minimum requirements in sciences or applied mathematics could remove deficiencies in the summer session prior to the fall semester, allowing completion of studies at the end of the normal period or in the following summer sessions.

Each applicant's undergraduate program is considered individually and, in general, a complete transfer of credits is possible.

HONORS PROGRAM

This program offers the exceptional student an opportunity to penetrate deeply into an area of special interest with exposure to various forms of research or independent study. Academically-promising entrants to the School, and students who develop academic promise during the freshman year, are assigned to honors advisers and are regarded as honors candidates. Special lectures, discussion groups

and seminars in the freshman and sophomore years introduce and reveal the possibilities for future development in the honors program. Towards the end of the freshman year, selected honors candidates are invited to become full members of the honors program. In the sophomore year, with honors adviser consent, honors students may begin to develop programs of strength in a special interest area. This may necessitate the substitution of preferred courses for those normally required. In the junior and senior years the student develops special interests, culminating in an honors thesis. The honors thesis ranges from a scholarly review of a special topic to a discussion of an experimental research problem.

FACILITIES

The Nelson Textile Building and David Clark Laboratories house one of the most modern, best-equipped textile institutions. Included is the Burlington Textiles Library, a division of the D. H. Hill Library and one of the country's most complete textile libraries.

SPECIAL SERVICES

The School of Textiles offers a number of services and programs which enriches its academic programs.

Textile Research is conducted on a wide variety of problems including some concerns of society with the environment and with health and safety. Frequently the problems are interdisciplinary and involve team effort. Students have an opportunity to participate in the solution to current problems.

Textiles Extension and Continuing Education is vigorously engaged in by all faculty. It serves the needs of the textile industry by disseminating research findings and offering short courses for executive, scientific and supervisory personnel. The two-way exchange in these activities keeps students and faculty informed on all of the latest developments.

Machine Design and Development including well equipped shops, provides engineering assistance to the faculty and students. This department endeavors to remain current with recent engineering advances applicable to textiles and maintains active liaison with industry and the scientific community.

The Office of Student Services is responsible for the placement and financial aid programs of the School of Textiles. The placement function makes available to a potential employer the credentials of our students for permanent and summer employment and in a great number of cases performs equally for alumni.

The financial aid function operates by committee and makes it possible for any North Carolina student to pursue an education in textiles through scholarships, loans or grants as long as one maintains the University's academic and moral standards.

Textile Chemistry

David Clark Laboratories

Professor W. M. Whaley, *Head of the Department*

Associate Professor C. D. Livengood, *Coordinator of Advising*

Professors: K. S. Campbell, D. M. Cates, J. A. Cuculo, R. D. Gilbert, G. Goldfinger, R. McGregor; *Professor Emeritus:* R. W. Work; *Adjunct Professors:* A. E. Davis Jr., H. F. Mark, A. Schindler, A. M. Sookne; *Associate Professors:* T. H. Guion, M. H. Theil, W. K. Walsh; *Adjunct Associate Professors:* H. N. Friedlander, K. K. Ghosh, T. Murayama; *Assistant Professor:* G. N. Mock; *Adjunct Assistant Professors:* L. A. Graham, W. R. Martin Jr.

The field of textile chemistry embraces a number of disciplines and is concerned, in part, with those industrial processes that constitute the final steps in the preparation of textile materials for the consumer. Common terms applied to these processes are scouring, bleaching, printing, dyeing and finishing. Textile chemistry is also concerned with fiber-forming polymers, both natural and man-made, and how the chemical and physical properties of such materials vary with fiber structure.

Students receive a fundamental knowledge of the underlying principles that relate to this derivative field and a perspective that includes the many interacting factors involved in the preparation and conversion of polymeric materials to useful products.

FACILITIES

David Clark Laboratories houses offices, classrooms, laboratories and pilot facilities for instruction and research. The departmental radiation laboratory is in Nelson Building. Radiation facilities include a Cobalt 60 source and a 500 KV Electron Accelerator.

Equipment is available for ultra-violet, visible, infrared, nmr and esr spectroscopy, reflectometry, colorimetry, viscometry, chromotography, differential thermal analysis, thermal gravimetric analysis, differential scanning calorimetry, instrumental measurement of color and computer color matching. Common testing equipment used for the evaluation of the physical properties of textile materials and for determining the color-fastness, wash-fastness, etc., of fibers and fabrics is also available. Complete pilot plant facilities allow demonstration of wet-processing operations used in textiles.

CURRICULA

The department has three undergraduate curricula: (a) Dyeing and Finishing Operations, (b) Dyeing and Finishing Science, and (c) Polymer Chemistry. The first concentration is primarily for students who wish a terminal Bachelor of Science degree, whereas the other concentrations are oriented toward advanced studies. However, the student taking Dyeing and Finishing Operations can use elective courses to achieve a background suitable for graduate studies if he wishes to do so.

For graduate degrees see pages 12-13 and consult the Graduate Catalog.

CURRICULUM IN TEXTILE CHEMISTRY

Dyeing and Finishing Science Concentration

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
T 101H Fundament. of Text.	2	T 203 Fiber Science I	3
ENG 111 Comp. & Rhetoric	3	ENG 112 Comp. & Reading	3
CH 101 Gen. Chemistry I	4	CH 107 Principles Chem.	4
MA 102 Analytic Geom. Calc. I	4	MA 201 Analytic Geom. Calc. II	4
Physical Education	1	Physical Education	1
	14		15

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
T 301 Tech. Dyeing Finish	4	TC 303 Textile Chemistry I	2
CH 221 Organic Chem. I	4	T 305 Intro. Color Science	1
MA 202 Analytic Geom. Calc. III	4	CH 223 Organic Chem. II	4
T 250 Fabric Form. System	4	PY 205 General Physics	4
Physical Education	1	MA 301 Appl. Diff. Equat.	3
	17	Free Elective	3
		Physical Education	1
			18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
TC 461 Chemistry of Fibers	3	Phys. Chem./Thermo. Elect.****	3
Dyeing Finishing Elective**	4	Dyeing Finishing Elect.**	5
PY 208 General Physics	4	Humanity-Social Sci. Elect.	6
T 220 Yarn Form. System	4	Free Elective	3
Phys. Chem./Thermo. Elect.****	3-4		17
	18-19		

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Dyeing Finishing Elective**	3	Polymer Chem. Elect.***	3
Polymer Chemistry Elective***	3	Textiles Elective[1]	2-5
Humanity-Social Science Elect.	6	Humanity-Social Science Elect.	6
PAMS Elective*	2-4	Free Elective	3
	14-16		14-17

Hours Required for Graduation 130

Restricted electives in

* PAMS—2-4 credits from the following:

CSC 111	2
CH 315	4
ST 361	3
CSC 101 + CSC 251	4

** Dyeing and Finishing—9 credits from the following:

TC 304	2	TC 405	1
TC 401	3	TC 406	2
TC 403	3	TC 412	3
TC 404	3	TC 505	3
		T 506	3

3 additional credits from the list above or the following:

TC 490	1-6	TC 591	3
TC 491	1	T 493	3

*** Polymer Chemistry—6 credits from the following:

T 402	3	TC 569	3
TC 504	3	TC 591 (Polymer Lab Course)	3
TC 561	3	TX 460	3
TC 562	3		

**** Physical Chemistry/Thermodynamics—6 credits from the following:

CH 431	3	or	CH 431	3	or	CHE 205	4
CH 433	3		CH 495 (Physical Chemistry)	3		CHE 316	3
	6			6			7

[1] Textiles—2-5 credits in TC, TXT or T courses at 300-500 level (including any elective course in dyeing and finishing or polymer chemistry listed above).

DYEING AND FINISHING OPERATIONS CONCENTRATION

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
T 101H Fundament. of Text.	2	T 203 Fiber Science I	3
ENG 111 Comp. & Rhetoric	3	ENG 112 Comp. & Reading	3
CH 101 Gen. Chemistry I	4	CH 107 Principles Chem.	4
MA 112 Analytic Geom. Calc. A	4	MA 212 Analytic Geom. Calc. B	3
Physical Education	1	Physical Education	1
	14		14

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
T 301 Tech. Dyeing Finish	4	TC 303 Textile Chem. I	2
CH 221 Organic Chem. I	4	T 305 Intro. Color Sci.	1
T 250 Fabric Forming Syst.	4	CH 223 Organic Chem. II	4
or		PY 211 General Physics	4
T 220 Yarn Forming Syst.	4	Humanity-Soc. Science Elect.	3
Humanity-Social Science Elect.	3	Free Elective	3
Physical Education	1	Physical Education	1
	16		18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
TC 461 Chem. of Fiber	3	Phys. Chem./Thermo. Elect.****	4
T 220 Yarn Forming Syst.	4	TC 404 Text. Chem. Tech.	3
or		TC 406 Text. Chem. Tech. Lab.	2
T 250 Fabric Forming Syst.	4	TC 412 Text. Chem. Analysis	3

TC 403 Text. Chem. Tech.	3
TC 405 Text. Che. Text. Lab	1
PY 212 General Physics	4
Humanity-Soc. Science Elect.	3
	18

Humanity-Social Sci. Elective	3
Free Elective	3
	18

SENIOR YEAR

Fall Semester	*Credits*
PAMS Elective**	2-4
Text. Elect.*	6
Textiles Elective***	3
Humanity-Social Science Elect.	3
	14-16

Spring Semester	*Credits*
PAMS Elective**	3-4
Textile Chem. Elective*	3
Textiles Electives	2-4
Humanity-Social Science Elect.	3
Free Elective	3
	14-17

Hours Required for Graduation 129

* Textile Chemistry Electives: 9 hrs. from following: TC 304; TC 401; TC 490; TC 491; TC 561; TC 562; TC 569; TC 591; T 402, T 493

** PAMS Electives: 5-8 hrs. from following or related courses: MA 114; MA 301; CH 315; ST 361; CSC 111; CSC 200 or CSC 101 + CSC 251

*** Textile Electives: 5-7 hrs. from any TC, TX or T courses in 300-500 level.

**** Physical Chemistry/Thermodynamics elective: either CHE 205 or CH 331

Note: (1) any course listed in Dyeing and Finishing Science or Polymer Chemistry may be substituted for required courses in Dyeing and Finishing Operations in the same subject and at the same level. *Example* MA 102 for MA 112 or PY 205 for PY 211.

(2) any student wishing Textile Management training is encouraged to select from the following list of courses for the 5-7 hours designated for textile elective courses:

TX 380	TX 484
TX 480	TX 491 - Supervision
TX 482	TX 586

POLYMER CHEMISTRY CONCENTRATION

FRESHMAN YEAR

Fall Semester	*Credits*
T 101H Fundament. of Textiles	2
ENG 111 Comp. & Rhetoric	3
CH 101 Gen. Chemistry I	4
MA 102 Analytic Geom. Calc. I	4
Physical Education	1
	14

Spring Semester	*Credits*
T 203 Fiber Science I	3
ENG 112 Comp. & Reading	3
CH 107 Principles Chem.	4
MA 201 Analytic Geom. Calc. II	4
Physical Education	1
	15

SOPHOMORE YEAR

Fall Semester	*Credits*
T 301 Tech. Dyeing Finish.	4
CH 221 Organic Chem. I	4
MA 202 Analytic Geom. Calc. III	4
T 250 Fabric Form System	4
Physical Education	1
	17

Spring Semester	*Credits*
TC 303 Textile Chem. I	2
T 305 Intro. Color Science	1
CH 223 Organic Chem. II	4
PY 205 General Physics	4
MA 301 Appl. Diff. Equa.	3
Free Elective	3
Physical Education	1
	18

JUNIOR YEAR

Fall Semester	*Credits*
TC 461 Chem. of Fibers	3
PY 208 General Physics	4
T 220 Yarn Form. System	4
Phys. Che./Thermo. Elect.****	3-4
Humanity-Soc. Sci. Elect.	3
	17-18

Spring Semester	*Credits*
Phys. Chem./Thermo. Elect.****	3
PAMS Elective*	2-4
Polymer Chem. Elect.***	3
Humanity-Soc. Sci. Elect.	3
Free Elective	3
	14-16

SENIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Dyeing Finishing Elective**	3	Polymer Chem. Elect.***	3
Polymer Chemistry Elective***	6	Textiles Elective[1]	2-5
Humanity-Social Sci. Elect.	6	Humanity-Social Sci. Elect.	6
Free Elective	3	Dyeing Finishing Elect.**	3
	18		14-17

Hours Required for Graduation 130

Restricted electives in

* PAMS—2-4 credits from the following:

CSC 111	2
CH 315	4
ST 361	3
CSC 101 + CSC 251	4

** Dyeing and Finishing—6 credits from the following:

TC 304	2	TC 406	2
TC 401	3	TC 505	3
TC 403	3	TC 591	3
TC 404	3	T 506	3
TC 405	1	TC 412	3

*** Polymer Chemistry electives—nine credits from the following:

TC 504 3	TC 569 3	TC 591 (Polymer Lab Course) 3
TC 561 3	TX 460 3	
TC 562 3	T 402 3	

Three additional credits from either the list above or the following:

TC 490 1-6	TC 591 3
TC 491 1	T 493 3

**** Physical Chemistry/Thermodynamics—6 credits from the following:

CH 431 3	or	CH 431 3	or	CHE 205 4	
CH 433 3		CH 495 (Physical Chemistry) 3		CHE 316 3	
6		6		7	

[1] Textiles—2-5 credits in TC, TXT or T courses at 300-500 level (including any elective course in dyeing and finishing or polymer chemistry listed above).

Textile Technology

Nelson Textile Building

Professor D. S. Hamby, *Acting Head of the Department*

Assistant Professor E. E. Hutchison, *Academic Coordinator*

Associate Professor M. L. Robinson Jr., *Coordinator of Advising*

Professors: J. F. Bogdan, A. H. El-Shiekh, T. W. George, S. P. Hersh, P. R. Lord, M. H. Mohamed, J. A. Porter Jr.; *Associate Professors:* E. H. Bradford, W. D. Cooper, C. L. Dyer, R. E. Fornes, P. L. Grady, B. S. Gupta, J. W. Klibbe, J. J. F. Knapton, W. E. Moser, J. E. Pardue, W. C. Stuckey Jr., P. A. Tucker; *Adjunct Associate Professors:* V. F. Holland, J. C. Lumsden, N. C. Morosoff, D. M. Powell, P. E. Sasser; *Associate Professor Emeritus:* T. G. Rochow; *Assistant Professors:* F. W. Massey, H. M. Middleton Jr.; *Adjunct Assistant Professor:* M. W. Suh; *Instructor:* G. W. Smith; *Lecturer:* T. R. Rhodes

CURRICULUM

The curriculum the first two years is concerned primarily with the physical sciences, humanities and social sciences, and with limited but important basic studies in textile fundamentals. The major work in textiles is done the junior and senior years.

The textile technology curriculum provides as general an education as possible, while preparing the graduate for a profitable, rewarding textile career. This is accomplished through an integration of the physical and social sciences and the application of these sciences and economics to the field of textiles.

In addition to the wide selection of sciences, the student has the opportunity for diversification within the School of Textiles. The curriculum offers depth in such selected areas as fiber and yarn technology, fabric technology, knitting technology, general textiles and textile management.

For graduate degrees, see pages 12-13.

CONCENTRATIONS

For a student to develop a second field of interest, the Department of Textile Technology offers an opportunity for the selection of a concentration from a discipline outside the department. Not only can strength be developed in a second discipline, but upon completion of the undergraduate work, one may pursue a graduate program of study in textiles or in the concentration discipline.

FACILITIES

Textile technology has laboratory areas for processing of short staple fibers, long staple synthetic fibers, throwing and texturizing continuous filament yarns. Laboratories for the study of the formation of woven, knitted and nonwoven fabrics including tufting and yarn preparation systems are available. The knitting laboratories include a hosiery section, circular and double knitting, warp and flat knitting, and knit goods finishing. The department has extensive facilities for physical testing of fibers, yarns and fabrics. A textile physics laboratory includes equipment designed for specialized problems related to textiles.

TEXTILE TECHNOLOGY CURRICULUM

FRESHMAN YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
CH 101 General Chemistry I	4	CH 103 General Chemistry II or	
ENG 111 Composition & Rhetoric	3	CH 107 Principles of Chemistry	4
Humanity-Social Science Elective	3	ENG 112 Composition & Reading	3
MA 111 Algebra and Trigonometry* or		MA 112 Analytic Geometry & Calculus A or	
MA 102 Analytic Geometry & Calculus I	4	MA 102 Analytic Geometry & Calculus I or	
T 101 Fundamentals of Textiles	2	MA 201 Analytic Geometry & Calculus II	4
Physical Education	1	T 220 Yarn Forming Systems	4
	17	Physical Education	1
			16

SOPHOMORE YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Humanity-Social Science Elective	3	CSC 200 Introduction to Computers & Their Uses	3
MA 212 Analytic Geometry & Calculus B or		Humanity-Social Science Elective	3
MA 202 Analytic Geometry & Calculus III	3 or 4	PY 205 General Physics or	
ST 361 Introduction to Statistics for Engineers	3	PY 211 General Physics	4
T 203 Fiber Science I	3	TX 211 Fiber Science II	3
T 250 Fabric Forming Systems	4	TX 330 Textile Measurements & Quality Control	4
Physical Education	1	Physical Education	1
	17-18		18

JUNIOR YEAR

Fall Semester	*Credits*	*Spring Semester*	*Credits*
Humanity-Social Science Elective	3	TX 340 Principles of Knitted Fabric Structures	5
PY 212 General Physics or		TX 350 Woven Fabric Structures	5
PY 208 General Physics	4	TX 380 Management & Control of Textile Systems	3
TC 301 Technology of Dyeing & Finishing	4	Concentration Hours (Programs A, B, C)	3
TX 320 Design & Control of Staple Yarn Systems	5		16
	16		

SENIOR YEAR

Fall Semester	*Credits*
Humanity-Social Science Elective	3
TX 460 Physical Properties of Textile Fibers or TX 560 Structural & Physical Properties of Fibers	3
Concentration Hours (Programs A, B, C)	6
Free Elective	3
	15

Spring Semester	*Credits*
Humanity-Social Science Elective	3
Concentration Hours (Programs A, B, C)	6
Free Electives	6
	15
Hours Required for Graduation	130

* MA 114 may, under certain circumstances, be substituted for MA 111.

The mathematics sequence for qualifying students shall be MA 102, 201 and 202. Eighteen credit hours of humanity-social science electives are required. These 18 hours are to include three credit hours of English and EB 201. Students are encouraged to take a minimum of two courses in the areas chosen to fulfill the humanity-social science requirement. The choice of course sequence and scheduling will be planned by the faculty adviser and the student.

PROGRAM A, TEXTILE SCIENCE

Program A is designed for the student interested in pursuing advanced studies in the basic and applied sciences. The textile courses in the concentration emphasize the physics and mechanics of textile structures and materials. The program is ideally suited for, but not limited to, those interested in pursuing graduate studies in the Master of Science or Doctor of Philosophy programs. The actual sequence of courses constituting the 15 hour concentration is based upon student interest with adviser approval. Typical courses from which the concentration may be structured are: MA 301, MA 511, ESM 301, PY 411, PY 412, PY 413, T 500, TC 461, TX 561. The student selects at least six hours of 400 or 500 level textile courses.

PROGRAM B, TEXTILE MANAGEMENT

Program B, consisting of 15 hours, is based upon a background in basic economics and is designed to develop an understanding of management control systems, decision-making theories and marketing and distribution systems. Six hours of course work must be selected from ACC 260, EB 420, 307, 326, 431, and 332, TX 586. The student would be expected to select at least six hours of 400 or 500 level textile courses.

PROGRAM C, GENERAL

Program C allows students to elect advanced courses in the field of textiles. These courses may be selected from the elective offerings by the School of Textiles and may be used to develop in-depth study in yarn forming, fabric forming, microscopy, quality control, textile chemistry or combinations of these areas.

For those students interested in developing a sequence of courses in a discipline outside of the School of Textiles, these 15 hours may be used, in whole or in part for a sequence of courses comprising the program of study planned by the student and faculty adviser and approved by the Head of Textile Technology.

University Studies

Harrelson Hall

Professor A. C. Barefoot, *Head*

Professors: D. Huisingh, J. R. Lambert Jr., J. C. Wallace; *Assistant Professor:* R. L. Hoffman; *Instructor:* C. L. Stalnaker; *Visiting Assistant Professor:* Elisabeth Wheeler

University Studies is an academic unit responsible for interdisciplinary programs dealing with contemporary issues and problems. Courses are taught by teams of faculty drawn from the Division and from the academic disciplines relating to the problems or issues under consideration. These courses are open without prerequisites to students in all curricula.

Military Education and Training

DEPARTMENT OF MILITARY SCIENCE (ARMY ROTC)

Professor: LTC S. A. Holcomb; *Instructors:* LTC B. J. Baucom, Capt. G. N. Edgar, Capt. L. G. Lupus, Capt. M. P. Kehoe, Capt. C. M. Rowley

DEPARTMENT OF AEROSPACE STUDIES (AIR FORCE ROTC)

Professor: LTC H. D. Woods; *Instructors:* Maj. M. T. Curran, Capt. J. E. Harper, Capt. H. O. Seagraves

The Department of Military Science (Army ROTC) and the Department of Aerospace Studies (Air Force ROTC) are separate academic and administrative subdivisions of the institution.

The mission of the Army ROTC program is to produce well-educated commissioned officers in sufficient numbers to meet Army requirements.

The mission of the Air Force Reserve Officers' Training Corps (AFROTC) is to recruit and, through a college campus education program, commission second lieutenants in response to Air Force requirements.

COURSE OF INSTRUCTION

Army ROTC—The program of instruction for the Army ROTC consists of a two-year basic course and a two-year advanced course. Also available is a two-year program designed for junior college graduates and students at four-year colleges who were unable to take ROTC during their first two years of college.

Air Force ROTC—The program of instruction consists of a two-year general military course, a field training course, and a two-year professional officer course.

Students desiring to enter either the Army or Air Force two-year program should contact the Military Science Department, Room 154, Reynolds Coliseum, or the Aerospace Studies Department, Room 145 Reynolds Coliseum, before the start of the spring semester of their sophomore year.

The Army and Air Force ROTC units conduct a flight instruction program. A limited number of highly qualified Army cadets participate and receive 36½ hours of flying in light aircraft. All Air Force ROTC cadets who are qualified and have volunteered for active duty pilot training receive 25 hours of flying. Both programs include ground school training. Successful completion of the Army program may qualify cadets for a Federal Aviation Agency private 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 University.

SELECTION

Army ROTC—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, and have not reached their 27th birthday and are selected by PMS and the University administration.

Air Force ROTC—A student enrolled in the Air Force ROTC may pursue a four-year program or a two-year program. Both offer the opportunity for receiving an AFROTC scholarship.

Students, to meet enrollment requirements for the professional officer course, must achieve a qualifying score on the Air Force Officer Qualification Test (AFOQT) and the SAT/ACT, meet necessary physical requirements and must have good academic records. Qualified veterans desiring a commission through an Air Force ROTC program complete the two-year advanced program and, in most cases, attend four weeks of field training. Non-veterans must complete the two-year general military course, the two-year professional officer course, and attend four weeks of field training. Non-veterans may elect to successfully complete six weeks field training and the two-year professional officer course in lieu of the above four-year program. Cadets must complete either program before their 30th birthday to qualify for a commission.

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.

FINANCIAL AID

Students in the Army basic or Air Force general military course, other than scholarship students, receive no monetary allowance. For summer training of four to six weeks, students receive pay and travel allowance. All Army and Air Force students in their last two years receive a subsistence allowance of $100 (tax free) per month. Scholarships which pay for tuition, all fees and textbooks are available to both Army and Air Force cadets.

Army ROTC—One-, two-, three- and four-year scholarships are available to selected Army ROTC students who are strongly motivated toward a career in the Army.

Air Force ROTC—A limited number of selected students enrolled in the Air Force ROTC program may qualify for two-, three- and four-year scholarships.

Uniforms—Uniforms for Army and Air Force ROTC are provided by the University from commutation funds paid by the Federal government.

ORGANIZATION

Army—The Army ROTC unit at N. C. State consists of a cadet battalion, commanded by a cadet lieutenant colonel, and comprised of a headquarters company and lettered companies. The cadet lieutenant colonel and all other cadet officers are selected from students enrolled in the second year advanced course. Cadet sergeant majors, 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 conduct all drill instruction with supervision by the University's Army faculty.

Air Force—The Air Force ROTC unit is organized as a cadet group (commanded by a cadet colonel) with an appropriate number of squadrons; the squadrons are composed of flights and squads. The group, squadron and flight commanders and their staff are cadet commissioned officers and are selected from cadets enrolled in the professional officers course. All other positions are held by cadet non-commissioned officers who are selected from general military course cadets. Cadet officers and non-commissioned officers plan and conduct the cadet group operation with AFROTC faculty supervision.

DISTINGUISHED STUDENTS

The University names outstanding students of the Army ROTC and Air Force ROTC as Distinguished Military Students or Distinguished Air Force ROTC Cadets. These students may, upon graduation, be designated Distinguished Military Graduates or Distinguished Air Force ROTC Graduates. Distinguished Military Graduates may be commissioned in the Regular Army.

Graduate School

V. T. Stannett, *Vice Provost and Graduate Dean*

The Graduate School provides instruction and facilities for advanced study and research in the fields of agriculture and life sciences, design, education, engineering, forestry, liberal arts, physical and mathematical sciences and textiles.

The School is currently composed of more than 1,000 graduate faculty members within the eight academic schools. Educated at major universities throughout the world and established both in advanced teaching and research, these scholars guide the University's graduate student body of some 2,500 men and women from all areas of the United States and about 70 other countries.

The faculty and students have available exceptional facilities, including libraries, laboratories, modern equipment and special research areas.

For a list of graduate degrees offered at North Carolina State University, see pages 12-13. Consult the Graduate Catalog for details on programs and admission.

University Extension

1911 Building

W. L. Turner, *Vice Chancellor for Extension and Public Service*

L. H. Hammond, *Assistant Vice Chancellor for Extension and Public Service*

M. F. Hester, *Assistant to the Vice Chancellor for Extension and Public Service*

The University administration is linked to the faculty of the various schools and with clientele groups throughout the state through the Vice Chancellor for Extension and Public Service, extension field staff, and through advisory or liaison groups. The University's overall extension program is coordinated through the Vice Chancellor for Extension and Public Service who administers program development, management of interschool and interinstitutional extension programs and projects and provides staff assistance for campus wide extension programs.

DIVISION OF CONTINUING EDUCATION

R. A. Mabry, *Director*

Associate Directors: J. Porter, D. B. Stansel; *Assistant Director:* C. F. Kolb; *Assistant to the Director:* H. H. Ethridge; *Continuing Education Specialists:* K. R. Crump, *In Charge*, J. F. Cudd Jr., D. Fender, D. S. Jackson, A. Lanier, H. G. Walker

The Division of Continuing Education of N. C. State is the statewide adult education service linking the University, its scholars, research, and resources with the people and communities of the State. The programs vary in length and format from one-day conferences and short courses to regular semester-length classes and educational television.

The Division's programs are designed to meet the needs of any adult who can benefit from university-level study. The instructional staff consists of University faculty, from N. C. State and other institutions and authorities in specific fields.

Only those programs appropriate to the standards of scholarship and instruction of N. C. State are offered. Both credit and noncredit programs are offered on the University campus, in communities throughout the State and by correspondence instruction.

Correspondence Courses—The Division offers more than 38 different courses in 14 subject areas and in high school review courses in English and mathematics. These courses are administered through the "Independent Study by Extension" UNC Extension Division, 121 Abernethy Hall, Chapel Hill, N. C. 27514.

Credit and Noncredit Evening Classes—The Division offers, during the fall and spring semesters, a series of credit and noncredit courses on the University campus. The credit courses are sponsored and taught by the University's academic departments and are generally conducted in the late afternoon and evening. These courses are offered to the already occupied mature person who is unable to attend classes during daytime hours. Approximately 110 courses in a variety of subject areas are given each semester. The noncredit classes are designed for cultural and professional enrichment.

Off-Campus Credit Courses—Extension classes are offered throughout the State. These classes are mainly on a need basis or by request from organizations or special groups. Courses are available in almost all subject matter areas from engineering to the social sciences. In 1973 the Division administered 80 credit classes in 27 different locations with registration totaling over 1,400.

Short Courses, Institutes, and Conferences—Short courses, institutes and conference programs, more than any others, mark the University's efforts to meet its Land-Grant tradition of providing education to all the people. The scope of the programs include: agriculture, engineering, forestry, textiles, the physical sciences, economics, management, communications, education, and recreation. During 1975-76 there were 225 courses offered with registrations totaling over 19,000.

The University awards Continuing Education Units to participants in qualified programs. Continuing Education Units are a part of a nationwide recording system to provide a uniform measure of attainment in noncredit educational programs. One CEU at N. C. State is defined as "ten contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction."

SUMMER SESSIONS

C. F. Kolb, *Director*

The Summer Sessions at N. C. State offer an extensive education program to meet the varied needs and interests of almost 9,000 students who come to the campus each summer.

Each of the University's eight schools—represented by more than 55 different departments—offers instruction in over 600 courses, more than 40 percent of which are at the graduate level. A faculty of more than 300 participates in programs for summer study. Six of the eight schools offer regular courses during the two five-week terms. Design offers one nine-week program. Forest Resources conducts a summer camp for sophomores and two five-week practicums. In addition, numerous special programs and institutes are offered during the summer. Summer courses and special programs meet the needs of undergraduate and graduate students of N. C. State and visiting students pursuing degrees from other institutions.

For information regarding summer activities write: Director of Summer Sessions, Box 5125, Raleigh, North Carolina 27607.

Water Resources Research Institute

The Water Resources Research Institute is a unit of the University of North Carolina System and is located on the campus of North Carolina State University. The deans of the School of Engineering and School of Agriculture and Life Sciences, the Dean for Research at North Carolina State University and two faculty members from the University of North Carolina at Chapel Hill serve as a board of directors. The Institute was established to promote a multidisciplinary attack on water prob-

lems, to develop and support research in response to the needs of North Carolina, to encourage strengthened educational programs in water resources, to coordinate research and educational programs dealing with water resources, and to provide a link between the state and federal water resources agencies and related interests in the University.

Research and educational activities are conducted through established departments and schools of the University System. All senior colleges and universities of North Carolina are eligible to participate in the Institute's research program. Applications for research grants must be received by October 1 for the Matching Grants Program and February 4 for the Annual Allotment Program preceding the fiscal year for which funds are requested. Basic support for the Institute's program is provided by the Office of Water Research and Technology, U. S. Department of the Interior, under the Water Resources Research Act of 1964, as amended, the U.S. Environmental Protection Agency, and appropriations from the State of North Carolina.

The Institute has sponsored a graduate minor in water resources which offers a strong water resources program with the major in any of the basic disciplines contributing to water resources planning, conservation, development and management. This capitalizes on the combined training resources of the Raleigh and Chapel Hill campuses of the University System and offers these in an organized way to graduate students seeking interdisciplinary training in this field. Additional information concerning the program is presented elsewhere in this catalog.

The Institute sponsors research and educational symposia and seminars, encourages the development of specialized training opportunities, and provides a means for the continuing evaluation and strengthening of the University System's total water resources program.

Civil engineering students learn surveying principles in order to understand the applications of surveying in planning, design and construction.

The artifacts of Asian religions are examined by students studying other cultures.

COURSE DESCRIPTIONS

In a typical course description, the semester hours of credit, the number of actual lecture and laboratory hours of meeting per week, and the term or terms in which the course is offered are shown in this manner: 2(1-2) F, S, Sum. or 1-3 F, S, Sum.

The 2 indicates the number of semester hours credit given for satisfactory completion of the course. The (1-2) indicates that the course meets for one hour of lecture and for two hours of laboratory work each week. The 1-3 indicates a minimum of 1 and a maximum of 3 semester hours credit can be earned. This is to be arranged with the instructor. The F designates the course is to be given the fall semester. Likewise, S designates spring; Sum, summer.

Abbreviations used in the course descriptions are: CI, consent of instructor; grad., graduate; undergrad., undergraduate; sr., senior; jr., junior; soph., sophomore; fr., freshman; preq., prerequisite; coreq., corequisite; lab., laboratory; lect., lecture; and alt. years, alternate years.

Waiver of prerequisites is at the discretion of the instructor.

CONTENTS

Accounting

(Also see Economics and Business.)

ACC 260 Accounting I—Concepts of Financial Reporting. 3(3-0) F,S. Financial reporting concepts, the information generating process, income measurement, resource valuation, corporate equity measurement, reporting practices, and the interpretation and analysis of financial statements. Introduction to internal controls and merchandising and manufacturing inventories. Staff

ACC 261 Accounting II—Financial Information Systems. Preq: ACC 260. 3(3-0) F,S. Information systems and their generation of financial data for reporting purposes. Includes consideration of the reporting practices related to noncorporate entities, financial statement structures and classifications, and internal controls. Staff

ACC 262 Managerial Use of Cost Data. Preq: ACC 260. 3(3-0) F,S. Managerial uses of cost data in planning, controlling, and evaluating organizational activities and in making business decisions. Includes consideration of budgeting, cost behavior, product costing and pricing, and an introduction to production cost. Staff

ACC 360 Financial Reporting Theory and Practice I. Preq: ACC 261. 3(3-0) F,S. The preparation of working papers and financial statements, the valuation and reporting problems relating to cash, receivables, inventories, investments, and tangible and intangible assets. Consideration of related professional pronouncements. Bergold, Brown

ACC 361 Financial Reporting Theory and Practice II. Preq: ACC 360. 3(3-0) F,S. The valuation and reporting problems relating to current and non-current liabilities, and corporate and non-corporate owners' equities. Includes cash and fund-flow reporting, the analysis of financial statements, the impact of price-level changes on financial reporting, and professional literature. Bergold, Brown

ACC 362 Production Cost Analysis and Control. Preq: ACC 262. 3(3-0) F,S. Managerial reporting practices for producing activities, the development and use of cost standards and budgets, and the cost measurement of productive inputs for units of productive outputs. Managerial use of cost data in analyzing, planning, and controlling business activity. Consideration of information systems and internal controls. Brown

ACC 460 Specialized Financial Reporting Theory and Practice. Preq: ACC 361. 3(3-0) F. The specialized valuation and reporting problems relating to consolidated financial statements, business combinations and reorganizations, governmental and nonprofit organizations, home office and branch relationships, foreign affiliates, estates and trusts, and business firms experiencing financial difficulties. Study of related professional publications. Windham

ACC 464 Income Taxation. Preq: ACC 260. 3(3-0) F,S. Federal and state income tax laws relating to individuals and other taxable or reporting entities, the measurement and reporting of taxable income, and basic research in taxation. Introduction to tax planning. Pinna, Messere

ACC 466 Examination of Financial Statements. Preq: ACC 361. 3(3-0) S. The objectives, standards, procedures, problems, practices and theory of financial statement examination as performed by independent public accountants. The professional standards and ethical codes, the features of information systems and internal control, and other professional topics. Extensive use of professional literature and authoritative pronouncements. Staff

ACC 304 An Introduction to Income Taxation 3(3-0) 1/18/78 eff 8/78

ACC 465 Advanced Income Taxation 3(3-0) 1/18/78 eff 8/78

ACC 468 Professional Accountancy Resume. Preqs: ACC 362 and 460. 3(3-0) S. A review and summation of the theory and practice of financial reporting and professional accountancy, as they relate to preparation for the certified public accountant's examination, covering both their general and specialized topics. Windham

Agriculture and Life Sciences

GENERAL COURSES

ALS 103 Introductory Topics in the Agricultural and Life Sciences. 1(1-0) F. The scope and objectives of a university education with emphasis on the sciences, particularly as related to biology and agriculture. Guest lectures and departmental programs presented. Glazener, Craig

ALS 299 Superior Student Seminar. Preq: Fr. and soph. honor students. 1, Maximum 2. S. Seminar program open only to fr. and soph. students in the honors program. Participation is by invitation. Staff

ALS (LA) 490 International Seminar. Preq: Jrs. and srs., upperclassmen interested in international affairs. 1(1-0) S. A weekly series of seminars on the economic and social aspects of developing countries. Staff

ALS 499 Honors Student Research. 1-3, Maximum 6. S. A research program open only to jr. and sr. students in the honors program. Participation is by invitation. Staff

AGRICULTURAL INFORMATION

AC 331 Communication Methods and Media. Preq: ENG 112. 3(3-0) S. Written, oral and visual techniques of communiciations; a survey of the channels of communications available; principles and techniques for using these channels individually or combined into a publicity, promotion, public relations, information or advertising program. Carpenter

Animal Science

ANS 200 Introduction to Animal Science. 4(3-3) F,S. The fundamental principles of dairying and meat animal production. The importance of dairy and meat products in the diet and in the economy. Goode, Rakes

ANS 204 Livestock Feeds and Feeding. 3(2-3) S. An introduction to applied animal nutrition, including the structure and function of the digestive tract, the nutrient value and classification of feedstuffs and the nutrient requirements and formulation of livestock rations. Leatherwood

ANS (FS,NTR) 301 Nutrition and Man. Preq: Two years of college work. 3(3-0) F,S. Basic principles relating to practical problems in the provision and utilization of nutrients for individuals and populations under various environmental conditions. McNeill

ANS 302 Selecting Dairy and Meat Animals. 3(0-6) S. Market classes and grades of beef cattle, swine and sheep are used to study live animal-carcass value interrelationships. Breed histories, pedigrees and desirable characteristics of dairy cattle, meat animals and quarter horses. Harvey, Wilk

ANS 308 Advanced Selection of Dairy and Meat Animals. Preq: ANS 302. 1(0-3) F. Includes intensive practice in selecting market and purebred livestock. Harvey, Wilk

ANS 401 Reproductive Physiology. Preq: ZO 421. 3(2-3) S.Current concepts of physiology related to mammalian reproduction. Emphasis on physiological processes, how they are influenced by external forces and their importance in reproductive performance. Myers, Johnson

ANS 402 Beef Cattle Management. Preq: ANS 204. 3(2-3) S. Modern management practices emphasizing the application of principles of genetics, ruminant nutrition and animal health to cow-calf programs and to stocker and feeder cattle operations. Harvey

ANS 403 Swine Management. Preq: ANS 204. 3(2-3) S. The economic, nutritional, genetic, physiological and managerial factors affecting the operation of modern swine enterprises. Clawson

cont/revised 3/15/78 eff 1/78

ANS 404 Dairy Cattle Management. Preq: ANS 204. 3(2-3) S. Dairy farm management, including feed acquisition and utilization, breeding and selection, health and sanitation, herd replacements and dairy farm buildings. Emphasis upon the consequences of management alternatives and the importance of herd and farm business records. Davenport

ANS 405 Lactation. Preq: ZO 421. 3(2-3) F. Gross and microscopic anatomy of the developing and the mature mammary gland. Physiological processes involved in milk secretion and the removal of milk from the gland. Research problem required. Mochrie

ANS 406 Sheep Management. Preq: ANS 204. 3(2-3) F. The economic, genetic, nutritional, physiological and managerial factors affecting the operation of the modern sheep enterprise. (Offered F 1977 and alt. years.) Goode

ANS (FS) 409 Meat and Meat Products. 3(2-3) S. (See food science, page 240.)

ANS 410 Horse Management. 3(2-2) F. Application of fundamentals of selection, nutrition, breeding and animal health to light horses. Managerial details are covered. Barrick

ANS 411 Breeding and Improvement of Domestic Animals. Preq: GN 411. 3(2-2) F. Genetic principles are stressed in relation to the improvement of economically important domestic animals. Emphasis on the specific requirements of breeding plans for individual species. McDaniel

ANS (NTR,PO) 415 Comparative Nutrition. Preq. CH 220 or 221. 3(3-0) F. Fundamentals of animal nutrition, including the classification of nutrients; the requirement and general metabolism by different species for health, maintenance, growth and other productive functions. Ramsey, Donaldson

~~**ANS (NTR) 416 Quantitative Nutrition.** Preq: BCH 351 or equivalent. 3 (1-6) F. Quantitative principles are applied to nutrition by using animals and microorganisms in practical experiments.~~ Armstrong

ANS 490 Animal Science Seminar. 1(1-0) S. Review and discussion of special topics in all phases. Lassiter

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ANS (PHY) 502 Reproductive Physiology of Vertebrates. Preq: ZO 421 or CI. 3(3-0) S. Emphasis upon discussion of mechanisms which control reproductive processes. Those which are species-limited are compared with those shared by all. Current knowledge of some subsystems is investigated in detail and others are referred to in reviews of well-documented research. Ulberg

ANS (VET) 505 Diseases of Farm Animals. 3(3-0) F. (See veterinary science, page 326.)

ANS (GN) 508 Genetics of Animal Improvement. Preq: GN 411, ST 511. 3(3-0) S. Emphasis upon the utilization of basic principles of population and quantitative genetics in animal improvement. Factors affecting genic and genotypic frequencies and methods of estimating genetic and non-genetic variance, heritabilities and breeding values. The roles of mating systems and selection procedures in producing superior genetic populations.

ANS 510 Advanced Livestock Management 3(3-0) eff. 1/78 Robison

ANS 520 Tropical Livestock Production. Preq: Six hours of ANS at 400-level or CI. 3(3-0) S. Modern principles of feeding, genetics, forage production and management are applied to improvement of meat and dairy animals in tropical, subtropical and high-altitude environments. Considers biological and socio-economic constraints to development of livestock industry. Discussion of climatic effects on production applies to U.S. conditions and to developing tropical countries. W. L. Johnson

ANS (PHY) 580 Mammalian Endocrine Physiology. Preqs: BCH 351, ZO 421. 3(3-0) F. Detailed discussions of the mammalian endocrine system emphasizing the functional aspect, chemistry and mode of action of specific hormones secreted by major endocrine glands. Modern biochemical and physiological principles of hormonal integrations and neuroendocrine integration. B. H. Johnson

ANS 590 Topical Problems in Animal Science. Maximum 6 F,S. Special problems are selected or assigned. Staff

ADT 354 8/1 8/79 Language and Culture 3(3-0) eff 8/77 2/25/77
ANT 254 ch.

Anthropology

(Also see Sociology.)

ANT 251 Physical Anthropology. 3(3-0) F,S. The evolution of man and his antecedents is illustrated by a study of fossil materials from Africa, Europe and the Far East. The course emphasizes the process of evolution, morphology, classification systems, dating techniques, the beginnings of culture and communication, and human variation, including contemporary races; and increases awareness of man as a culture-bearing primate.

ANT 252 Cultural Anthropology. 3(3-0) F,S,Sum. Through the study of nonliterate peasant and complex societies, an overview is given of the history of ethnological theory, methods in cultural anthropology, ethnographic field-work, personality and culture, the socialization process, cultural ecology, structural-functional analysis, language, art and society, kinship systems, political and economic anthropology, religions, magic and witchcraft, and social and cultural change.

ANT 305 Peoples of the World. 3(3-0) F,S,Sum. Introductory course in ethnology which develops a general understanding of the culture of primitive peoples, peasants, and of modern man. Specific problems are investigated such as cultural ecology, evolution, subsistence practices, nutrition, and economic development.

ANT ~~305~~ 310 Indians of North America. 6/6/78 eff 8/79 Preq: Six hours ANT and/or SOC. 3(3-0) F. Analyzes North American Indian and Eskimo life, including: 1) theories of provenience and an overview of selected prehistoric cultural manifestations; 2) peoples and cultures at the time of European contact; 3) the nature and concomitants of contacts between native Americans and whites; 4) examines contemporary Indian and Eskimo problems relating to identity, accommodation, assimilation and self-determination.

ANT ~~406~~ 325 Peoples and Cultures of South America. 6/6/78 eff 8/79 Preq: Six hours ANT and/or SOC. 3(3-0) S. Introduces student to the types of social groups found in South America, and explores the cultural development from prehistoric times to the present. Analyzes problems facing their developing nations from an anthropological point of view, stressing the interrelationships between the national decision-making processes and the small community.

ANT 416 Field Methods in Cultural Anthropology. Preq: Six hours ANT. 3(3-0) F,S. Provides a systematic experience with anthropological field techniques, i.e., community mapping; household census; kinship analysis; life-history recording; participant observation; inventory of material culture; child rearing observation. Familiarizes student with conventional anthropological field tools, i.e., tape recorder, motion picture camera, still camera, fieldwork journal, unstructured interview. Through textbooks and supplementary reading, provides a view of anthropologists' reports of their own field methods and problems encountered.

ANT 420 Biological Bases for Human Social Behavior. Preq: ANT 251, or BS 100 or 105, or GN 301, or equivalent. 3(3-0) S. This course entails an examination of the relevancy and applicability of animal behavior to the study of human social behavior. The nature and uniqueness of human behavior is evaluated in light of what is known about the social behavior of animals, particularly the nonhuman primates.

ANT 498 Special Topics in Anthropology. Preq: Six hours of SOC/ANT 1-6 F,S. A detailed investigation of a special topis in anthropology. The topic and mode of study will be determined by the faculty member(s) and the student. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ANT 505 Comparative Social Organization. Preq: ANT 501 or six hours cultural anthropology. 3(3-0) Alt. yrs. Course focuses on an analysis of forms of social organization in both technologically simple and complex societies from several analytical perspectives. Discussion of kinship theory: the relationship of social organization to systems such as the economic, political, and religious; an examination of modern development in social organization research will be stressed.

ANT 508 Culture and Personality. Preq: ANT 501 or six hours cultural anthropology. 3(3-0) Alt. yrs. Course focuses on the interplay between cultural norms and the enculturation process. Within a cross-cultural perspective, it examines the process by which cultural norms are transmitted and learned, as well as the effect of culture change on the individual. The

historical development of the field as well as contemporary trends are also discussed in both theoretical and applied contexts.

ANT 511 Anthropological Theory. Preqs: Six hours SOC, ANT 252 and 305, or equivalent. 3(3-0) Approaches theory from both an historical and contemporary point of view. Emphasizes the key anthropological concept of culture and its significance for understanding man and his works.

ANT 512 Applied Anthropology. Preq: ANT 252 or CI. 3(3-0) Includes a review of the historical development of applied anthropology and a study of anthropology as applied in government, industry, community development, education and medicine. The processes of cultural change are analyzed in terms of the application of anthropological techniques to programs of developmental change.

ANT 591 Special Topics in Anthropology. Preq: ANT 501 or equiv. 3 F,S. Course is designed to provide the opportunity for students to investigate in some depth particular topic in anthropology. Course content and mode of study will vary, reflecting current student needs and interests. Topics will be determined by the faculty members(s) and student.

FOR GRADUATES ONLY

ANT 501 Advanced Survey of Cultural Anthropology. 3(3-0) F.

Architecture

(See Design.)

Art

Art 200 The Visual Arts in Contemporary Life. 3(3-0) F,S. For undergraduates who are not majors in Design. Painting, sculpture, crafts, the useful arts of commerce,and the aesthetic nature of man are studied to increase understanding of man's artistic achievements and relate creative experience to every day life. Staff

Biochemistry

BCH 351 Elementary Biochemistry. Preq: CH 223. 3(3-0) F,S, Sum. A survey course to introduce basics of biochemistry and the various areas of research the discipline encompasses. Armstrong, Horton, Main

BCH 352 Elementary Biochemistry Laboratory. Preq: BCH 351 (may be taken concurrently). 1-2. F,S. A laboratory experience to complement BCH 351 which will emphasize basic biochemical laboratory techniques and analysis of data. Knopp, Miller

BCH 490 Special Studies in Biochemistry. Preq: Senior standing. 1-3 F,S,Sum.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BCH 551 General Biochemistry. Preq: Three years of CH including CH 223 or equivalent; CH 331 or 431 strongly recommended. 3(3-0) F. Principles of modern biochemistry including structural and metabolic relationships of carbohydrates, lipids, proteins, nucleic acids, enzymes and metabolic regulation. Jones

BCH 552 Experimental Biochemistry. Preq: CH 223; CH 315 recommended; Coreq: BCH 551. 3(1-6) F. Introduction to fundamental techniques of biochemistry and molecular biology involving experimental study of carbohydrates, proteins, enzymes, nucleic acids, lipids, metabolism and subcellular organization. Theil

BCH (PHY) 553 Physiological Biochemistry. Preq: BCH 551. 3(3-0) S. Application of biochemical methods to the elucidation of the function of whole organisms. A. Biochemistry of 1) blood, 2) water, electrolyte, acid-base balance, 3)renal function, 4) muscle metabolism, 5) central nervous system, 6) autonomic nervous system, and 7) endocrine system. B. Biochemistry of adaptation to environment 1) high and low P_{O_2}, 2) hot and cold, 3) wet and dry, and 4) pollution. Longmuir

BCH 554 Radioisotope Techniques in Biology. Preq: BCH 351 or CI. 2(-3) S,Sum. The different modes of radioactivity are correlated with methods of measurement. Emphasis on use and limitations of various instruments and techniques and on their application to research problems. Sisler

BCH 557 Introductory Enzyme Kinetics. Preq: BCH 551 and MA 201 or MA 212. 3(3-0) S. Basic principles of chemical kinetics are applied to the development of enzyme kinetics. Limitations of the Michaelis equation are considered in light of the general rate equation. Inhibition and activation, pH functions, effects of temperature, elucidation of mechanisms, and transient state and relaxation kinetics are also considered. Main

BCH (GN, MB) 561 Biochemical and Microbial Genetics. Preq: BCH 351 or 551, GN 411 or 505, MB 401 or equivalent. 3(3-0) S. The development of biochemical and microbial genetics, emphasizing both techniques and concepts currently used in research. Lectures and discussions of current research publications. Armstrong

BCH 590 Special Topics in Biochemistry. Preq: BCH 351 or equivalent. Credits Arranged, Maximum 3. F,S,Sum. Topics of special interest studied by small groups of students under faculty supervision, usually for the purpose of developing new courses. Staff

Biololgical and Agricultural Engineering

BAE 201 Shop Practices. 2(1-3) F.S. Designed to give the student an understanding of materials, tool processes and safety practices related to the operation and maintenance of a mechanized farming operations as well as general shop practice related to other agricultural industries. Laboratory exercises will be used to relate theory to practice as basic shop skills are developed. Blum, Howell

BAE 211 Farm Machinery. 3(2-3). F.S. A study of the operations, servicing, and adjustment of farm machines. Functional and energy requirements, and efficient operations as well as economic considerations in ownership, are stressed. Howell

BAE 251 Elements of Biological and Agricultural Engineering. Preq: Enrollment in SBE curriculum. 3(2-3) F. Pertinent topics basic to agricultural engineering and current progress relating to the different subject areas. Introduction to various engineering procedures, tool processes and materials utilized by the agricultural industries. Blum

FOR ADVANCED UNDERGRADUATES

BAE 303 Energy Conversion in Biological Systems. Preq: BS 100, MA 112 or 201, PY 205 or 211. 2(2-0) S. Energy transformations and exchanges of plants and animals are studied on the basis of physical theories and principles. Discussion of examples in convection, conduction, radiation, phase change, muscle work, photosynthesis, respiration and concentration of solutions. Suggs

BAE (SSC) 321 Water Management. Preq: Junior standing. 4(3-3) F. The application of water management principles is examined. Topics discussed include the hydrologic cycle, runoff, surface and subsurface drainage to include open ditch drainage and land forming, irrigation, erosion, soil conservation practices such as terracing, contouring and strip cropping, sedimentation, farm pond construction, open channel flow, environmental laws that pertain to water management, and the basic principles of surveying. Sneed

BAE 332 Farm Structures. Preq: PY 211 or 221. 3(2-3) S. Environmental relationships, design methods, materials, construction procedures and layout practices as they relate to current changes in agricultural production techniques. Problem situations relating to farm structures are investigated individually by each student in the laboratory. Emphasis on relating the theory to current applications. Blum

BAE 341 Farm Electrification and Utilities. Coreq: PY 212 or 221. 4(3-3) S. Practical and efficient use of electricity as an energy source for agricultural and home applications. Topics include energy conservation, electric rates, farm and house wiring, circuit design, single phase and three-phase distribution systems, electric motors, lighting, heating, electric controls, safety and protective devices, and home water systems. Glover

BAE 342 Agricultural Processing. Preq: MA 301, MAE 301. 4(3-2) S. Theory and application of heat and mass transfer to processing of agricultural crops. Topics include psychrometrics, thin layer and deep bed drying, continuous-flow drying, and principles of biochemical processing. Problem sessions will demonstrate principles of fluid flow, materials handling, process control, and various drying systems. Young, Johnson

BAE 361 Analytical Methods. Preq: MA 301; Coreq: ESM 307. 3(2-3) F. Develops skills in mechanical design and problem solving. Mechanical design includes graphical and

analytical determinations of velocity and acceleration, analysis and synthesis of linkages, design and/or selecting of beams, shafts, columns, bearings, clutches, brakes, gears, belts and chains. Approximately one-fourth of the course develops skills related to converting ill-defined problem situations into tractable engineering problems. Bowen

BAE 381 Agricultural Structures and Environment. Preq: ESM 307, MAE 301. 3(2-3) S. Principles of environmental control and structural analysis are combined with biological principles for the design of agricultural structures. Topics include physiological reactions of animals, plants and agricultural produce to their environment, applications of heat transfer and psychometrics in calculating ventilation requirements and heating or cooling loads, structural analysis, material selection, agricultural waste management, and economic considerations of various structural alternatives. Baughman

BAE 391 Electrotechnology in Biological and Agricultural Engineering. Preq: EE 331. 3(2-3) F. Basic concepts for selecting and utilizing electromagnetic devices. Switching circuits and central circuits are discussed and transducers and measurement techniques are related to agricultural problems. McClure

BAE 411 Farm Power and Machinery. Preq: BAE 211, PY 211 or 221. 3(2-3) S. The application of heat engineering principles in the development and utilization of power of internal combustion engines, both spark ignition and diesel. Thermodynamic principles and their application to the actual design and construction of engines. Principles of carburetion and ignition. Power transmission units, hydraulics and hydraulic controls. Power measurement and testing, and the economic utilization of power units. Fore

BAE (FS) 432 Food Engineering II. 3(2-3) S. (See food science, page 240.)

BAE 433 Processing Agricultural Products. Preq: PY 212. 4(3-3). S. This course will investigate the equipment used for agricultural processing on the farm or farm-related enterprises. The principles of operation and design features of processing equipment will be covered. Major topics include: (1) feed grinding and (2) milk processing, (3) cleaning, grading, and handling agricultural commodities, (4) crop drying and storing, and (5) refrigerated storage. Young, Willits

BAE 451, 452 Agricultural Engineering Design I and II. Preq: Sr. standing in SBE curriculum. 3(1-6) F,S. Design concepts are applied to current agricultural engineering problems. One major design project is combined with a variety of case studies and short term design problems. Rohrbach

BAE 461 Analysis of Agricultural Systems. Preq: MA 114 or 112, EB 212. 3(2-2). F. Basic concepts of systems analysis with application to agricultural problems. Tools and methodology of systems analysis. Topics include economics of decision making, linear programming, networks and inventory. A unit on machinery management includes cost analysis, scheduling, selection and replacement. Sowell

BAE 462 Functional Design of Field Machines. Preqs: BAE 361 or equivalent, SSC 200. 3(2-3) S. The design and operation of the modern farm tractor and field machines that make effective use of energy and labor in farm commodities production. Topics include (a) engine cycles and efficiencies, Nebraska test procedures, power trains, traction efficiencies, rolling resistances, and hitching of tractors and (b) principles and devices used to accomplish functional objectives in tillage, planting, pesticide application and harvesting equipment. Bowen

BAE (CHE) 465 Introduction to Biomedical Engineering. 3(3-0) F. (See chemical engineering, page 198.)

BAE (SSC) 471 Agricultural Water Management. Preq: BS 100, SSC 200. 4(3-2) F. Aspects of hydrology and soil-water-plant relationships as related to agricultural water management. Drainage and irrigation emphasized. Water quality, agricultural related pollution, and water laws discussed. Skaggs

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BAE 552 Instrumentation for Agricultural Research and Processing. Preqs: EE 331, MA 301. 2(1-3) Alt. F. Theory and application of primary sensing elements and transducers. Generalized performance characteristics and the use of standards. Use of specialized measurement systems for agricultural research and processing including an introduction to correlation and power spectral density measurements. McClure

BAE (CE,MB) 570 Sanitary Microbiology. Preq: MB 401 or equivalent. 3(2-3) S. Aspects of microbiology and biochemistry as related to problems of stream pollution, refuse disposal and biological treatment. Laboratory exercises present basic microbiological techniques and illustrate from a chemical viewpoint some of the basic microbial aspects of waste disposal. Staff

BAE (CE) 578 Agricultural Waste Management. Preq: Grad. or advanced undergrad. standing. 3(2-3) F. Special laboratory techniques required for the characterization of agricultural and associated processing wastes. Principles and examples to develop waste management and nondestructive waste utilization systems that are integral to the total operations. Humenik

BAE (FS) 585 Biorheology. Preq: PY 205, ESM 307. 3(2-2). Alt. S. The concepts of strain, stress and the mechanical viscoelastic properties of biological solids, fluids and slurries. The time-dependent deformation and flow of bio-materials elements of strength of materials, rheological equations and model concepts, creep-relaxation and dynamic behavior, contact problems and the Boltzman superposition principle as a function of time, temperature and moisture content. Hamann

BAE 590 Special Problems. Preq: Sr. or grad. standing in agricultural engineering. Credits Arranged. Each student selects a subject for research and writes a technical report on results. Subject may pertain to any area of study in BAE. Staff

Biological Sciences

BS 100 General Biology. 4(3-3) F,S,Sum. Basic principles and concepts including the structure and function of cells and organisms, the organization and requirements of living systems, development, heredity and evolution. Lytle, Barthalmus, Staff

BS 105 Biology in the Modern World. 4(3-3) F,S. For students who are not science majors. Treats the broad themes or principles of biology, such as metabolism, homeostasis, and interrelationships of organisms, at all levels of biological organization (i.e., molecular to biome). Emphasis on the organismic level with man as the representative organism; his physiology, behavior, genetics and ecology are treated in depth. Wynn

~~BS (ENT) 410 Biology of Insects. 3(2-2) F,Sum. (See entomology, page 239.)~~ eff 8/78 4/1/78

BS 495 Special Topics in Biology. 1-6 F,S,Sum. Independent research projects supervised by faculty member. Projects selected with faculty assistance and with approval of the coordinator of the Biological Sciences interdepartmental program.

BS 590 Special Problems in Biological Instrumentation. Preq: CI. 1-3, F,S. Basic components of spectrophotometers including light sources, dispersing devices, detectors and read-out methods; theoretical and practical aspects of electron microscopy; basics of analog and digital computing methods and applications of computers to biological research; methods of separation and identification of bio-polymers; principles of measurement; and the application of electronics in biological measuring and sensing devices. Staff

Biomathematics

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BMA 451 Introduction to Mathematical Modeling of Biological Systems. Preq: MA 112; two biology courses. Credit not allowed for BMA, MA or ST majors. 3(3-0) S. Intended primarily for students in biological sciences to develop an understanding of how biological concepts may be formulated in mathematical terms and how these formulations may be used in biological research. Topics include use of diagrams and flow charts in mathematical modeling, set relations, measurement error, proper use of dimension, probability models, rate equations, control and feedback. Illustrative examples from a variety of biological fields. Gold

eff 1/77

BMA 493 Special Topics in Biomathematics. Preq: CI. 1-3 F,S. Directed readings, problem sets, written and oral reports at an introductory level to meet student need and interest; 400-level courses during the developmental phase. Staff

~~BMA 501 Theoretical Biochemistry I. Preqs: MA 405, CH 433, BCH 351 or CI. 3(3-0) F.~~ Application of physical theory and mathematics to biochemistry. Examination of basic prin-

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BS(ENT) 401 Bibliographic Research in Biology 2(2-0) 3/1/78 eff 8/78

ciples of molecular theory, reaction rate theory, statistical mechanics and nonequilibrium thermodynamics as applied to biochemical systems. (Offered F 1975 and alt. years.) Gold

BMA 502 Theoretical Biochemistry II. Preq: BMA 501. 3(3-0) S. Coupling of diffusion and chemical reactions. Mathematical description of enzyme control, coupled sequences of enzyme reactions, feedback loops and oscillatory reactions. Experimentally oriented topics include theory of chemical relaxation and tracer dynamics. (Offered S 1976 and alt. years.) Gold

BMA (MS, ST) 571 Biomathematics I. Preq: Advanced calculus, reasonable background in biology or C.I. 3(3-0) F. The role of theory construction and model building in the development of experimental science. Induction vs. deduction. The historical development of mathematical theories and models for the growth of one-species populations (logistic and offshoots), including consideration of age distributions (matrix theory, Leslie and Lopez: continuous theory, Lotka). Elementary theories on growth of organisms (von Bertalanffy, with applications to ecology; allometric theories, cultures grown in a chemostat). Mathematical theories of two and more species systems (predator-prey,competition, symbiosis; according to the Volterra-Lotka schemes, including present-day research), and related models for chemical reaction kinetics. Emphasis on scrutiny of the biological concepts and of the mathematical structure of the models in order to uncover weak and strong points. Mathematical treatment of differential equations in these models stresses qualitative and geometric aspects. van der Vaart

BMA (MA,ST) 572 Biomathematics II. Preqs: BMA 571, elementary probability theory. 3(3-0) S. Advanced mathematical techniques concerning nonlinear differential equations of the types encountered in BMA 571: several concepts of stability, asymptotic directions, periodic models. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Certain aspects of linear system theory (time-invariant and variable models) used for the analysis of biological systems. Some recent research. van der Vaart

BMA 591 Special Topics. Preq: CI. Maximum 3 F,S. Directed readings, problem sets, written and oral reports to meet student need and interest; 500-level courses during the developmental phase. Staff

Botany

BO 200 Plant Life. 4(3-3) F,S,Sum. A survey of the types of plants and their diversities in structure, life cycle, habitat, and economic importance. Witherspoon, Van Dyke

BO 320 Local Flora. 2(0-4) F,S,Sum. A field study for non-majors of the vascular plants of the area with emphasis on identification, ecology, and natural history. May be taken during the spring and fall, spring and summer or summer and fall, or all three semesters, for a maximum of 6 hours credit. Hardin, Stucky

BO (ZO) 360 Introduction to Ecology. Preq: A 200 level biology course. 4(3-3) F,S,Sum. The relationships between organisms and their environment, and of the interactions among organisms. An overview of basic ecology principles and their importance to man and his environment. Staff

BO 400 Plant Diversity. Preq: BO 200. 4(3-3) F. A comprehensive survey of the evolutionary diversity and phylogeny of the plant kingdom. Emphasis on the evolutionary trends and the basis for assumed relationships, considering fossils as well as living forms. Hardin

BO (CS) 402 Economic Botany. Preq: BO 200. 3(2-3) S. Emphasis is on plants and human affairs. Discussions center on all phases of the interrelatonships of the plant world and the life history of incipient to modern human cultures. Treatment includes plants and plant products, beneficial and harmful, that man has used as necessities of life, as ameliorants contributing to his well-being, and as raw materials for industry. Ornamentals are excluded. Timothy

BO 403 Systematic Botany. Preq: BS 100 or 105 or BO 200. 4(2-4) S. A systematic survey of vascular plants, emphasizing terminology, family characteristics, field identification, general evolutionary relationships, and mechanisms of plant speciation. Stucky

BO (ZO) 414 Cell Biology. 3(3-0) F. (See zoology, page 329.)

BO 421 Plant Physiology. Preq: BS 100, BS 105 or BO 200, one year of college chemistry. 4(3-3) F,S. Physiology of the green plant emphasizing plant organization, water and solute relationships, organic and inorganic nutrition, growth and development. Noggle, Troyer

BO 480 Air Pollution Biology. Preq: An introductory biological course and chemistry, jr. standing. 3(2-3) S. The effects of air pollutants on biological systems at the subcellular, cellular, tissue, organ, individual and community level. Anderson

BO 499 Independent Study in Botany. Preq: At least eight hours of botany, advanced standing, and presentation of plan of work approved by a faculty member. 1-3 F,S. Discussions, library research, field or laboratory investigations of topics under faculty direction on a tutorial basis. May be repeated for a maximum of six credits. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BO 510 Plant Anatomy. Preq: BO 200. 4(2-6) F. The cells, tissues and organs of common flowering plants and gymnosperms. Growth and differentiation patterns with emphasis on current research. Anderson

BO 522 Advanced Morphology and Phylogeny of Seed Plants. Preq: BO 403. 4(3-3) S. Survey of morphology and evolution of angiosperms and gymnosperms. Emphasis on detailed vegetative and reproductive morphology of fossil and living forms, and on their presumed evolutionary relationships. (Offered S 1977 and alt. years.) Hardin

BO 524 Grasses, Sedges, and Rushes. Preq: BO 403. 4(2-6) F. Course deals with three large, economically and ecologically important plant families. An introduction to terminology, extensive field work emphasizing keying our plants collected, and a study of recently developed classification of the grasses. (Offered F 1977 and alt. years.) Staff

BO 544 Plant Geography. Preqs: BO 360, BO 403, GN 411, or equivalents. 3(3-0) S. Descriptive and interpretive plant geography, synthesizing data from ecology, genetics, geography, paleobotany and taxonomy. Includes a survey of the present distribution of major vegetation types throughout the world. A discussion of the history and development of this present pattern of vegetation, and of the principles and theories of plant geography. (Offered S 1978 and alt. years.) Staff

BO 551 Advanced Plant Physiology I. Preq: General botany or biology, and biochemistry. 3(3-0) F. The first half of a two-semester sequence covering the current status of plant physiology. Topics include plant organization, metabolism, respiration, and water and solute relations. Troyer

BO 552 Advanced Plant Physiology II. Preq: General botany or biology, and biochemistry. 3(3-0) S. The second half of a two-semester sequence. Topics include photobiology, photosynthesis, inorganic nutrition, plant growth substances, physiology of seeds, vegetative growth, reproductive growth, aging and senescence. Noggle

BO 553 Laboratory in Advanced Plant Physiology I. Preq or Coreq: BO 551. 1(0-3) F. Accompanies BO 551. Laboratory procedures in plant nutrition, plant structure and composition, water relations, respiration. Staff

BO 554 Laboratory in Advanced Plant Physiology II. Preq or Coreq: BO 552. 1 (0-3) S. Accompanies BO 552. Laboratory procedures in enzymes, photosynthesis, photobiology, plant growth substances. Staff

BO (ZO) 560 Principles of Ecology. Preq: Three semesters of college-level biology courses. 4(3-3) F. Provides a factual and philosophical framework for the understanding of ecology. Staff

BO 561 Physiological Ecology. Preqs: BO 421, BO (ZO) 560, or equivalents. 4(3-3) S. Approaches the plant community from a physiological standpoint. Emphasis on the individual in the community and how it responds to its immediate environment on a short- and long-term basis (Offered S 1977 and alt. years.) Blum

BO 565 Plant Community Ecology. Preqs: BO (ZO) 560 or BO (ZO) 360 or equiv. 4(3-3) F. Consideration of the structure and function of terrestrial vascular plant communities with emphasis on classical and recent research. Topics include measurement and description of community properties, classification, ordination, vegetation pattern in relation to environment, ecological succession, and a survey of the vegetation of North America. Wentworth

BO 570 Quantitative Ecology. Preqs: BO (ZO) 560 and ST 512 of equiv. 3(3-0) F. Alt. yrs. A course emphasizing the quantitative techniques and theories of vegetation analysis. Topics include sampling methodologies, the evaluation of sample adequacy, spatial patterns and species associations, the measurement and interpretation of ecological diversity, gradient analysis and classification of communities, and plant population dynamics. Each of these topics will be considered from a theoretical and a practical basis. This involves local field trips, sampling, data analysis, computer programming, and interpretation in light of contemporary ecological theories. (Offered F 1978 and alt. years.) Reynolds

BO (MB) 574 Phycology. Preq: BS 100 or BO 200. 3(1-4) S. An introduction to the classes of algae. The systematic position, life history and ecology of important genera in the local flora, both fresh-water and marine. Witherspoon

BO (MB,PP) 575 The Fungi. Preq: BO 200 or equivalent. 3(3-0) F. An overview of the fungi within the framework of a survey of the major classes. Topics include ultrastructure, environmental adaptations, sexuality, ontogeny, and economic importance. Van Dyke

BO (MB,PP) 576 The Fungi-Laboratory. Coreq: BO 575. 1(0-3) F. Provides illustrative material of the fungal assemblages discussed in BO 575. Van Dyke

BO 590 Topical Problems. Preq: CI. 1-3 F,S. Discussions and readings on problems in ecology, anatomy and morphology, taxonomy, and plant physiology. May be repeated, with change in topic, for a maximum of six credits. Graduate Staff

Chemical Engineering

revised 2/23/78 eff 8/78

CHE 205 Chemical Process Principles. Preq: CH 107, MA 201. 4(3-2). F.S. Engineering methods of treating material balances, stoichiometry, phase equilibrium calculations, thermophysics, thermochemistry, and the first law of thermodynamics. Felder

CHE 225 Chemical Process Systems. Preq: PY 208; Coreq: MA 301. 4(3-2). F.S. Process measurements of importance in chemical engineering: temperature, pressure, flow rate,level, concentration. Static calibration of measuring instruments. An introduction to process dynamics and control via theory and experiment. Marsland

eff 8/78

CHE (UNI) 300 Chemical Technology and the Environment. 3(3-0) F. Provides a basis for informed judgment regarding appropriate political, economic and technical means to prevent and control pollution. Chemical technology as a source of pollution and as a means for pollution control. Open to all students. Hopfenberg

CHE 301, 302 Elements of Chemical Engineering. Preq: (301) MA 212;(302) CHE 301. 3(3-0) F,S. Principles including calculations involved in industrial processes and equipment. For students not majoring in CHE. Seely

CHE 311 Transport Processes I. Preq: MA 301, PY 208, CHE 205. 3(3-0) F,S. Momentum and heat transfer with emphasis on applications in chemical processing. Problems in the design of fluid flow systems and heat exchangers. Rousseau

CHE 315 Chemical Process Thermodynamics. Preq: CHE 205, MA 301. 3(3-0) S. The laws of thermodynamics and their application to chemical engineering problems, both in theory and in practice. Criteria of equilibrium in physical and chemical changes. Behavior of real fluids, including mixtures. Beatty

CHE 316 Thermodynamics of Chemical and Phase Equilibria. Preq: CHE 315. 3(3-0) S. Thermodynamics is the principal tool for systematic study of chemical reaction equilibria and phase equilibrium. Fugacity, activity and chemical potential as methods for predicting the effect of temperature, pressure, etc. on equilibrium compositions. Methods for measuring and estimating thermodynamics properties important to equilibrium calculation in real systems. Hopfenberg

CHE 325 Introduction to Plastics. Preq: CH 103. 3(3-0) F,S. Survey of plastics and polymers: types, applications, fabrication, processing and testing. Seely

CHE 327 Separation Processes I. Preq: CHE 311. 3(3-0) S. Applying principles of transport phenomena to the unit operations of absorption, extraction, distillation, drying, filtration, etc. with emphasis on design procedures and economic consideration. Rousseau

CHE 330 Chemical Engineering Lab I. Preq: CHE 205; Coreq: CHE 311. 2(0-4). F. Laboratory experiments in unit operations that augment the theory and data of CHE 311,

Transport Processes I, in the areas of momentum and heat transfer. An added emphasis is on technical report writing. Seely

CHE 331 Chemical Engineering Lab II. Preq: CHE 330; Coreq: CHE 327. 2(0-4). S. A continuation of Chemical Engineering Lab I with emphasis on report writing and on the unit operation of absorption, extraction, distillation, drying, etc. Seely

CHE 412 Transport Processes II. Preq: CHE 327. 3(3-0) S. Momentum, heat and mass transport processes, with emphasis on CHE. Problems in fluid, heat and mass transfer. Ferrell

CHE 425 Process Measurement and Control I. Preq: CHE 225, 327. 3(2-2) F. The continuous control of typical chemical engineering processes including the techniques of feedback, cascade, feedforward and interacting systems. Dynamics, stability, and control of heat exchangers, flow systems, distillation columns and chemical reactors. Winston

CHE 426 Process Measurement and Control II. Preq: CHE 425 or EE 435 or MAE 435. 3(2-2) S. An extension of the theory and application of process control techniques to the analysis of physical systems. Sampled data and nonlinear systems and an introduction to optimum control techniques and adaptive control. Martin

CHE 432 Chemical Engineering Lab III. Preq: CHE 431. 2(1-5). F.S. Projects in research, design or development in various areas of chemical engineering. Seely

CHE 446 Chemical Process Kinetics. Preq: CHE 315. 3(3-0) F. The characterization and measurement of the rates of homogeneous and heterogeneous reactions. The design and analysis of chemical reactors. Stahel

CHE 451 Chemical Engineering Design. Preq: CHE 315, 327, 432. 3(2-2) F,S. Chemical process design and optimization. The interplay of economic and technical factors in process development, site selection, project design, construction and production management. Applications of cost accounting, cost estimation for new equipment, measures of profitability. Marsland

CHE (BAE) 465 Introduction to Biomedical Engineering. Preq: MA 202 or 212, PY 212 or 221. 3(3-0) F. Engineering applications to biomedical problems such as flow in the cardiovascular and respiratory systems; transfer of thermal energy in and from warm-blooded animals; transport of materials through physiological tissues and membranes, and performance of organ replacement and assist devices such as the artificial kidney and the intra-aortic balloon. Beatty

CHE 495 Seminar in Chemical Engineering. Preq: One semester required of CHE srs.1(1-0) F,S. Professional aspects and topics of current interest. Staff

CHE 497 Chemical Engineering Projects. Preq: Elective of CHE srs. 1-3 F,S. Introduction to research through experimental, theoretical and literature studies of CHE problems. Oral and written presentation of reports. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CHE 511 Chemical Engineering Process Modeling. Preq: CHE 311, CHE 327, MA 301. 3(3-0) S. The application of the methods of mathematical analysis to the formulation and solution of problems in transport phenomena, process dynamics and chemical reaction engineering. Felder

CHE 513 Thermodynamics I. Preq: CHE 315. 3(3-0) F. An intermediate course in thermodynamic principles and their applications to chemical and phase equilibria. The course is largely from a macroscopic viewpoint but consideration given to the statistical viewpoint. Beatty

CHE 515 Transport Phenomena. Preq: ~~CHE 327~~. 3(3-0) S. A theoretical study of transport of momentum, energy and matter with emphasis on the latter two. The diffusional operations, including coupled heat and mass transfer, are introduced in the light of the theory. Marsland

CHE 517 Kinetics and Catalysis. Preq: CHE 446. 3(3-0) F. Homogeneous and heterogeneous kinetic reactons. Emphasis on fundamental approaches, experimental methods and mathematical techniques in engineering analysis of chemical reaction systems. Stahel

CHE 521 Mass Transfer Operations. Preq: CHE 327 or equivalent. 3(3-0) S. Multicomponent operations will be discussed in light of recent developments and innovations in both the operations themselves and in calculational techniques used in analyzing the operations. The equilibrium stage concept will be developed. If there is time, the continuous rate processes will be discussed. Problems unique to given operations, such as are encountered in extractive and azeotropic distillation. Rousseau

CHE 523 Fluid Dynamics and Heat Transfer. Preq: CHE 311. 3(3-0) F. Convective heat transfers in chemical process equipment, such as heat exchangers, chemical reactors, distillation and extraction reboilers, etc., and fluid dynamics and heat transfer of multiphase, multicomponent and chemically reactive systems. Ferrell

CHE 525 Chemical Process Control. Preq: CHE 425. 3(3-0) S. The application of control techniques to sampled data chemical process systems. Z-transform and state variable methods for the determination of open loop and closed loop system responses and for the synthesis of controller algorithms. Hybrid computer simulation and control of on-line real time processes. Winston

Y12/78 CHE 451 or OR 501

Fortran Programming

CHE (OR) 527 Optimization of Engineering Processes. Preq: ~~GSC 111, MA 301 and MA 405.~~ 3(3-0) F. The formulation and solution of process optimization problems, with emphasis on nonlinear programming techniques. Computer implementation of optimization algorithms, and structuring of process models to increase computational efficiency. Felder

CHE 535 Engineering Economy in Air Pollution Control Systems. Preq: MAE 409, CE 576, or equivalent first course. 3(3-2) S. Principles and practice in designing equipment for the abatement of air pollution; estimation of capital cost and operating expense; economic optimization under various kinds of tax laws. Marsland

CHE 541 Cellulose Industries. Preq: Organic chemistry. 3(3-0) F. Methods of manufacture and application of cellulose chemical conversion products. Emphasis is on recent developments of synthetic fibers, films, lacquers and other cellulose compounds. Seely

Polymers 1/24/78 eff 1/79

CHE 543 Technology of ~~Plastics~~. Preq: Organic chemistry. 3(3-0) S. The properties, methods of manufacture and applications of synthetic resins. Recent developments in the field. Schoenborn

CHE 561 Biomedical Engineering I: Fluid Flow and Heat Transfer. Preq: CHE (BAE) 465, or equivalent background. 3(3-0) S. The extension of fluid flow and heat transfer concepts to biomedical engineering is presented along with the grounding in physiology requisite to proper modeling of mammalian flow and thermal processes. Beatty

2/9/78 eff 8/78

CHE (TC) 569 Polymers, Surfactants and Colloidal Materials. Preq: CHE 315, CH ~~431~~ 223. 3(3-0) F. The relationship between molecular structure and bulk properties of nonmetallic materials as applied in CHE processes. Attention to the application of surface and colloid chemistry as well as polymer science.

CHE (TC) 570 Radiation Chemistry and Technology of Polymeric Systems. Preqs: CH 221, 431. 3(3-0) S. Principles and practice of isotope and electron beam radiation treatment. Applications of high energy radiation in polymer chemistry and technology, including the use of radiation to cross-link and degrade polymers. Similarities and differences between radiation polymerization and photopolymerization. Stannett, Williams

CHE 697 Advanced Chemical Engineering Projects (1-3) 1/24/78 eff 6/78

Prereq: None, but CH 111 or equivalent strongly recommended. eff 6/77 2/10/77

Chemistry

CH 101 General Chemistry I. 4(3-3) F,S,Sum. Fundamental concepts, including atomic and molecular structure, states of aggregation of matter, chemical reactions and stoichiometry. Should be followed by CH 103, 105 or 107.

CH 103 General Chemistry II. Preq: CH 101. 4(3-3) F,S,Sum. Designed as a terminal course and for students in curricula which do not require full-year chemistry courses beyond the freshman level. Topics include acid-base reactions, homogeneous and heterogeneous equilibria, electrochemistry, and descriptive aspects of inorganic, organic, nuclear and biochemistry.

CH 104 Experimental Chemistry. Coreq: CH 105. 1(0-3) F,S,Sum. Laboratory supplement to CH 105. Required for CH 105 students who plan to take additional chemistry courses.

CH 105 Chemistry—Principles and Applications. Preq: CH 101. 3(3-0) F,S,Sum. A continuation of CH 101, intended primarily for engineering students. Emphasis on introductory chemical thermodynamics, equilibrium, electrochemistry, chemical kinetics, and the application of basic chemical principles to the treatment of organic and inorganic systems. CH 105 serves as prerequisite for additional chemistry courses only if supplemented by CH 104.

CH 106 Laboratory Techniques I. Coreq: CH 101H. 1(0-3) F. For students majoring in chemistry to supplement CH 101 laboratory.

CH 107 Principles of Chemistry. Preq: CH 101 with a grade of C or better. 4(3-3) F,S,Sum. Continuation of CH 101 for students who plan to take a full-year course in advanced chemistry and for those desiring a more quantitative course than CH 103. Emphasizes detailed quantitative aspects of stoichiometry, kinetics, equilibrium and electrochemistry, and the treatment of chemical reactions in terms of acid-base concepts.

CH 108 Laboratory Techniques II. Coreq: CH 107H. 1(0-3) S. For students majoring in chemistry to supplement CH 107 laboratory.

revised 3/15/78

CH 111 Foundations of Chemistry. 4(3-2) F,S,Sum. General chemistry for liberal arts students. Topics include atomic and molecular structure, periodic classification, gas laws, chemical equilibrium, and elementary descriptive inorganic and organic chemistry.

CH 220 Introductory Organic Chemistry. Preq: CH 103 or 107, or CH 104 and 105. 4(3-3) F,S,Sum. Topics include alkanes and cycloalkanes, reactions of carbon-carbon multiple bonds, elimination and substitution reactions of alcohols and alkyl halides, aromatic compounds, carbonyl compounds, organic acids and derivatives, and organic bases.

CH 221, 223 Organic Chemistry I, II. Preq: (221) CH 107; (223) CH 221. 4(3-3) F,S,Sum. CH 221 and CH 223 cover the fundamentals of organic chemistry, including both aliphatic and aromatic compounds. CH 221 deals mostly with structure, stereochemistry, reactions, and mechanisms associated with a study of the hydrocarbons.

CH 315 Quantitative Analysis. Preq: CH 103 or 107, or CH 104 and 105. [Credit not allowed for both CH 315 and 317.] 4(3-3) F,S,Sum Fundamental principles and modern techniques of chemical analyses. Topics include spectrochemical, electrochemical, and volumetric methods of analysis, modern chemical instrumentation, and interpretation of data.

CH 317 Quantitative Analysis for Life Science Students. Preq: CH 103 or CH 107 or CH 104-105. (Credit not allowed for both CH 315 and CH 317.) 4(3-3) S. An introduction to modern methods of qualitative and quantitative chemical analysis. Emphasis will be placed on clinical and biochemical techniques.

CH 331 Introductory Physical Chemistry. Preqs: CH 103 or 107, or CH 104 and 105; MA 102 or 112. 4(3-3) F,S. For students whose mathematics background is not sufficient to meet CH 431, 433 requirements, but who desire instruction on chemical principles above freshman level.

ex CH 331 revised 3/24/77

CH 401 Systematic Inorganic Chemistry. Coreq: CH 431/3(3-0) S. Studies of theoretical principles and discussions of experimental synthetic, purification, and identification procedures pertaining to inorganic substances. The physical and chemical behavior of inorganic compounds is also discussed.

CH 411 Analytical Chemistry I. Preq: CH 434. 4(2-6) F. Includes the design, execution, and interpretation of quantitative chemical measurements. Chromatographic, precipitation and spectroscopic methods.

CH 413 Analytical Chemistry II. Preq: CH 411. 4(2-6) S. Methods of quantitative analysis based on solution chemistry, electrochemistry and reaction kinetics.

CH 428 Qualitative Organic Analysis. Preq: CH 223. 3(1-6) F,S,Sum. Introduction to the systematic identification and separation of organic compounds by the application of both physical and chemical techniques. Infrared and nuclear magnetic spectroscopy, chemical classification tests, and the preparation of derivatives are used to acquaint the student with organic research methods.

CH 431 Physical Chemistry I. Preq: CH 107, MA 202, PY 203 or 208; Coreq: MA 301. 3(3-0) F,S,Sum. CH 431 and CH 433 provide an intensive study of physical chemical principles including states of matter, classical and statistical thermodynamics, physical and chemical

equilibrium, properties of solids and solutions, electrochemistry, reaction kinetics, kinetic theory, and transport properties. Arrangement of topics between courses may vary from year to year.

CH 433 Physical Chemistry II. Preq: CH 431, MA 301. 3(2-1). F,S. (See description under CH 431.)

CH 434 Physical Chemistry II Laboratory. Coreq: CH 433. 2(0-6) S. A project-oriented course to acquaint chemistry students with modern physical chemistry techniques.

CH 435 Physical Chemistry III. Preq: CH 431, MA 301. 3(3-0) F. A continuation of CH 431, emphasizing quantum mechanics, molecular structure and chemical bonding.

CH (TC) 461 Chemistry of Fibers. 3(3-0) F. (See textile chemistry, page 319.)

CH 490 Chemical Preparations. Preq: Three years of CH. 3~~(1-6)~~ 0-9 Revised 4/27/77 F,S. Lectures and laboratory work in preparative chemistry. Synthetic procedures illustrate advanced methods and techniques in both inorganic and organic chemistry.

CH 491 Honors Chemistry. Preq: Admission to honors program or consent of department. 1-3 F,S. A special studies course for superior students pursuing chemistry studies in greater depth.

CH 493 Chemical Literature. Preq: Three years of CH. 1(1-0) F. A systematic introduction to the location and retrieval of information required for the solution of chemical problems.

CH 495 Special Topics in Chemistry. Preq: CI. 1-3 F,S. To serve needs not covered by existing courses.

CH 499 Senior Research in Chemistry. Preq: Three years CH. Credits Arranged. 1-3 F,S,Sum. Independent investigation of a research problem under the supervision of a chemistry faculty member.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CH 501 Inorganic Chemistry I. Preq: CH 433. 3(3-0) F. Modern chemistry from the point of view of the chemical bond, molecular structure, and spectroscopy. Several topics chosen from group theory, molecular symmetry, molecular orbital and crystal field theories, electronegativity, solid state, magnetic properties, electronic absorption, ORD, CD, and MCD, Mossbauer, nmr, nqr, ESCA, photoelectron, and vibrational spectroscopies. Computer facilites are used.

CH 503 Inorganic Chemistry II Preq: CH 501. 3(3-0) S. A continuation of CH 501. Knowledge of physical methods applied to chemistry of representative elements, transition metals (3d, 4d, 5d), lanthanides, and actinides. Topics include nonaqueous solvents, acids and bases, inorganic reaction mechanisms, solid state reactions, coordination chemistry including chelates and organometallic compounds, crystal field stabilization energy, Jahn-Teller and trans effects, stabilization of valence states, and some bio-inorganic chemistry.

CH 511 Chemical Spectroscopy. Preq: CH 433 3(3-0) F. Theory, analytical applications and interpretation of spectra as applied to chemical problems. Emphasis upon ultraviolet, visible and infrared spectra. (Offered F 1978 and alt. years.)

CH 515 Chemical Instrumentation. Preq: CH 431; Coreq: CH 411. 3(3-0) S. Basic electronic components and circuits, the response of laboratory instruments, design and modification of typical electronic control and measurement systems. Emphasis on transducers and control elements utilized in chemical research. (Offered S 1978 and alt. years.)

CH 517 Physical Methods of Elemental Trace Analysis. Preq: CH 315 or 331 or CI. 3(3-0) F. The principles and applications of currently used methods of trace analysis. Topics include pulse polarography, potentiometry, UV-Vis spectrophotometry, atomic absorption, emission spectrometry, fluorescence, neutron activation analysis, and spark source mass spectrometry.

CH 518 Trace Analysis Laboratory. Coreq: CH 517 or CI. 2(0-6) F. Instrumental techniques including UV-Vis spectrophotometry, fluorescence, emission spectrometry, atomic absorption, pulse polarography, and neutron activation analysis.

CH 521 Advanced Organic Chemistry. Preq: CH 223, 433 or 435. 3(3-0) F. Structure, stereochemistry and reactions of the various classes of hydrocarbons. The molecular orbital

treatment of bonding and reactivity of alkenes, the conformational interpretation of cycloalkene and cycloalkane reactivity, and the application of optical isomerism to reaction mechanisms.

CH 523 Advanced Organic Chemistry II. Preq: CH 521. 3(3-0) S. Acid-base theory and mechanistic organic chemistry as applied to synthetically useful organic reactions.

CH 525 Physical Methods in Organic Chemistry. Preq: CH 223, and 433 or 435. 3(3-0) S. Physical methods applied to solution of structural problems in organic chemistry. Emphasis on spectral methods including infrared, ultraviolet, nuclear magnetic resonance, mass spectrometry, electron paramagnetic resonance, x-ray and electron diffraction, and optical rotatory dispersion.

CH 531 Chemical Thermodynamics. Preq: CH 433, MA 301. 3(3-0) F. Extension of elementary principles to treatment of ideal and real gases, ideal solutions, electrolytic solutions, galvanic cells, surface systems and irreversible processes. Introduction to statistical thermodynamics and the estimation of thermodynamic functions from spectroscopic data.

CH 533 Chemical Kinetics. Preq: CH 433, MA 301. 3(3-0) S. 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. (Offered S 1977 and alt. years.)

CH 535 Surface Phenomena. Preq: CH 433, MA 301. 3(3-0) S. Formulations of basic theories are presented with illustrations of their current applications. (Offered S 1978 and alt. years.)

CH 537 Quantum Chemistry. Preq: MA 301, CH 435 or PY 407. 3(3-0) S. The elements of wave mechanics applied to stationary energy states and time dependent phenomena. Applications of quantum theory to chemistry, particularly chemical bonds.

CH 539 Colloid Chemistry. Preq: CH 220, 315 or 331 or CI. 3(2-3) S. Theories, basic principles, and fundamental concepts including preparation and behavior of sols, gels, emulsions, foams, and aerosols and topics in areas of adsorption, Donnan equilibrium, dialysis, and small particle dynamics. Laboratory includes independent project studies in specialized areas. (Offered S 1977 and alt. years.)

CH 545 Radiochemistry. Preq: CH 431 or PY 410. 3(2-3) S. Applications of radioactivity to chemistry and application of chemistry to radioactive elements, particularly transuranium elements and fission products.(Offered S 1978 and alt. years.)

CH (TC) 562 Physical Chemistry of High Polymers — Bulk Properties. 3(3-0) F. (See textile chemistry, page 319.)

Civil Engineering

CE 201 Elements of Plane Surveying. Preq: Soph. standing. 3(2-3) F. Not for CE department majors. Theory and practice of plane surveying precision specifications, horizontal and vertical control, stadia surveys, area determinations, circular and compound curves, topographic mapping, solar and celestial observations, rural and urban land surveys.
Rihani

CE 202 Introduction to Civil Engineering. Preq: MA 201. 2(1-3) F,S. Computer solution of typical problems in each subject area of civil engineering. Ely, Smith

CE 301 Engineering Surveying. Preq: Junior standing. 3(2-3) F,S. Principles of surveying and applications in planning, design and construction; including horizontal and vertical control; topographic maps, photogrammetry and elements of geodesy. Babcock

CE 305 Transportation Engineering I. Preq: CE 301. 4(3-2) F,S. Integrated approach to planning, designing operation of transportation systems. Engineering and economic aspects of basic transport modes, (including highway, rail, water and air facilities) are studied.

CE 308 Solid Mechanics II 3(3-0) 6/21/78 eff 1/79 Cribbins, Heimback, Rihani

CE 325 Structural Analysis. Preq: ESM 301. 3(2-2) F,S,Sum. Stress analysis of statically determinate beams and framed structures under fixed and moving loads; analysis of displacements by methods of conjugate beam and virtual work; indeterminate structural analysis of both rigid frames and trusses by virtual work and by stiffness method.

CE 211 Introduction to Applied mechanics 3(3-0) 6/21/78 eff 1/79 Havner, Tung
CE 212 Mechanics of Engineering materials 3(3-0) 6/21/78 eff 1/79
CE 213 Introduction to Mechanics 3(3-0) 6/21/78 eff 1/79
CE 311 Experimental Engineering Science I 3(1-6) 6/21/78 eff 1/79
CE 312 Experimental Engineering Science II 3(1-6) 6/21/78 eff 1/79
CE 313 Mechanics of Solid 6/21/78 eff 1/79
CE 415 Engineering Science in Contemporary Design 6/21/78 eff 1/79
CE 411 Engineering Cybernetics I 6/21/78 eff 1/79
CE 412 Engineering Cybernetics II 6/21/78 eff 1/79

CE 326 Structural Engineering I. Preq: CE 325 4(3-2) F,S. Fundamental principles of elastic, inelastic and ultimate strength analysis and proportioning of structural members in metal, concrete and timber.

CE 332 Materials of Construction. Preq: MAT 200. 3(2-3) F,S,Sum. Manufacture and properties of mineral and bituminous cements and mineral aggregates. Mechanical properties of portland cement concrete, bituminous concrete, masonry units materials and timber products. Materials testing for research. Mullen

CE 342 Soil Engineering I. Preq: CE 332; Coreq: ESM 301. 4(3-2) F,S. Soil identification, index properties, effective stress coneepts, settlement analysis, evaluation of shear strength and bearing capacity, fundamentals of foundation selection and design. Kashef

CE 365 Construction Engineering I. Preq: Jr. standing. 4(3-2) F,S. Construction operations course emphasizing organization of construction industry; construction methods, equipment, productivity and safety; project planning; scheduling and control.Blessis, Nunnally

CE 370 Elements of Environmental Hygiene. Preq: Soph. standing. 3(2-3) S. Environmental factors affecting human health and their evaluation and control. Topics include: water supplies; sewage disposal; swimming pool and refuse sanitation; insect and rodent control; milk and food sanitation; the physical factors of noise, heat, illumination and ionizing radiation; housing; industrial hygiene; and environmental hygiene programs. Johnston

CE 382 Hydraulics. Preq: ESM 200 4(3-3) F,S. Properties of fluid, laws of conservation of mass, momentum and energy; applications to the mechanics of flow through pipes and channels; fluid measurements; theory of design and characteristics of hydraulic machines. Amein, Machemehl

CE 383 Water Resources Engineering I. Preq: CE 382. 4(3-3) F,S. Application of natural science, physics and chemistry in the engineering of urban water and waste systems. Case studies illustrate applications and relationship of systems to management of environmental quality in urban areas. Amien, Malcolm

CE 406 Transportation Engineering II. Preq: CE 305. 3(2-2) F,S. Urban transportation problems and design of modal interfaces such as airports, shopping centers, parking garages, port facilities and other multimodal terminals. Babcock, Rihani

CE 425 Intermediate Structural Analysis. Preq: CE 325. 3(3-0) F,S. Rigorous treatment, at intermediate level, of indeterminate structural analysis. Energy principles, force and displacement methods, special topics. Havner, Mirza

CE 427 Structural Engineering II. Preq: CE 326. 3(2-2) F,S. Basic concepts of structural design. Analysis and design of complete structural systems. Hulsey, Uyanik

CE 428 Structural Design in Wood. Preq: CE 326. 3(2-2) F. Structural behavior of wood under loads; design of structural elements in wood; strength properties of wood fasteners; design projects with clear wood, plywood and glued-laminated wood.

CE 433 Soil Engineering II. Preq: CE 342. 3(3-0) F,S. Lateral earth pressure theories and their application to analysis and design of slopes and retaining structures; ground water hydraulics; placement of fills; soil behavior in pavement systems, stabilization techniques. Wahls

CE 450 Civil Engineering Design. Preq: One from: CE 406, 427, 443, or 484. 3(1-6) F,S. Integrated team approach to a major civil engineering project involving planning, design and analysis under realistic conditions including environmental factors. Babcock

CE 460 Construction Engineering Project. Preq: CE 463, 466. 3(1-6) F,S. Planning, design, construction and management of a construction project. Blessis

CE 463 Cost Analysis and Control. Preq: CE 365. 3(2-3) F,S. Cost engineering, project estimating, bid procedures, construction cost analysis and control. Blessis, Nunnally

CE 464 Legal Aspects of Contracting. Preq: Sr. standing. 3(3-0) S. Legal aspects of construction contract documents and specifications; owner-engineer-contractor relationships and responsibilities; bids and contract performance; labor laws. Blessis

CE 466 Construction Engineering II. Preq: CE 326, 365. 3(2-3) F,S. Introduction to building systems construction emphasizing planning, analysis, design and construction of structural subsystems. Debruhl

CE 472 Elements of Air Quality Management. Preq: College level physics and sr. standing. 3(2-3) F. Pollution and community air quality management, including pollutant sources; effects on biological systems, materials, and the atmosphere; meteorological factors; air sampling; abatement and control techniques; air quality and emission standards; and legal, economic and administrative aspects. Shearer

CE 484 Water Resources Engineering II. Preq: CE 383. 3(3-0) F,S. Occurrence, flow and control of natural and impounded waters. Case studies of storm drainage, flood control and stream sanitation illustrate the use of these principles in the management of river basin water resources. Content Revised 8|77 Malcom, Smallwood

CE 486 Sanitary Engineering Measurements of Water Quality. Preq: Freshman chemistry and sr. standing in Engineering or Agriculture and Life Sciences. 3(2-3) S. Introduction to elementary measurement and interpretations of pollutants in water and wastewater. Examination of the nature and character of municipal refuse. Staff

~~**CE (OY, MAS) 487 Physical Oceanography.** 3(3-0) S. (See physical oceanography, page 293.)~~ 2|

CE 495 Special Studies in Mechanics 1-3 6/21/78 eff 1/79

CE 498 Special Problems in Civil Engineering. Preq: Sr. standing in CE or CEC. 1-3 F,S. Directed reading in the literature of civil engineering, introduction to research methodology, seminar discussions, dealing with special civil engineering topics of current interest. Staff

CE 501 Transportation Systems Analysis 3(3-0) 4/6/77 eff. 8/77

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CE 502 Transportation Behavior 3(3-0) 4/14/77 eff 8/77

CE 507 Airphoto Analysis I. Preq: Sr. standing 3(2-3) S. Principles and concepts for engineering evaluation of aerial photographs, including analysis of soils and surface drainage characteristics. Wahls

Stress Wave 3(3-0) 9-7-78 eff 8/78

CE 514 ~~Municipal Engineering Projects.~~ ~~Preq: Sr. standing in CE. 3(2-3) S. Special problems relating to public works, public utilities, urban planning and city engineering.~~ Babcock, Smallwood

CE 515 Transportation Operations. Preq: CE 305. 3(3-0) F. Analysis of traffic and transportation engineering operations. Heimback, Rihani

CE 516 Transportation Design. Preq: CE 305. 3(2-3) F. Geometric elements of traffic and transportation engineering design. Cribbins

CE 517 Water Transportation. Preq: CE 305. 3(3-0) F. Planning, design, construction and operation of waterways, ports, harbors and related facilities. Feasibility of piers, ports and multipurpose river basin projects. Design of marine structures and civil works including locks, dams, harbors, ports and contractive and protective works. Cribbins

CE 524 Analysis and Design of Masonry Structures. Coreq: CE 427. 3(3-0) F. Theory and design of masonry arches, culverts, dams, foundations and masonry walls subjected to lateral loads. Staff

CE 525, 526 Matrix Structural Analysis I, II. Preq: (525), CE 425; (526), CE 326, 3(3-0) F.S. Matrix methods of structural analysis for digital computer solutions for general frames, trusses, and grids as well as general three dimensional trusses and frames. Inclusion of effects due to prestrain, temperature, elastic stability functions, joint deformations, and support settlements. Introduction to finite-element analysis of plane elasticity problems.Dean, Smith

Revised 9/7/78 eff 1/79

CE 531 Structural Models. Preq: CE 427. 3(2-3) S. Dimensional analysis and structural similitude, indirect and direct models, model materials and experimental techniques, individual project in structural model analysis. Mirza, Zia

CE 534 Plastic Analysis and Design. Preq: CE 427. 3(3-0) S. Theory of plastic behavior of steel structures; concept of design for ultimate load and the use of load factors. Analysis and design of components of steel frames including bracing and connections. Ely, Smith

CE 536 Theory and Design of Prestressed Concrete. Preq: CE 427. 3(3-0) F. Principles and concepts of design in prestressed concrete including elastic and ultimate strength analyses for flexural, shear, bond and deflection. Principles of concordancy and linear transformation for indeterminate prestressed structures. Mirza, Zia

CE (MAS, OY) 541 Gravity Wave Theory I. 3(3-0) S. (See marine sciences, page 267.)

CE 503 Transportation Design 3(2-3) 4/14/77 eff. 8/77
CE 504 Water Transportation 3(3-0) eff 8/77
CE 505 Mass Transportation 3(3-0) eff 8/78
CE 506 Municipal Engineering Projects 3(2-3) eff 8/77 4/14/77
CE 511,512 Continuum Mechanics I, II 3(3-0) 4/14/77 eff 8/77
CE 513 Theory of Elasticity I 3(3-0) 4/14/77 eff 8/77

CE 521 Advanced Strength of Materials 3(3-0) 4/14/77 eff 8/77
CE 522 Plastic Stability 3(3-0) 4/14/77 eff 8/77
CE 523 Theory of Plates and Shells 4/14/77 eff 8/77 3(3-0)
CE 557,558 Properties of Solids I, II 4/14/77 eff 8/77 3(3-0)
CE 611,612 Unifying Concepts in Mechanics I, I 4/14/77 eff 8/77 3(3-

CE 543 Hydraulics of Ground Water. Preq: CE 382 or 342 or equivalent. 3(3-0) F. Principles of ground water hydraulics; theory of flow through idealized porous media; the flow net solution; seepage and well problems. Kashef

CE 544 Foundation Engineering. Preq: CE 342. 3(3-0) S. Subsoil investigations; excavations; design of sheeting and bracing systems; control of water; footing, grillage and pile foundations; caisson and cofferdam methods of construction. Kashef, Langfelder

CE 548 Engineering Properties of Soils I. Preq: CE 342. 3(2-3) F. Study of soil properties significant in earthwork engineering, including soil solids, basic physiochemical concepts, classification, identification, plasticity, permeability, capillarity and stabilization. Laboratory work includes classification, permeability and compaction tests. Kashef, Langfelder

CE 549 Engineering Properties of Soils II. Preq: CE 548. 3(2-3) S. Continuation of CE 548. Compressibility, stress-strain relations and shear strength theories for soil. Laboratory work includes consolidation and shear strength tests. Langfelder

CE 551 Theory of Concrete Mixtures. Preq: CE 332. 3(3-0) F. Study in depth of portland cement concrete mixtures including types and properties of portland and special cements, mix design methods, fresh and hardened concretes, admixtures. Mullen

CE 553 Asphalt and Bituminous Materials. Preq: CE 332. 3(2-3) S. Study in depth of asphalts and tars properties for use in waterproofing and bituminous materials. Theories of design of bituminous mixtures for construction and paving uses including types and properties of asphalt cements, cutbacks, emulsions, blown asphalts and tars. Laboratory work required. Mullen

CE 555 Highway and Airport Pavement Design. Preq: CE 406 or CE 443. 3(2-3) S. Theoretical analysis and design of highway and airport pavements with critical evaluation of current design practices. Staff

CE (BAE, MB) 570 Sanitary Microbiology. Preq: MB 401 or equivalent 3(2-3) S. Fundamental aspects of microbiology and biochemistry presented and related to problems of stream pollution, refuse disposal and biological treatment. Laboratory exercises present basic microbiological techniques and illustrate basic microbial aspects of waste disposal. Staff

CE 573 Unit Operations and Processes in Waste Treatment. Preq: CE 486; Coreq: CE 571. 3(1-6) F. Unit operations and processes in water and wastes engineering, including sedimentation, thickening, chemical coagulation, vacuum filtration, carbon adsorption, biological treatment, and special projects. Galler

CE (NE) 574 Environmental Consequences of Nuclear Power. Preq: CI. 3(3-0) S. Examination of environmental consequences resulting from the siting, construction and operation of nuclear power plants and the environmental consequences of alternatives to nuclear power. Smallwood

CE 575 Civil Engineering Systems. Preq: MA 405. 3(3-0) S. Examination of civil engineering systems and their design optimization. Systems studied include water resources engineering, structural engineering, transportation engineering and construction. Galler

CE 576 Atmospheric Pollution. Preq: Grad. or advanced undergrad. standing. 3(3-0) S. Topics include: pollutant sources; effects on man and other animals, vegetation, materials and visibility; meteorological factors; air sampling, control devices; air quality and emission standards; and legal, economic and administrative aspects. Shearer

CE (BAE) 578 Agricultural Waste Management. 3(2-3) F. (See biological and agricultural engineering, page 193.)

CE 580 Flow in Open Channels. Preq: CE 382. 3(3-0) F.Theory and application of flow in open channels, including dimensional analysis, momentum-energy principle, gradually varied flow, high-velocity flow, energy dissipators, spillways, waves, channel transitions and model studies. Amein

CE (MAS) 581 Introduction to Oceanographic Engineering. Preq: CE 382. 3(3-0) S. Engineering aspects of physical oceanography. Propagation of waves theory, methods of wave forecasting and analysis of wave spectra. Application of physical oceanography to design of marine and coastal installations. Amein, Machemehl

CE 613 Theory of Elasticity II 3(3-0) 4/14/77 off 8/77
CE 614 Plasticity and Limit Analysis 3(3-0) 4/14/77 off 8/77
CE 619 Experimental Methods in Mechanics 3(2-3) 4/14/77 off 8/77
CE 620 Numerical Methods in Structural Mechanics 3(3-0) 4/14/77 off 8/77

CE 591, 592 Civil Engineering Seminar. 1(1-0) F,S. Discussions and reports. Staff

CE 598 Civil Engineering Projects. 1-6 F,S. Special projects. Staff

FOR GRADUATES ONLY

CE 571 Theory of Water and Waste Treatment. 3(3-0) F. Galler

CE 572 Design of Water and Wastewater Facilities. 3(3-0) S. Smallwood

CE 615 Inelastic Solids 3(3-0) 4/14/77 off 8/77
CE 618 Optical Mechanics 3(2-3) 4/14/77 off 8/77

Computer Science

CSC 101 Introduction to Programming. 3(2-2) F,S. Understanding algorithms, programs and computer. Organization and characteristics of computers. Fundamental algorithms associated with computing. Data representation. Basic programming and program structure. Debugging and verification of programs. Computer solution of numerical and non-numerical problems using one or more programming languages.

CSC 102 Programming Concepts. Preq: CSC 101. 3(3-0) F,S. The features available in higher-level programming languages. The student develops good programming habits by writing a variety of non-numerical application programs. Emphasis is on the global properties of programs in a block-structured language with list and string manipulation facilities.

CSC 111 ~~Algorithmic Languages I.~~ Introduction to Fortran Programming & Coreq: MA 102. 2(2-1) F,S. Introduction to a problem-oriented computer language (currently FORTRAN IV) for use in a problem solution using digital computers. Designed as a two-hour service course for scientifically oriented students, primarily in Engineering with programs slanted toward engineering applications. revised 2/23/78 off 8/78

CSC 112 Basic Computer Organization and Assembly Language. Preq: CSC 101 or 111. 3(3-0) F,S. Binary and hexadecimal number systems. Description of machine organization, including memory, addressing schemes, registers, and data channels. Internal representation of data and instructions. Machine language and the assembly process. Loading and execution. Program relocation. Input and output using facilities of a supervisor program. Interrupts and their priorities. Combining separately translated programs for execution.

CSC 200 Introduction to Computers and Their Uses. (A student who has taken CSC 101 or 111 may not receive credit.) 3(3-0) F,S. An introduction to electronic digital computers, including the parts of a computer, a step-by-step description of the processes which the computer goes through in performing its tasks, and description of several uses to which the computer is currently being put. Intended for non-technical students desiring knowledge of computer capabilities and limitations.

CSC 251 Principles of Programming — Fortran. Preq: CSC 111 or 102.1(1-0) S. The programming language Fortran and its applications to numerical computation and file manipulation. Emphasis on features and restrictions which are unique to Fortran. Programming assignments which explore the language in depth (Grading S—NC).

CSC 252 Principles of Programming — Cobol. Preq: CSC 101. 1(1-0) F,S. Introduction to the business-oriented programming language Cobol. Programming assignments cover general data processing, file maintenance and report generation. (Grading S—NC).

CSC 253 Principles of Programming — Algol. Preq: CSC 102. 1(1-0) F. Algol 60 presented as a theoretical construct and a practical programming language. Extensions to Algol 60. Programming problems in a variety of applications areas. (Grading S—NC).

CSC 254 Principles of Programming — APL. Preq: MA 405. 1(1-0) S. Advanced programming concepts in APL and their application to a wide variety of computing problems. The APL reference language and locally available APL hardware representations. (Grading S-NC).

CSC 255 Principles of Programming — Snobol. 1(1-0) F. The syntax and semantics of the symbol manipulation language Snobol 4. Applications of the language to programming problems in non-numeric areas. (Grading S-NC).

CSC 301 Principles of Systems Programs. Preq: CSC 112. 3(3-0) S. Advanced topics in assembly language programming. Program relocatability. Definition, call and expansion of macros. Historical survey of development of operating systems. Definition of operating system components. Use of operating system facilities.

CE 630 Probabilistic Methods in Structural Engineering 3(3-0) 4/14/77 to 2000 off 8/77

CSC 302 Introduction to Numerical Methods. Preq: CSC 101 or 111; ~~Coreq. MA 301 or 312.~~ 3(3-0) F,S. Numerical computations with digital computers; floating point arithmetic and implications of round-off error. Algorithms and computer techniques for the numerical solution of problems in: function evaluation; zeros of functions; interpolation; numerical differentiation and integration; linear systems of equations; curve fitting; solutions of nonlinear equations; numerical solutions of ordinary differential equations.

CSC 311 Data Structures. Preq: CSC ~~302~~ and ~~312.~~ 3(3-0) F,S. Fundamental algorithms associated with data structures. Topics are: linear lists including stacks, queues and deques; sequential and linked allocation of linear lists; circular lists, doubly-linked lists, arrays and orthogonal lists; trees including traversal of binary trees and binary representation of trees; lists and garbage collection; multilinked structures; dynamic storage allocation.

CSC 312 Computer Organization and Logic. Preq: CSC ~~112,~~ ~~222.~~ 3(3-0) F,S. Application of Boolean algebra to combinational circuit design problems. Sequential circuits. Organization and functional design of simplified computer components such as the memory unit, the arithmetic and logic unit and input-output devices. Architecture of computing systems. Functional characteristics of I/O devices, data channels, interrupt and priority systems. Microprogram control. Hardware-software tradeoffs and firmware.

CSC (E) 321 Computer Graphics. 3(2-2) S. (See engineering, general courses, page 232.)

CSC 322 Applied Algebraic Structures. Preq: MA 405. 3(3-0) F,S. Naive set theory, order and equivalence relations, functions, partitions, operations and congruences. Boolean algebra, semi-group, group and graph theory. Logic of propositions, first order predicate calculus, models for an axiomatic theory. Some applications and examples of these algebraic structures selected from formal language description, data structures, file organization, information retrieval, games, switching circuits, neural nets, sequential machines, artificial intelligence, syntactic structure of arithmetic expressions and theory of algorithms.

CSC 351 Principles of Programming — LISP. Preq:CSC 311. 1(1-0) F. The programming language LISP and its application to the processing of general list structures, with emphasis on recursive programming. Assignments demonstrate the power and versatility of LISP. (Grading S-NC).

CSC 401 Sorting and Searching. Preq: CSC 311. 3(3-0) F. Sorting and searching procedures and their implications for file structure design. On-line and batch processing systems.

CSC 411 Introduction to Simulation. Preq: MA 312 and ST 371 or equivalent. 3(3-0) F,S. Introduces simulation concepts and methodology to CSC and other students. Modeling and computational techniques, Monte Carlo methods and interactive simulation. Projects are developed in areas of student interest.

CSC 412 Introduction to Computability, Language and Automata. Preq: CSC 322. 3(3-0) F,S. Sequential machines as abstractions of digital computers described by state-transition graphs. Sequential machine as language acceptors and as the finite control of a Turing machine. Chomsky classification of languages and machines. Universal Turing machines and the halting problem. Church's thesis. Recursive functions. Heuristic argument that a function is recursive if and only if it is Turing computable. The semi-group word problem and tree searching algorithm. Applications to artificial intelligence, perceptron simulation, game playing, syntactic analysis algorithms.

CSC 421 Computer Systems for Management. Preq: CSC 311. 3(3-0) F. Management information systems (MIS). The data base approach. Characteristics of successful systems and dimensions of system evolution and evaluation. Models versus modeling in MIS design. A model of information flow and its economics. Profitability and risk analysis in corporate financial systems. Production/inventory control through MIS. Operations research techniques for MIS development. Management's MIS consultant. The general purpose MIS. Human factors in design and implementation of the new company MIS.

CSC (MA) 427 Introduction to Numerical Analysis I. Preq: MA 301 or 312 and programming language proficiency. 3(3-0) F. For undergraduate students in any department who wish to learn the theory and practice of computational procedures using a digital computer. Topics include: approximation of functions by interpolating polynomials; numerical differentiaton and integration; solution of systems of ordinary differential equations in-

cluding both initial valve and boundary value problem. Computer applications and techniques.

CSC (MA) 428 Introduction to Numerical Analysis II. Preq: MA 405 and programming language proficiency. 3(3-0) S. For students who wish to learn computational procedures using digital computers. Topics include: solution of linear and nonlinear equations; matrices and iegenvalue calculations; orthogonal polynomials and Gaussian quadrature; curve fitting and function approximation by least squares smoothing formulas; minimax approximations. [CSC (MA) 427 is not a prerequisite.]

CSC 431 Information Retrieval. Preq: CSC 311. 3(3-0) S. Organization and retrieval of information in natural language form. Analysis of information content by statistical, syntactic and logical methods. Automatic clustering and statistical association methods. Dictionary construction and utilization. File organization and retrieval techniques for text processing systems. Evaluation of retrieval effectiveness. Applications to both document retrieval and question answering systems.

CSC 432 Introduction to Digital Signal Processing. Preq: CSC 302, ST 371, and MA 405. 3(2-2) S. Use of digital computers in the processing of analog signals. The uses of operational amplifiers in SAH, DAC, and ADC's and other data acquisition devices. The discrete Fourier transform, digital filters and other algorithms used in processing time series.

CSC 462 Computing for the Social Sciences. Preq: ST 311 or equivalent. 3(3-0) S. To acquaint the social scientist with the information processing capabilities of a computer. Examples and problems from the social sciences. Topics include: a higher level programming language, procedures for accessing statistical packages and other library routines, and data management using disks and tapes. (CSC majors may not receive credit.)

CSC 495 Special Topics in Computer Science. Preq: CI. 1-6 F,S. Consists of the following types of study: readings in the literature of computer science, introductory research projects, major computer programming projects, seminars, or new course development. Work may be done in any CSC area such as software, hardware utilization, programming languages, numerical methods or telecommunications.

CSC 499 Undergraduate Research in Computer Science. Preq: CI. 1-6 F,S. Independent investigation of a research problem under faculty supervision.

CSC 501 Design of Systems Programs. Preq: CSC 311, 312 (CSC 301 recommended). 3(3-0) F. Review of batch process systems programs, their components, operating characteristics, user services and their limitations. Implementation techniques for parallel processing of input-output and interrupt handling. Overall structure of multiprogramming systems on multi-processor hardware configurations. Details on addressing techniques, core management, file system design and management, system accounting, and other user-related services. Traffic control, interprocess communication, design of system modules, and interfaces. System updating, documentation and operation.

CSC 502 Computational Linguistics. Preq: CI. 3(3-0) F. Use of a symbol manipulation language (SNOBOL 4) in solving non-numeric problems. Study of generative grammars, including finite-state, context-free, context-sensitive, and transformational grammers. Syntactic analysis by computers: algorithms and existing analysis systems for English. Computational semantics. Information retrieval and question-answering systems. Open to CSC and other students.

CSC 504 Application of Linguistic Techniques to Computer Problems. Preq: CSC 502. 3(3-0) S. Semiotics and programming languages. Comparison of semantic theories. Representation, classification and interpretation of scenes and other multi-dimensional illustrations. Design of a formal language for describing two-dimensional geometric figures, such as flow charts, chemical structures and logic diagrams. Characterization of programming languages according to the theory of transformational grammar.

CSC 511 Artificial Intelligence. Preq: CSC 311. 3(3-0) F. (Odd-numbered years.) Definition of heuristic versus algorithmic methods, rationale of heuristic approach, description of cognitive processes. Objectives of work in artificial intelligence, simulation of cognitive behavior. Heuristic programming techniques. Survey of examples from representative application areas. The mind-brain problem and the nature of intelligence. Individual projects.

CSE 505 Design and Analysis of Algorithms 3(3-0) 12/1/77 eff 1/78
CSE 506 Digital Systems Architecture 3(3-0) 12/1/77 eff 1/78
CSE 510 Software Engineering 3(3-0) 12/1/77 eff 8/78
CSE 571 Data Transmissions/Communications 3(3-0) 12/1/77 eff 1/79

CSC 512 Metaprograms. Preq: CSC 311. (CSC 412 recommended.) 3(3-0) S. The techniques used in the design and implementation of compilers. Introduction to formal grammars and relations concerning a grammar. Detailed study of algorithms for lexical scanners, top-down recognizers, bottom-up recognizers for simple precedence grammars, operator precedence grammars, higher order precedence grammars, and bounded-context grammars. Run-time storage organization for a compiler including symbol tables, internal forms for source programs, semantic routines, error recovery and diagnostics, code generation and optimization, and interpreters.

CSC 522 Formal Languages and Syntactic Analysis. Preq: CSC 412 (CSC 512 recommended). 3(3-0) F. Formal languages and their relation to automata: languages and their representation, grammars, finite automata and regular grammars context free grammars and pushdown automata, type 0 grammars and Turing machines, the halting problem, context-sensitive grammars and linear bounded automata, and operations on languages.

CSC (MA) 529 Numerical Analysis I. 3(3-0) F. (See mathematics, page 270.)

CSC (MA) 530 Numerical Analysis II. 3(3-0) S. (See mathematics, page 270.)

CSC 532 Artificial Intelligence II. Preq: CSC 511, a course in mathematical logic. 3(3-0) S. (even numbered years). Emphasizes patter recognition, theorem proving, game playing, learning and heuristic programming. Students assigned computer projects illustrating theoretical concepts.

CSC (MA) 536 Theory of Sequential Machines. (See mathematics, page 270.)

CSC (MA) 537 Theory of Computability. Preq: CSC 412 or grad. standing. 3(3-0) S. Effective computability. Turing machines. Primitive recursive functions. The u operator. u-recursive functions. Godel numbering. Equivalence of Turing machines and u-recursion. Undecidable predicates. Universal Turing Machines. Other formulations of the concept of effective computability.

CSC 542 Database Management. Preq: CSC 431. 3(3-0) F. The course will cover the fundamentals of the area of database management. Basic topics will include: general architecture for database management systems, current data models such as network, relational, hierarchical; security and integrity; discussion of currently implemented systems.

CSC (IE, OR) 562 Advanced Topics in Computer Simulation. Preq: ST 421 or equivalent or grad. standing. 3(3-0) S. Basic simulation methodology; general principles of the Monte Carlo Method: random number generation, accuracy, variance reduction methods, classical applications in mathematics and physics; simulation of queuing systems; development of a research problem in depth where computer simulation is required 1) to provide insight through experientation with a model, 2) to provide approximate answers and practical solutions, and 3) to test the model and the solutions.

CSC (MA) 582 Special Topics in Numerical Solution of Linear Algebraic Equations. Preq: MA 405 or equivalent and a knowledge of computer programming. 3(3-0) S. A mathematical and numerical investigation of direct iterative and semi-iterative methods for the solution of linear systems. Methods for calculating eigenvalues and eigenvector of matrices.

CSC (MA) 583 Special Topics in the Numerical Solution of Ordinary Differential Equations. 3(30) F. (See mathematics, page 270.)

CSC (MA) 584 Special Topics in the Numerical Solution of Partial Differential Equations. 3(3-0) F. (See mathematics, page 270.)

CSC (OR, MA) 585 Graph Theory. 3(3-0) F. (See operations research, page 287.)

CSC 595 Special Topics. Preq: CI. 1-6 F,S. Topics of current interest in CSC not covered in existing courses.
CSC 605(OR) Large Scale Linear Programming Systems 3(3-0) eff 1/78

Crop Science

CS 211 Crop Science. Preq: BS 100. 4(4-0) F,S. Fundamental morphological, physiological and reproductive features of crop plants and the management practices for economical production. Emery, Fike

CS 214 Crop Science Laboratory. Preq: or Coreq: Any CS course. 1 (0-2) F,S. (Can be

CSE 572 Computer Communications 3(3-0) 12/1/77 eff 1/78
CSE 574 Real Time Computer Systems 3(3-0) 12/1/77 eff 1/78
CSE 591 Special Topics in Computer Studies 3(3-0) 12/1/77 eff 1/78
CSE 671 Computer Systems Performance Evaluation 3(3-0) 12/1/77 eff 1/79
CSE 691 Advanced Topics in Computer Studies 3(3-0) 12/1/77 eff 1/78
CSE 692 Individual Topics in Computer Studies 1-3 12/1/77 eff 1/78

CSE 695 Seminar in Computer Studies 1(1-0) 12/1/77 eff 1/78
CSE 699 Computer Studies Research 12/1/77 eff 1/78
CSE 457 Electric Circuits ~~Practice~~ 1(3-0) 6/23/78 eff 8/78
CSE 458 Electric Circuits module 1(3-0) 6/23/78 eff 8/78

taken only once for credit.) Evaluates methods of identifying and dealing with the problems of growing and managing crop plants. Emery, Fike

CS 295 Special Topics in Crop Science. Preq: CS 211 or BO 200. 1-6 F,S,Sum. To be used for intensive or extensive study of specific crop science principles or production practices. It may also serve as a means for presenting crop science topics of current interest to non-majors. Emery

CS 312 Pastures and Forage Crop. Preqs: BS 100, SSC 200 recommended. 3(3-0) S. Production and preservation of the principal forage crops, with attention to the development and maintenance of pastures. Chamblee

CS 315 Turf Management. Preq: BS 100. 3(2-2) S. Production, utilization, and management of turf grasses. The growth responses of different plant species to natural and imposed environmental factors. Interrelationships of climate, soil, biotic factors, and plants are examined in the field, laboratory, and classroom. Gilbert

CS (BO) 402 Economic Botany. Preq: ~~BO 200.~~ 3(2-3) S. Emphasis is on plants and human affairs. All phases of the interrelationships of the plant world and the life history incipient to modern human cultures. Includes plants and plant products, beneficial and harmful, that man has used as necessities of life, ameliorants contributing to his well-being, and as raw materials for industry. Ornamentals are excluded. Timothy

CS 411 Environmental Aspects of Crop Production. Preq: BO 421. 2(2-0) F. The productivity and quality of crops in relation to all environmental factors, including man. Disorders caused by physical and biotic environmental stresses and the role of these environmental factors in normal crop development are emphasized. Utilization and manipulation of the environment for the continued improvement of crops are discussed. Patterson

CS 413 Plant Breeding. Preq: GN 411. 2(2-0) S. Discussion of reproductive systems of higher plants; the genetic basis for plant improvement and the selection, evaluation, and utilization of crop varieties. Emery

CS 414 Weed Science. Preq: CH 220. 4(3-2) F. Introduction to weed science covering principles and practices of cultural, biological, and chemical control. Chemistry, properties and effects of herbicides on plants are studied. Weed identification and principles and practices of application of herbicides and their safe use are covered. There are three parts of lecture content: introduction, history, fundamentals of weed growth, spread and control; a section on chemical herbicides; and a section on weed control practices in crops and noncropland areas. Worsham

CS (SSC) 462 Soil-Crop Management Systems. 3(2-3) S. (See soil science, page 314.)

CS 490 Senior Seminar in Crop Science. Preq: Sr. standing. 1(1-0) S. The collection, organization, written preparation, and oral delivery of scientific information. Emery

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CS 511 Tobacco Technology. Preq: BO 421 or equivalent. 3(3-0) S. Special problems concerned with the tobacco crop. The latest research problems and findings dealing with this important cash crop. Collins

CS 513 Physiological Aspects of Crop Production. Preq: BO 421. 3(3-0) S. Emphasizes pertinent physiological processes associated with crops and crop management such as plant growth, maturation, respiration and photoperiodism. Relationship of the environment to maximum crop yields. (Offered S 76 and alt. years.) Fike

CS (HS) 514 Principles and Methods in Weed Science. Preqs: CS 414 or equivalent. 3(2-2) S. The losses caused by the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques and field research techniques. Monaco

CS (GN, HS) 541 Plant Breeding Methods. Preqs: GN 506 and ST 511. 3(3-0) F. Methods of plant breeding as related to principles and concepts of inheritance. Henderson, Staff

CS (GN, HS) 542 Plant Breeding Methods. Preq: CS (GN, HS) 541. 2(0-4) Sum. Laboratory and field study of the application of the various plant breeding techniques and

CSE 459 Linear Systems module 1(3-0) 6/23/78 eff 8/78

methods used in the improvement of economic plants. (Offerred Sum. 1976 and alt. years.) Caldwell

CS (GN) 545 Origin and Evolution of Cultivated Plants. Preq: CS 541 or GN 540. 2(2-0) S. Discussion topics include: mankind as a potential cultivator; man's anatomy, physiology and alimentary needs; origins of cultivation; spread of agriculture in terms of various theories; interactions of crops and environments with reference to crop evolution; special attributes of cultigens; modern aspects of evolution breeding. (Offered S 1976 and alt. years.) Lee

CS 591 Special Problems. Preq:. CI. Credits Arranged. Crop science problems may be selected or assigned. Emphasis on review of recent and current research. Staff

Design

ARC 400 Intermediate Architectural Design (Series). Preq: DF 102. May not be taken more than six times. 6(0-9) F,S. Design investigation aimed at the development of an understanding of the major issues confronting the architect and at the expanding of problem-solving abilities in architectural design. Students must complete four semesters to satisfy this requirement, selecting from a number of vertically organized workshop studios which offer on an optional basis a wide range of program emphases.

DF ~~101~~ 102 Environmental Design I, II. Preq: (DF 102) 101. Available to School of Design students only; this restriction may be waived by Dean and Program Director. 6(0-9) F,S. Introduction to the design disciplines and programs of the School of Design. A studio course examining the techniques and attitudes for dealing with identification, solution and evaluation arising from the design of physical artifacts in the natural and man-made environment. The acquisition of languages and skills appropriate to these studies.

DF 285 Environmental Design Studio for General Undergraduates. Preq: Sophomore Standing. This course is not open to School of Design students. 3(0-6) F,S. A studio structured investigation of participant-context relationships as they help to determine the design of physical objects. Work involves the construction of various perceptual and conceptual simulations and/or models. Course places major stress on self-discovery and development.

DF 400 Advanced Design Studio. Preq: DF 102. Open only to School of Design Students — Restriction waived at discretion of Dean and Program Director. 6(0-9) F,S. Studio offering upper level undergraduates the opportunity to intensively study fundamental design issues (form, color, structure, proportion, scale etc.) in a studio mode. Course may be used to partially satisfy studio requirement in all undergraduate programs in school.

DF 485 Design Studio for Non-Design Undergraduates. Preq: Junior Standing. Not open to School of Design Students. 3(0-6) F,S. The course in intended to enrich the undergraduate program of students desiring some contact with the "studio" course structure of the School of Design. Design problems will be addressed in the studio milieu; the content of the problems will be drawn as much as possible from each student's major field of undergraduate studies.

DN 141 History of Design I. Open to University students on a space available basis. 3(3-0) F. A critical study of the related design fields from prehistoric to early Christian times with reference to the social, political and technological movements which affected their development.

DN 142 History of Design II. Open to University students on a space-available basis. 3(3-0) S. A critical study of the related design fields from early Christian to modern times with refernce to the social, political and technological movements which affected their development.

DN 221 Introduction to Environment and Behavior for Designers. Credit in both DC 221/231 and DN 232 is not allowed. Students must concurrently enroll in DN 221 and 231. 3(3-0) F,S. An introductory integration of behavioral and environmental information, emphasizing a basic understanding of human behavior, natural systems, and their relation to environmental design. Examined is the impact of people and their artifacts on natural systems, and the impact of natural systems on people and their artifacts. Humane, ecologically sound utilization of these relations is explored.

ARC 600 Advanced Architectural Design 6 (0-12) 4/28/77 eff 1/78

ARC 591 Special Seminar 1-3 10/27/77 eff 8/78
ARC 592 Special Topics 2-3 10/27/77 eff 8/78
ARC 595 Independent Study 1-3 10/27/77 eff 8/78

DN 222 Human Perception and Behavior for Designers. 3(3-0) S. Course examines the linkages among perception, cognition and behavior with a strong emphasis on the perceptual mechanisms of humans, especially the eyes and ears. Also deals with the cognitive organization of perceptual information, its relation to language, society and culture and isolated human behavior at the micro and macro levels.

DN 231 Introduction to Environment and Behavior for Designers. (See DN 221).

DN 232 Introduction to Natural Systems and the Built Environment. Credit in both DN 221/231 and DN 232 is not allowed. 3(3-0) F,S. This course is an introduction to natural systems and their integration into environmental design processes. Historical and present relationships between people and the physical environment are examined. Natural systems are analyzed as a foundation for environmental design decisions and ecologically sound habitation systems are explored.

DN 251 Principles of Architectural Structures. 3(3-0) F,S. Development of the principles of structural behavior. A survey of structural systems, both natural and man-made, with an emphasis on a qualitative examination of the forces, influences or purposes to which they respond.

DN 252 Environmental Responses in Design. 3(3-0) S. An introductory study in form seen as a response between man and the natural environment. The morphological relationship between material properties and environmental energies and their dual impact on the shape of the built artifact is investigated.

DN 253 Basic Environmental Systems. 3(2-2) F,S. Natural and man-made laws as applied to buildings and their various applications to lighting, heating, cooling, ventilation, plumbing, vertical transporation and sound.

DN 254 Architectural Materials and Construction Systems. 3(2-2) F,S. Development of the concept of building as an environmental control and response mechanism. A description of environmental and use factors upon which the science of building construction is based. An investigation of basic building materials, their properties, processes of production and principal systems of enclosure, consideration also given to economic factors and legal controls.

DN 255 Contemporary Manufacturing Processes I. 3(3-0) F. Introduction to mass production processes and their influences on design. Emphasis is placed on material search and process selection in relation to form, function, human factors, finishes and joining methods. An analysis of paper, wood and metal manufacturing processes utilized in the production of mass-produced products.

DN 256 Contemporary Manufacturing Processes II. 3(3-0) S. Introduction to mass production processes and their influences on design. Emphasis is placed on material search and process selection in relation to form, function, human factors, finishes and joining methods. An analysis of plastics and rubber and their specific manufacturing processes utilized in the production of mass-produced products.

DN 257 Landscape Materials and Construction I. 3(2-4) F. An option for those students wishing to concentrate on the use of materials in small scale physical design. The course will concentrate on the properties of materials in design and construction techniques. Exercises in design will stress the implementation and use of materials for particular situations.

DN 258 Landscape Materials and Construction II. 3(2-4) S. A continuation of DN 257 with an emphasis on material use and construction techniques; the development of construction documents; project organization and control and professional office organization will also be covered.

DN 261 Design Methods. 3(3-0) F. Descriptive, comparisons, and testing of methods available in design with emphasis on problem-solving techniques.

DN 311, 312 Advanced Visual Laboratory I, II. Preq: DF 201, soph. standing. 2-4 F,S. Continuation, on an advanced level, of the activities encountered in Design Fundamentals that relate to the major design areas in the School of Design. Activities involve study of visual communication skills in areas of sculpture, life drawing, graphics, painting, photography. The student elects instructor and area(s) of activity.

DN 349 Historic Architecture Research. Preq: DN 141/142. 3 F,S. Research and the recording of sites, monuments, buildings or artifacts of historical interest.

LAR 531 Project Planning and Design 3(3-0) 4/20/78 eff 8/78

DN 351 Architectural Structures I. Preq: or Coreq: DN 251. 3(3-0) F. An introduction to force systems, quantitative treatment of equilibrium conditions; analysis of forces in trusses, frames and beams; behavior of materials: stress-strain diagrams, ductility, brittleness, creep; mechanics of areas; column behavior; stresses and deflection in beams.

DN 352 Architectural Structures II. Preq: DN 351. 3(3-0) S. Selection of structural system and design of structural elements in wood, steel, concrete and aluminum.

DN 411, 412 Advanced Visual Laboratory III, IV. Preq: DF 102, soph. standing. 2-4 F,S. Continuation, on an advanced level, of the activities encountered in Design Fundamentals that relate to the major design areas in the School of Design. Activities involve study of visual communication skills in areas of sculpture, life drawing, graphics, painting, photography. The student elects instructor and area(s) of activity.

DN 413 Geometry for Designers. Preq: DF 102. 3(2-3) F,S. An opportunity to explore and examine geometry and geometrization as applied to the various fields of physical design. Limited mathematical and drawing skills needed.

DN 414 Color and Light Laboratory. Preq: DF 102. 3(2-2) F,S. A course dealing with the physical and perceptual nature of color. It will be one-third lecture, one-third studio and one-third discussion-seminar. Its purpose is to develop color awareness, sensitivity and skills in visual communication with color as a designer's tool.

DN 415 Visual Design Materials and Processes I. Preq: DF 102. 3(2-2) F. Introduction to basic tools and materials of visual design, packaging, typography and layout. The course will acquaint the student with mass production of two- and three-dimensional visual designs, packages and display techniques.

DN 416 Visual Design Materials and Processes II. Preq: DF 102. 3(2-2) S. Introduction to basic tools and materials of visual design, packaging, typography and layout. The course will acquaint the student with mass production of two- and three-dimensional visual designs, packages and display techniques.

DN 419 Multi-Media in Design 10/2/78 eff 1/79

DN 421 Environmental Cognition for Designers. Preq: DN 221/231 or DN 222. 3(3-0) F. A basic model of cognitive processes is examined, providing a framework for a lengthy exploration of cognitive imagery. This commences with body imagery and images of self, moving from there to developmental images of home, school, neighborhood and city. Mature imagery of similar things is studied, concluding with a model of the micro-genetic development of environmental imagery useful in design decision-making.

DN 423 Spatial Cognition for Designers. Preq: DN 221/DN 231 or DN 222. 3(3-0) F. The history of the concept of space in the Western world is examined as a foundation from which to look at how humans cognize space. A childe developmental perspective is emphasized, but a model of spatial cognition in the adult is described. The relation of spatial to environmental cognition is treated.

DN 424 Social Factors Analysis in Design. Preq: DN 221/231 or 222. 3(2-4) S. The course introduces the student to human analysis techniques which can be applied to landscape architectural design. Interaction theory, neighborhood theory, social design policy and user preference approaches will be presented.

DN 430 Site Planning. Preq: DN 221/231 and GY 120/110 or GY 101/110 or SSC 205. 3(2-2) F,S. Introduction into the technical operations and environmental landscape controls on project scale developments. The course covers site analysis, road alignment, grading hydrologic control, sedementation control and related problems of land development.

DN 431 Natural Environment Analysis. Preq: DN 221/231 or DN 232. 3(3-0) F. Course in the theory and methods of landscape description, assessment and analysis of natural environments. Environmental science applications are described in relationship to land planning and management.

DN 432 Environmental Assessment and Design Field Workshop. Preq: DN 221/231 or DN 232. 3 Sum. This summer field workshop is a hands-on experience concerned with the assessment of natural systems and their utilization in the active manipulation of the environmental setting. Experiments relating to alternative decentralized energy systems, energy conservation methods, and low-technology, ecologically sound site support systems will be designed and executed.

DN 433 Plants and Design 10/2/78 eff 1/79

LAR 591 Special Seminar 1-3 11/3/77 eff 8/78
LAR 592 Special Topics 2-3 10/27/77 eff 8/78
LAR 595 Independent Study 1-3 10/27/77 eff 8/78

LAR 573 Historic Preservation 3(3-0) 1/26/78 eff 8/78
LAR 574 Landscape Design Controls 3(3-0) 1/26/78 eff 8/78

DN 441 Origins and Development of Contemporary Architecture. Preq: DN 141, 142 for Design students only. Others: Junior Standing. 3(3-0) F,S. A survey and critical examination of modern architecture from its origins in 19th century philosophy and technology to the most recent developments in world architecture. The work of significant architects are explored through lectures and slide presentations.

DN 443 Landscape History: From the Ice Age to the Present. Preq: DN 141, 142. 3(3-0) F. The landscape designer deals with a landscape that has been shaped by man for the past fifteen or so thousand years. What has been the nature of man's agency? How extensive have the changes he has wrought been? Course examines in depth the landscape impacts of agriculture, commerce and industry attempting to establish the context within which the landscape designer operates.

DN 444 History of Landscape Architecture. Preq: DN 141, 142. 3(3-0) F. The history of man's deliberate and conscious attempts to design the landscape is examined, beginning with a view of the efforts and results of primitive man. Ancient, medieval and Renaissance work is examined in garden and urban design to set the stage for the explosion of professional activity that followed. The work of Frederick Law Olmsted is examined in detail.

DN 447 Architecture History Seminar. Preq: DN 141, 142. 3(3-0) F,S. Presentations and discussions of specific areas in architectural history and allied design fields. eff 1/79

DN 451 Illumination. Preq: DN 253. 3(1-4) S. Design of illumination systems for interior space. Model simulation of alternative lighting schemes.

DN 452 Climate Control Systems and Design. Preq: DN 253. 3(1-4) F. Mechanical and non-mechanical systems for heating, cooling, ventilating, interior of building with emphasis on energy conscious design.

DN 453 The Systems Approach to Building. Preq: DN 254. 3(3-0) S. An examination of a totally integrated process of programming, designing, constructing and evaluating buildings or larger environmental units. The history of industrialized building and case studies of significant systems building efforst of recent years will be investigated. Included will be an assessment of the future potentials of the systems approach and the designer's role.

DN 462 Predictive Techniques, Predesign Methods, and Programming. Preq: DN 261. 3(3-0) S. Problem solving, research methods, programming, games, graph theory and their applications to design.

DN 491 Special Seminar in Design. 1-3 F,S. Seminars on subjects of current interest in design which are presented by persons not part of the regular faculty.

DN 492 Special Topics in Design. 1-3 F,S. Topics of current interest to the programs in the School of Design offered by faculty in the School. Courses offered under this number are normally used to develop new courses.

DN 493 Mini-Course in Design. 1-2 F,S. Seminars, workshops and lectures which by nature of their subject matter, focus or method of instruction do not fit the semester model.

DN 494 Internship in Design. Preq: Junior Standing. Approval of program director. Max. 6 cr. hrs. 3-6 F,S. Supervised field experience in professional offices and organizations whose activities are related to the programs of the School of Design.

DN 495 Independent Study in Design. Preq: Junior Standing. Max. 6 cr. hrs. Approval of program director and core chairman. 1-3 S,F. Special problems in various aspects of design developed under the direction of a faculty member on a tutorial basis.

LAR 400 Intermediate Landscape Architecture Design (Series). Preq: DF 102. May not be taken more than six times. 6(0-9) F,S. This series of courses covers small scale design, urban landscape architecture, public and institutional design. The problems of project organization, design and execution will be studied in each course. Students must complete four semesters to satisfy this requirement, selecting from a number of vertically organized workshop studios which offer on an optional basis a wide range of program emphases.

PD 400 Intermediate Product Design (Series). Preq: DF 102. May not be taken more than six times. 6(0-9) F,S. This series of courses is concerned with various social/economic age groups, various forms and rates of production, and various natural and synthetic materials. Students must complete four semesters to satisfy this requirement, selecting from a number of vertically organized workshop studios which offer on an optional basis a wide range of program emphases.

PD (T) 471 Introduction to Textile Design I 3(2-2) eff 8/77
PD (T) 472 Textile Design II/Internship 3 eff 8/77
PD (T) 473 Textile Design III 3(2-2) eff 8/77

LAR 575 Land Development Techniques for Designers 3(3-0) eff 1/78
LAR 510 Participatory Communication 3(2-2) eff 8/77

LAR 600 Landscape Design Studio 6(0-12) eff 1/78
~~LAR 691~~
Pd 591 Special Seminar 1-3 10/27/77 eff 8/78
Pd 592 Special Topics 2-3 10/27/77 eff 8/78

PVD 400 Intermediate Visual Design (Series). Preq: DF 102. May not be taken more than six times. 6(0-9) F,S. Investigations of visual environment through the agency of various materials and processes leading to professional competence. Students must complete four semesters to satisfy this requirement, selecting from a number of vertically organized workshop studios which offer on an optional basis a wide range of program emphases.

Economics and Business

(Also see Accounting.)

revised eff 8/78

EB 201 Economics I. 3(3-0) F,S. Development of the modern economy and the history of economic thought to help understand economic problems. The market system as a means of cooperation and as facilitator of individual choice and efficiency in resource use. Inflation, employment, and growth in the national economy and their management by fiscal and monetary policies. Economic theories are presented to clarify policy issues and empirically resolvable controversies. Staff

EB 202 Economics II. Preq: EB 201. 3(3-0) F,S. Analysis of problems of contemporary national and international economics. Topics include the public economy, the financial system, industrial organization, pricing of factors of production, international trade, economic growth and development, and comparative economic systems. Staff

EB 212 Economics of Agriculture. Preq: MA 111. 3(3-0) F,S. The functioning of the agricultural economy including the allocation of resources in agricultural production, relationships between agriculture and other segments of the economy, and current problems within the agricultural sector. Staff

cr/13 10/11/78

EB 301 Production and Prices. Preq: MA 112 and EB 201 or 212. 3(3-0) F,S. The functioning of the market economy. 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. Staff

or EB 212

EB 302 Aggregate Economic Analysis: Theory and Policy. Preq: EB 201 and MA 112. cr/13 10/11/78
3(3-0) F,S. Factors determining the national income. Relates the economic behavior of households, business firms and government to the determination of total output, employment, the price level and other aggregate economic variables. Problems of public policy-making in achieving full employment and a stable price level. Staff

EB 303 Farm Management. Preq: EB 201 or 212. 3(2-2) F,S. Basic economic principles including the use of budgeting, linear programming, systems analysis and other techniques in determining what, how and how much to produce under various economic conditions. Neuman

EB 304 Financial Institutions. Preq: EB 201. 3(3-0) F,S. The flow-of-funds among the principal financial institutions in the American economy; the behavior of the money and capital markets; and the allocation of savings flows into investment expenditures. Jones, Poindexter, Lapp

EB 307 Business Law I. Preq: EB 201 or 212. 3(3-0) F,S. The main principles of law affecting the conduct of trade as it is affected by contracts, agency and property ownership. Major areas include criminal law, tort law, contract, agency, real and personal property, wills and estates. Holcomb

EB 308 Business Law II. Preq: EB 307. 3(3-0) F,S. The main principles of law affecting the conduct of trade and industry including real and personal property, mortgages, insurance, wills and estates, sales, business organizations and bankruptcy. Pinna

EB 310 Economics of the Firm. Preq: EB 201 or 212. 3(3-0) F,S. The economic setting within which the business firm makes decisions and an application of economic analysis to these decisions. Economics in managerial decision making. Harrell, Holthausen, Loeb

EB 311 Agricultural Markets. Preq: EB 201 or 212. 3(3-0) S. The agricultural marketing system and the current economic forces affecting its structure and efficiency; decision making by agricultural business firms including integration and interfirm relationships; effects of monopoly in marketing relative to government policies of control. Visits to marketing firms and practical problems illustrating firm decisions. A laboratory period in alternate weeks beginning with the second full week of classes. Students examine individually the marketing problems associated with the commodity of their choice. Staff

EB 230 Economics of Cooperatives 2(2-0) 11/3/77 eff 8/78

ARC 543 Analysis of Precedent 3(0-3) 11/15/78 eff 1/79
LAR 611 Advanced Community Design and Development Control 3(1-3) 13/3 eff 5/79

EB 313 Marketing Methods. Preq: EB 201 or 212. 3(3-0) F,S. The functions of marketing for goods and services in the consumer, industrial and government markets. Emphasis on the role of marketing in our free exchange economic system. Areas studied are the activities of market research, advertising, pricing, channels of distribution, agricultural marketing, international marketing, and the marketing of services. "Consumerism," its causes and its probable future. Leonard

EB 325 Industrial Management. Preq: EB 201 or 212. 3(3-0) F,S. Principles of management and the management process within the industrial organization. The relation of the financial, marketing, organization, and communication systems to the operations function. Quantitative decision methods for operations planning, organizing, and control. The student manages the operations system of a firm in a simulated environment. Loeb

EB 326 Personnel Management. Preq: EB 201 or 212. 3(3-0) F,S. 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. Clark, Wessels

EB 332 Industrial Relations. Preq: EB 201 or 212. 3(3-0) F,S. The nature and functions of collective bargaining. The objectives and tactics of both labor and management within public policy guidelines. An examination of labor contracts and their implications for labor and management. Emphasis of the impact of change, economic and technological. Fearn

cr 113 10/14/78

EB (ST) 350 Economics and Business Statistics. Preq: MA 112, EB 201 and 202 or equivalent. 3(3-0) F,S. An introduction of statistical application to economics and business problems. Included are such topics as probability, sampling, statistical estimation, inference, index numbers and linear regression. Wilson, T. Johnson

EB (HI) 370 The Rise of Industrialism. Preq: EB 201 or 212. 3(3-0) F,S. The pattern of historical development of modern industrial economy. Capitalism origins in 16th century England are related to succeeding developments in the overseas colonial empire and in other areas influenced by that development. Sylla

EB (HI) 371 Evolution of the American Economy. Preq: EB 201 or 212. 3(3-0) F,S. Advances of modern industrialization are related to the development of America. Contemporary problems and issues are analyzed with reference to their origins in the historical growth of the economy. Sylla

EB 401 Economic Analysis for Nonmajors. Preq: EB 201 or 212. 3(3-0) F,S. Intermediate economic theory of firm, household and market behavior primarily for graduate students desiring an economics minor at the master's level. Students with adequate background in economics and mathematics elect EB 501 instead. Topics include demand, production and cost theory, market equilibrium under competitive and non-competitive conditions, an introduction to input-output and general equilibrium theory, the spatial arrangement of economic activity and problems of economic efficiency. Grennes

EB 410 Public Finance. Preq: EB 301. 3(3-0) F. A micro-economic analysis of the rationale for public expenditure and taxation. Topics include externalities, pollution and public policy, income redistribution and public welfare, public goods, collective choice and political institutions, public budgeting techniques and cost-benefit analysis, taxation and tax policy, state-local finance and fiscal federalism. Hyman, Knoeber

EB 413 Competition, Monopoly and Public Policy. Preq: EB 301. 3(3-0) S. The effect of modern industrial structure on competitive behavior and performance, considering theories of contemporary price and workable competition. Evaluation of the legislative content, judicial interpretation and economic effects of the anti-trust laws. Erickson, Flath

EB 415 Farm Appraisal and Finance. Preq: EB 303 or 310. 3(2-2) F. The earnings, market and cost approaches to real estate valuation with practice in the application of current appraisal procedures to rural property. Criteria and techniques for the financial management of a farm. Topics include existing sources and terms of capital, forms of business organization and methods of credit analysis. Neuman

EB 420 Corporation Finance. Preq: EB 201 or 212, and ACC 260. 3(3-0) F,S. The principal areas of managerial finance including the techniques necessary to make decisions. Attempts to integrate finance and other functional areas that a corporation must deal with.

EB 404 Money, Financial Markets, & the Economy 3(3-0) 1/18/78.

Relevant macro economics topics. Cases and problems dealing with important topics are analyzed and discussed. Jones

EB 422 Investments and Portfolio Management. Preq: EB 201 and 350 or ST 311. 3(3-0) F,S. Analysis of investment process problems including security analysis and emphasizing porfolio management. Brief explanation of traditional thinking and an examination of the modern revolution in investments which emphasizes a quantitative framework to achieve the goal of performance. After describing what an individual investor faces in making decisions, the question of professional management as an alternative is viewed critically. Jones

EB 430 Agricultural Price Analysis. Preq: EB 301. 3(3-0) F. Principles of price formation; the role of price in the determination of economic activity; the interaction of cash and future 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. Gardner, Schrimper

EB 431 Labor Economics. Preq: EB 301. 3(3-0) F,S. An economic approach to the labor market and its problems including unemployment and the determination of wages, hours and working conditions under various labor market structures. The economic effects of trade unions. Introduction to human capital theory. Clark, Fearn

EB 435 Urban Economics. Preq: EB 301. 3(3-0) S. Application of land use and location theory to urban structure and centralized economic activity. Analysis of trends in urbanization and suburbanization. Urban poverty, housing, transportation, pollution and financial problems. Diamond

EB 436 Environmental Economics. Preq: EB 301. 3(3-0) S. The usefulness of economics in understanding pollution, congestion, conservation and other environmental problems. Relevant economic tools such as pricing schemes, abatement cost curves, damage functions and benefit-cost analysis. Pollution taxes, regulations and subsidies considered in designing alterations in the incentive system. Public policy alternatives examined in the context of non-market decision making. Carlson

EB 442 Evolution of Economic Ideas. Preq: EB 202 or 212. 3(3-0) F. The general development of economic ideas from ancient times through Keynes. Emphasis on the classical school and developments thereafter. Though chronological in presentation, the course will review the evolution of economic ideas in the context of the changes in technology and the increasing complexity of economic activity. Turner

EB 448 International Economics. Preq: EB 301. 3(3-0) F,S. Trade, investment, monetary relations and certain aspects of economic development. Emphasis on analytical and policy approaches with some study of specific international organizations. Ball

EB 451 Introduction to Econometrics. Preq: EB 301, 302 and 350 or ST 311. 3(3-0) F. The measurement, specification, estimation and interpretation of functional relationships through single equation least-square techniques. Simple and multiple regression, curvilinear regression and various transformations will be used to measure: demand, cost, production, consumption and investment relationships. Wilson

EB 475 Comparative Economic Systems Preq: EB 201 or 212. 3(3-0) F,S. Concentration on capitalist or market economies which will be contrasted with collectivist types of systems. Emphasis on the Soviet economy. Turner

EB (TX) 482 Sales Management for Textiles 3(3-0) S. (See textile technology, page 000.)

EB 490, 491 Senior Seminars in Economics. Preq: EB 301 and 302 and 350 or ST 311 (plus two courses from list of restricted EB electives). 3(3-0) F,S. The terminal EB courses in which undergraduates are assisted in summarizing training, and improving capacity to recognze problems and select logically consistent means of solving problems. This is done on a small-group and individual basis. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

EB 501 Price Theory. Preq: MA ~~112~~ 113 9/1/78 and EB 301. 3(3-0) F,S. An intensive analysis of the determination of prices and of market behavior, including demand, cost and production, pricing under competitive conditions and pricing under monopoly and other imperfectly competitive conditions. Sylla, Chappell, Ball, Holthausen

EB 485(WPS) Management Development Seminar 3(3-0) 4/19/78 eff 1/79

EB 502 Income and Employment Theory. Preq: MA ~~112~~ 113 9/1/78 and EB 301 and 302. 3(3-0) F,S. The methods and concepts of national income analysis with particular reference to the role of fiscal and monetary policy in maintaining full employment without inflation.
Poindexter, Lapp

EB (RRA) 503 Economics of Recreation. 3(3-0) F. (See recreation resources administration, page 307.)

EB 515 Water Resources Economics. Preq: EB 401 recommended. 3(3-0) F. Applying economic principles to water resources allocation. Attention to how to effect maximum economic efficiency in the use of a resource that is no longer a free good, under the consideration of the goals of the public and private sectors of the enterprise economy. Both economic and political consequences of decision-making. Seagraves

EB 520 The Theory of Finance. Preq: EB 301 or 401 3(3-0) F. An analysis of the current state of the related financial areas of portfolio theory, the theory of capital markets, and the theory of firm finance. Emphasis is placed upon the optimum financial choice by both the firm and the individual. Basic topics include decision making under uncertainty, firm investment and financing decisions, portfolio theory and analysis, capital asset pricing models, and the theory of capital market equilibrium. Jones

EB 521 Markets and Trade. Preq: EB 301 or 401 3(3-0) F. Emphasizes the space, form and time dimensions of market price and the location and product combination decisions of firms. Consideration to the ways in which non-price factors and public-policy choices influence firm behavior and the efficiency of marketing systems. Application of these models to agricultural, industrial and public-service questions, including the relationship between resource availability and the spatial arrangement of economic activity. King

EB 523 Planning Farm and Area Adjustments. Preq: EB 310, 303, or 401. 3(2-2) S. The application of economic principles to producion 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. Liner

EB 525 Management Policy and Decision Making. Preq: EB 301 or 401. 3(3-0) F. Modern management processes used in making top-level policies and decisions; an evaluation of economic, social and institutional pressures and of the economic and noneconomic motivations, which impinge upon the individual and the organization. The problem of coordinating the objectives and the mechanics of management. Erickson, Flath

EB 533 Agricultural Policy. Preq: EB 301 or 401. 3(3-0) S. The agricultural policy and action programs of the federal government as regards both input supply and commodities, analysis of objectives, principal means and observable results as regards resource use and income distribution within agriculture, and between agriculture and the rest of the economy. Appraisal of alternative policy proposal effects on domestic and foreign consumption.
Mangum

EB 535 Social Science Concepts in Managerial Processes. Preq: Six hours EB. 3(3-0) S. Interrelationships among economic concepts and social sciences concepts in managerial processes of clarifying goals, discovering alternatives and choosing courses of action. Cases used to compare contributions of theoretical concepts from economics, political science, social psychology, sociology and management science to managerial processes. Theoretical concepts are drawn from readings in the various disciplines. Staff

EB 540 Economic Development. Preq: EB 301 or 401. 3(3-0) F. An examination of the problems encountered in promoting regional and national economic development. Consideration is given to the structural changes required for raising standards of living. Some basic principles of economics are applied to suggest ways of achieving development goals. Topics include planning strategies, policies and external assistance. Olsen

EB 550 Mathematical Models in Economics. Preq: EB 301, 302, MA 212 and MA 405 recommended but not required 3(3-0) F. Formal properties of economic models. The theory of individual economic units as a special case in the theory of inductive behavior. Mathematical discussion of the theories of the consumer and of the firm and welfare economics shows the relevance of constrained maxima and minima, set theory, partially and simply ordered systems, probability theory and game theory to economics. Staff

EB 551 Agricultural Production Economics. Preqs: MA ~~112~~ 113 and EB 301 or 401. 3(3-0) F. 9/1/78

An economic analysis of agricultural production including: production functions, cost functions, programming and decision-making principles. Application of these principles to farm and regional resources allocation and to the distribution of income to and within agriculture. Perrin

EB 555 Linear Programming. Preqs: MA 231 or 405 and EB 301 or 401. 3(3-0) F. 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. Staff

EB (ST) 561 Intermediate Econometrics. Preqs: EB 501 and ST 513. 3(3-0) S. Emphasizes the formalization of economic hypotheses into testable relationships and the application of appropriate statistical techniques with attention to procedures applicable for single equation stochastic models expressing microeconomic and macroeconomic relationships. Statistical considerations that are relevant in working with time series and cross-sectional data in economic investigations. Survey of simultaneous equation models and the available estimation techniques. P. Johnson, T. Johnson

EB 570 Analysis of American Economic History. Preq: EB (HI) 371 or grad. standing. 3(3-0) S. Stresses the application of economic analysis to the formulation and testing of hypotheses concerning economic growth and development in the historical context. Problems analyzed drawn primarily from American economic history. Sylla

EB (SOC) 574 The Economics of Population. Preq: EB 301 or 401. 3(3-0) S. Pre-Malthusian thought through contemporary population theories. Introduction to data sources, statistical tools and methodology for economic analysis in demography. There follows an intensive treatment of microeconomic models of fertility. In macroeconomics economic demographic models are examined and implications for public policy are developed. Underpopulation, overpopulation, optimum growth rate and incentive schemes. El-Kammash

EB (TX) 585 Market Research in Textiles. 3(3-0) S. (See textile technology, page 320.)

EB 590 Special Economics Topics. Preq: CI. Maximum 6. An examination of current problems on a lecture-discussion basis. Course content varies as changing conditions require new approaches to deal with emerging problems. Staff

EB 598 Topical Problems in Economics. Preq: CI. 1-6. An investigation of topics of particular interest to advanced students under faculty direction on a tutorial basis. Credits and content vary with student needs. Staff

Education

ED 100 Introduction to Industrial Education. 2(2-0) F. The framework of vocational education as it relates to the historical and legislative development, programs and purposes in industrial and technical education. Emphasis upon the current status of industrial and technical education in the nation, state and community. Program visitations and observations. Parker

ED 101 Orientation. 0(1-0) F. New freshmen and transfer students (Math Science Education) are required to attend one hour per week during the fall semester. Activities help establish good study habits and adjust to university life. Staff

ED 102 Objectives in Agricultural Education. 1(1-0) F,S. Helps understand the purpose of agricultural education at North Carolina State. Also, develops an understanding of purposes of vocational agriculture and other programs of education in agriculture. Clary

ED 203 Introduction to Teaching Mathematics and Science. 3(2-3) F,S. For prospective teachers of mathematics/science at the secondary school level. Emphasis on different modes of instruction and instructonal strategies. Each prospective teacher designs and teaches a lesson to students in the school at which he is a teacher assistant. (Offered S only for science education majors.) Simpson, Watson

ED 205 Introduction to Teaching Humanities and Social Sciences. 3(2-3) F,S. For prospective teachers in the school curricular areas of social studies, English, speech, and modern languages. Emphasis on differing aspects and procedures of instruction and an analysis of the competencies required of teachers. Lab. observation and work with children

ED 220 Introduction to Paraprofessional Counseling 2(2-0) F 8/77

Ed 296 Special Topics in Education 1-3 6/22/78 GJ 8/78
Ed 407 Methods of Teaching Agricultural Mechanics 3(3-0) GJ

and youth in a variety of educational settings, including an extended period in one curricula area. Parramore, Staff

ED 242 Introduction to Teaching Industrial Arts. Preq: Nine semester hours in industrial arts. 3(4-2). S. To provide in-school experience for sophomore students. This will consist of observation, instructing individual students and small groups or providing aid to the local teachers in laboratory management and maintenance. Lecture and discussion will correlate these activities with teaching theory and practice. Staff

ED (PHI) 304 Philosophy of Education. 3(3-0) F,S. (See philosophy, page 288.)

ED 305 Analysis of Technical Education Programs and Course Construction. Preq: ED 100 or equivalent. 3(3-0) S. Selecting and analyzing suitable teaching activities and arranging such material into a functional instructional order. Instructional units prepared will be based on an analysis of a technical occupation or activity. A detailed course of study will be prepared. Shore

ED 313 Contemporary Vocational Agriculture. 3(3-0) F,S. The contemporary program is examined in relation to changing and expanding career opportunities in agricultural education. The continuing adjustment of the program objectives, curriculum organization, content of courses, teaching practices, instructional resources and evaluation emphasis in modern programs in vocational agriculture. Prerequisite for student teaching in agricultural education. Clary

ED (SOC) 318 Introduction to the Sociology of Education. 3(3-0) F. (See sociology, page 310.)

ED 327 History and Philosophy of Industrial and Technical Education. Preq: ED 100. 3(3-0) F. Place, function and changing concepts of industrial and technical education in America. Economic, sociological and psychological aspects. Parker, Shore

ED 344 School and Society. Preq: Jr. or sr. standing. 3(3-0) F,S,Sum. The interrelationship between the school and other institutions, values, and patterns of thought in American society. Beezer, Ivie

ED 362 Curriculum and Methods in Industrial Arts. Preq: ED 344, PSY 304. 4(3-2). S. Study of philosophy and objectives for industrial arts education; design and development of ucrriculum models; comparative teaching methodologies and evaluation. Young

ED 405 Industrial and Technical Education Shop and Laboratory Planning. Preq: Sr. standing, six hours of drawing and design. 3(3-0) F. Principles and techniques of planning and organizing shop and laboratory facilities. Problems of locating and equipping vocational schools; the planning and layout of shops and related technology laboratories and classrooms. Individual and group assignments on planning and layout of post-secondary school buildings. Staff

ED 411 Student Teaching in Agriculture. Preq: ED 313, 344, PSY 304; senior standing, admission to teacher education. 8(2-15). F.S. During student teaching, prospective teachers develop skills and techniques involved in teaching vocational agriculture. Each student spends about 9 weeks full-time in a public school. In addition to teaching classes, the student teacher is expected to become familiar with the total program of the school and to participate in as many school activities as possible. Bryant, Miller

ED 412 Teaching Adults. Preq: Admission to student teaching semester (ED 102 and 313). 2(2-0). F.S. Principles of effective teaching applied to adults. Experience in organizing and conducting groups for discussion of local problems. Bryant, Miller

ED 413 Planning Educational Programs. Preq: Admission to student teaching semester (ED 102 and 313). 2(2-0). F.S. Principles of program planning applied to educational programs in agriculture. Resources needed for adequate planning. Field work in planning programs. Bryant, Miller

ED 420 Principles of Guidance. Preq: ED 344. 3(3-0) F,S. An overview of philosophies and principles of guidance services and of the classroom teacher's role in helping the school to realize the goals of developmental guidance programs. Topics include: philosophy, history and models of guidance, principles of counseling, accumulation and use of appraisal and information data, career planning, and placement. Staff

ED 421 Principles and Practices in Industrial Cooperative Training. Preq: ED 327,

344, 305. 3(3-0). F. Consideration of the concepts and principles, aims and objectives, developments, operation and evaluation of the industrial cooperative training program in the area of vocational education. Shore, Smith

ED 422 Methods of Teaching Vocational Industrial/Technical Education. Preq: ED 327, 305. 3(3-0). F,S,Sum. Study of effective methods and techniques of teaching industrial subjects. The course includes competencies needed by successful teachers and how to acquire and use them. Emphasis is given to the preparation of lesson plans, methods and techniques in the presentation of lessons, use of teaching aids and materials, class organization, shop safety, and evaluation. Smith

ED 423 Methods and Materials in Teaching Modern Foreign Languages. Preq: ED 205, 344, PSY 304; Coreq: ED 424, senior standing, admission to teacher education. 5(4-2). A study of the methods of teaching modern languages including the use of instructional media. Girardi

424 Student Teaching in Modern Foreign Languages. Preq: ED 205, 344, PSY 304; Coreq: ED 423, senior standing, admission to teacher education. 8(2-15). S. Provides the prospective teacher of French or Spanish an opportunity to develop and practice the competencies essential for language teaching during 10-week practicum of full-time teaching in a selected off-campus center. Girardi

ED 428 Organization of Related Study Materials in Vocational Education. Preq: ED 327, 344. 3(3-0). S. The principles of selecting, preparing, and organizing related instructional materials for trade preparatory and industrial cooperative training classes. Shore, Smith

ED 440 Vocational Education. Preq: ED 444, PSY 304. 2(2-0) F. Comprehensive study of vocational education of less than college grade provided for through federal legislation and an evaluation of program effectiveness. Detailed study of the North Carolina Plan. Staff

ED 444 Student Teaching in Vocational Industrial/Technical Education Preq: ED 344, PSY 304; senior standing, admission to teacher education. 8(2-15) F,S. Provides prospective teachers an opportunity to acquire experience in the techniques and skills involved in teaching vocational industrial/technical education curricula. Students will devote the semester to full-time off-campus teaching in selected schools. In addition to acquiring competencies essential for teaching vocational industrial/technical subjects, the student teacher will have an opportunity to become familiar with the total operation of a school program and with cooperating industries in the community. Smith

ED 450 Methods and Materials in Teaching English. Preq: ED 205, 344, PSY 304; senior standing and admission to teacher education with a major in English. 3(3-0) F.S. A study of the purposes, curricula, materials, and methods of teaching literature and the skills of reading, writing, speaking, and listening in secondary schools, combined with opportunity for application and practice based on this study. Betts, Walters

ED 451 ~~**Teaching Secondary School Reading.**~~ Improving Reading in Secondary Schools Revised eff. 8/78 Preq: ~~Admission to teacher certification program.~~ 2(2-0) F,S. The nature of the reading process and principles, methods and materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. Betts, Walters

ED 454 Student Teaching in English. Preq: ED 205, 344, PSY 304, sr. standing, admission to teacher education with a 2.1 overall average and 2.2 in English. 8 F,S. Provides the prospective teacher with experience in the techniques and skills involved in teaching English. Each student during the senior year will spend 10 weeks in a selected off-campus center. In addition to acquiring teaching competencies, the student teacher may become familiar with the total school program and may participate in as many school and community activities as time permits. Betts, Walters

ED 457 Organization and Management of Youth Club Activities. Preq: Jr. standing. 3(3-0) F,S,Sum. A study of the history and purposes of organized young adult activities in education. Emphasis upon organization and management of activities to prepare future teachers as competent advisers to the young adult groups in the school setting. Parker

ED 460 Methods and Materials in Teaching Social Studies. Preqs: ED 205, 344, PSY 304, sr. standing and admission to teacher education with a major in either history, sociology,

politics, or economics. 4(3-1) F,S. A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of social studies at the secondary level.
Harper

ED 464 Student Teaching in Social Studies. Preq: ED 205, 344, PSY 304; senior standing, admission to teacher education; Coreq: ED 460. 8(2-15). F.S. This course provides the prospective teacher an opportunity to acquire practical experience in using skills and techniques in teaching social studies in secondary schools. Each student during the senior year will spend eight weeks in a selected off-campus center. The student will demonstrate competencies essential for teaching social studies, become familiar with the total school program and participate in as many school and community activities as time will permit.
Harper

ED 470 Methods of Teaching Mathematics. Preq: Admission to teacher education.3(3-0) F,S. A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of mathematics at the secondary level. Kolb, Speece, Waters, Watson

ED 471 Student Teaching in Mathematics. Preq: ED 203, 344, PSY 304, sr. standing, admission to teacher education; Coreq: ED 470, 472. 8(2-15) F,S. Provides the prospective teacher with an opportunity to get experience in the skills and the techniques involved in teaching mathematics. Each student during the senior year will spend 10 weeks off-campus in a selected center. In addition to acquiring teaching competencies, the student teachers may become familiar with the total school program and may participate in as many community activities as time permits. Kolb, Speece, Waters, Watson

ED 472 Developing and Selecting Teaching Materials in Mathematics. Preq: Admission to teacher education. Coreq: ED 470, 471. 2(0-6) F,S. Developing and selecting teaching material to effect new and changing concepts of the content and emphasis in high school mathematics. Course follows the class discussion and demonstration pattern. Study of latest instructional materials and devising materials and aids for increasing the effectiveness of the content and instruction. Kolb, Speece, Waters, Watson

ED 473 Student Teaching in Industrial Arts. Preq: Admission to teacher education. 8(0-8). F. Students in industrial arts will devote eight 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. Young

ED 475 Methods of Teaching Science. Preq: ED 203, 344, PSY 304. 3(3-0) F. A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of physical and natural science at the secondary level. Anderson, Simpson

ED 476 Student Teaching in Science. Preq: ED 203, 344, PSY 304; Coreq: Sr. standing and admission to teacher education, ED 475, 477. 8(2-15) F. Provides prospective teachers with an opportunity to get experience in the skills and techniques involved in teaching science. Each student during the senior year will spend 10 weeks off-campus in a selected center. In addition to acquiring competencies for teaching science, the student teacher may become familiar with the total program and may participate in as many community activities as time permits. Anderson, Simpson

ED 477 Instructional Materials in Science. Preq: ED 203, 344, PSY 304; Coreq: ED 475, 476, sr. standing and admission to teacher education. 2(1-3) F. Developing and selecting teaching materials in keeping with the new and changing concepts of the content and emphasis in high school science, particularly the experimental and laboratory approach. Students study the latest instructional materials and discover or devise materials and aids for increasing the effectiveness of the content and instruction. Anderson, Simpson

ED 479 Industrial Arts Laboratory Planning. Preq: Junior standing in industrial arts education. 3(1-4) F. Industrial arts laboratory planning for efficient and safe operations, management of materials and supplies, budgeting, inventory, maintenance of common tools and equipment, safety equipment, and regulations and practices pertaining to laboratory operations are considered. Young

ED 480 Methods and Materials in Teaching Speech. Preq: PSY 304, ED 344, sr. standing and admission to teacher education with a major in speech. 3(3-0) S. The purposes,

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curricula, materials and methods of teaching speech, including public speaking, discussion, debate, speech improvement, oral reading and play production. Staff

ED 481 Student Teaching in Speech. Preq: ED 205, 344, PSY 304, sr. standing and admission to teacher education. 8 S. Provides the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching speech. Each student during the senior year will spend 10 weeks in a selected off-campus center. Staff

ED 483 An Introduction to Instructional Media. Preq: Advanced undergrad. standing. 3(3-0) F,S,Sum. The characteristics and utilization of media for instruction; study and implementation of the relationship between media and instructional objectives; and elementary projects in designing, developing, and using instructional media materials. Gibson

ED 490 Senior Seminar in Agricultural Education. 1(1-0) F,S. Analysis of opportunities and problems facing educational leaders in agriculture with emphasis upon current problems. Staff

ED 495 Senior Seminar in Mathematics and Science Education. 1-3 F,S. An in-depth investigation of a teaching area in mathematics and/or science education by above-average department majors following their student teaching. Staff

ED 496 Senior Seminar in Education. Preq: CI. 1-3 F,S,Sum. An in-depth investigation and discussion of a topic or set of problems in professional education. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 500 The Community College System. Preq: Grad. or advanced undergrad. standing. 3(3-0) F,S,Sum. Comprehensive community colleges and technical institutes and the state systems of which they are a part; underlying concepts, education needs they serve, role in meeting these needs, historical development, issues in the establishment and operation of state systems and individual institutions, unresolved issues and emerging trends. Gregg, Segner

ED (SOC) 501 Leadership. 3(3-0) F,S. (See sociology, page 310.)

ED 503 The Programming Process in Adult and Community College Education. Preq: ED 501, CI. 3(3-0) F,S. Principles and processes involved in programming, including basic theories and supporting concepts. Attention to the general framework in which programming is done, the organization needed and the program roles of professional and lay leaders. Boone, White

ED 504 Principles and Practices of Introduction to Vocations. Preq: Twelve hours ED. 3(3-0) F,S. Designed for North Carolina public school teachers of Introduction to Vocations. Emphasizes the place of the Introductioin to Vocations Program in the overall school curriculum, special methods of instruction, use of teaching aids and use of student evaluation instruments. An overview in community organization, job markets, group procedures, occupational and educational information, and the changing occupational structure in our society. Cox

ED 506 Education of Exceptional Children. Preq: Six hours ED or PSY. 3(3-0) F,S,Sum. Principles and techniques of teaching the exceptional child, especially the mentally handicapped and slow learner. Practice in curriculum instruction for groups of children, and individual techniques for dealing with retarded children in the average classroom. Opportunity for individual work with an exceptional child. Mahmoud

ED 509 Methods and Materials-Teaching Retarded Children. Preq: ED 506. 3(3-0) Emphasis on understanding and correlating developmental levels of mentally retarded children and appropriate educational methods and materials. Use of individual child's diagnostic data; consideration of long and short range education scheduling; teacher guidance of children toward social and emotional maturity. Mahmoud

ED 511 Implications of Mathematical Content, Structure and Processes for the Teaching of Mathematics in the Elementary School. Preq: Bachelor's degree in elementary education, or CI. 3(3-0) Designed for teachers and supervisors of mathematics in the elementary school. Emphasis on implications of mathematical content, structure and processes in teaching arithmetic and geometry in the elementary school. Attention to use of logic and fundamental rules of inference, deductive and inductive reasoning, the field proper-

Ed 508 Severe and Profound Mental Retardation 3(3-0) 4/20/77 eff 5/77

ties in the sets of integers and rational numbers, elementary number theory, metric and non-metric geometry. Watson

ED 512 Teaching Mathematics in the Elementary School. Preq: ED 471 or equiv. 3(3-0) Emphasis on the laboratory approach to teaching mathematics and the use of the manipulative materials and activities of the Nuffield Project, the Madison Project, Dienes, Cuisenaire, and Gattegno. Attention to research supporting the laboratory approach using manipulative materials in the elementary school. Suggestions for designing activities for independent and group study and in assessing individual progress. Watson

ED (SOC) 513 Community Organization and Development. 3(3-0) F. (See sociology, page 310.)

ED 514 Formative Ideas in American Education. Preq: Six hrs. ED or PSY or CI. 3(3-0) F,Sum. An analysis of the theory and practice of American education as a logical extension of the philosophical assumptions of different intellectual ages and how the present status of our educational system is grounded in the thought of the past. Beezer, Ivie

ED 515 Teaching Disadvantaged Youth. Preq: Six hrs. ED or PSY; teaching experience. 3(3-0) Alt. F,Sum. This course presents a theoretical structure for looking at and understanding the problems of disadvantaged youth in our educational system. It offers a set of alternative teaching strategies for improving the quality of instruction in the classroom. Ivie

ED 516 Community Occupational Surveys. Preq: Six hours ED, CI. 2(2-0) S. Methods in organizing and conducting local surveys and evaluation of findings in planning a program of vocational education. Shore, Hanson

ED 517 Implications for Data Processing in Education. Preq: CSC 111; ED 529 or CI. 3(3-0) S. Current attempts to apply new technologies to education. Attention to research findings related to Computer Assisted Instruction, gamed instructional simulation, approaches to guidance and prescription learning. Administrative problems pertaining to student scheduling, pupil transportation and data reporting systems. Staff

Introduction to Education Law off 1/77

ED 518 ~~Principles of School Law.~~ Preq: Six hours graduate credit. 3(3-0) F.Intensive study of legal rights, duties, privileges and responsibilities entailed in the educational enterprise. Covers the essentials of school law for both 1) the processes of law as they affect American education and 2) specific legal aspects which affect vocational education. Included are the secondary, post-secondary and adult vocational education laws and their implications. Beezer

ED 519 Early Childhood Education. Preq: PSY 475 or 576. 3(1-4) The plannings, selection and utilization of human resources, activities, materials and facilities relating to the education of young children. Emphasis on student observation, participation and evaluation of educational experiences appropriate for the developmental level of individual children, including flexible grouping, curricula planning and instructional techniques for an optimum learning environment. A synthesis of the student's knowledge of human development, learning theory and research findings as related to classroom application. Staff

Introduction to Guidance and Counseling off 1/77 12-2-

ED 520 ~~Personnel and Guidance Services.~~ Preq: Six hours in ED or PSY. 3(3-0) F,S,Sum. The philosophies, theories, principles and practices of personnel and guidance services; the relationship of personnel services with the purposes and objectives of the school and the curriculum. Staff

ED 521 Internship in Guidance and Personnel Services. Preq: Eighteen hours in department and CI. Credits Arranged. F,S. A continuous full-time internship of at least one-half semester. Framework of school and community. Work with students, teachers, administrators, guidance and pupil personnel workers, parents, and resource personnel in the community. Supervision of intern by school guidance personnel and course instructors.Staff

ED 522 Career Exploration. Preq: ED 344, grad. status or CI. 3(3-0) F,S,Sum. Designed for North Carolina public school teachers in career exploration programs. Emphasizes the philosophy, theories and the place of career exploration programs in the overall school curriculum. Correlation of occupational information in academic subjects, sources of occupational information and its use, and approaches to teaching. Cox

ED 523 Orientation and Mobility of the Visually Impaired. 3(3-0) Sum. The sensory processes and cues on which independent mobility depends for the visually impaired person.

Various techniques and modes of travel considered. Emphasis on instruction and background which will enable persons not teaching orientation mobility as a skill to reinforce the learning that takes place in other situations. R. Rawls

ED 524 ~~Occupational Information~~ Information Processes and Group Guidance eff 1/77 12-2-76. Preq: Six hours ED or PSY, ED 520 or equivalent. 3(3-0) F,S,Sum. Gives teachers, counselors, placement workers and personnel workers in business and industry an understanding of how to collect, classify, evaluate and use occupational and educational information. Includes a study of the world of work, sources of occupational information, establishing an educational-occupational information library, using educational, occupational and social information and sociological and psychological factors, influencing career planning. Hopke

ED 525 Trade Analysis and Course Construction. Preq: ED 344, PSY 304. 3(3-0) F. Principles and practices in analyzing occupations to determine teaching content. Practice in the principles underlying industrial course organization based on occupational analysis covering instruction in skills and technology and including course outlines, job sequences, the development of industrial materials and instructional schedules. Shore, Hanson

ED 526 Teaching in College. 3(3-0) F,S, Sum. Designed for graduate students not in Education. Focuses on developing competencies to perform the day-to-day tasks of a college teacher, long-range tasks such as course development and the university responsibilities of a professor. Students will make video tapes of their teaching, develop tests, design an introductory course in teaching field, and engage in other similar types of activities. Simpson

ED 528 Cooperative Occupational Education. Preq: CI. 3(3-0) F,S. Designed for individuals preparing to be directors, administrators or supervisors of vocational education programs at the local, state and/or national levels. Emphasis on organization and operation of cooperative occupational programs. Covers the entire field of cooperative occupational education on secondary, post-secondary and adult levels with references to accepted essentials of cooperative education so details of planning, organization, establishment, and operation of cooperative occupational programs will be practical and meaningful. Student visitations to existing quality programs in cooperative occupational education to study on-site conditions in specialized areas. Smith

ED 529 Curriculum Materials Development. Preq: ED 525. 3(3-0) F. Selection and organization of curricula used in vocational-industrial and technical education; development of curricula and instructional materials. Hanson

ED 530 ~~Group Guidance~~ Theories and Techniques of Counseling eff 1/77. Preq: Six hours ED or PSY, ED 520 or equivalent. 3(3-0) S,Sum. 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. Locke

ED (PSY) 531 Mental Deficiency. Preq: Nine hours PSY and special education. 3(3-0) F,Sum. Description, causation, psychological factors and sociological aspects of mental retardation. Education methods for the mentally retarded. Course designed primarily for school psychologists and special-class teachers of retarded children, both educable and trainable. Mahmoud

Ed 533 Group Counseling eff 1/77 12-2-76

ED 534 Guidance in the Elementary School. Preq: Nine hours PSY or CI. 3(3-0) F. Designed for acquainting elementary school teachers, counselors and administrators with theory, practice and organization of elementary school guidance. Hopke

ED 535 Student Personnel Work in Higher Education. Preq: Nine hours PSY or CI. 3(3-0) F,S. Examines practices in various areas of student personnel work. Studies both structure and function of personnel programs in higher education. McVay

ED 536 Structure and Function of the Eye and Use of Low Vision. Preq: CI. 3(5-0) Sum. In this special institute participants spend a minimum of 45 hours in class and related activities. Medical and educational consultants discuss the structure and function of the eye, eye anomalies likely to affect children with low vision, methods of evaluating type and potential use of residual vision, and methods of teaching children to use minimal vision effectively. Course for teachers and administrators either presently employed in or planning to participate in educational programs for low vision persons. R. Rawls

ED 537 The Extension and Public Service Function in Higher Education. Preq: ED

Ed 539 Educational Gerontology 3(3-0) eff 1/77
Ed 541 Community Education 3(3-0) 4/14/77 eff 1/77
Ed 543 Adulthood and Learning: The Later Years 3(3-0) 4/14/77 eff 8/78

510. 3(3-0) S. The background, history, philosophy and contemporary nature of the extension and public service function of institutions of higher education in the United States. Emphasis on the adult education role of public and private universities and colleges. Specific focus on: general, industrial, engineering, and cooperative extension and continuing education. Compton, Trent

2/24/77 eff 8/77

ED 540 Individual and Group Appraisal I. Preq: ED 520, PSY 535, or equivalent. 3(3-0) Use of group tests of intelligence, interest and achievement in educational and career planning and placement. Theories of intelligence and interest will be followed by laboratory in evaluating, administering and interpreting widely used group test. Emphasis on group test use in group guidance. Staff

ED 542 Contemporary Approaches in the Teaching of Social Studies. Preq: Advanced undergrad. or grad. must have completed student teaching. 3(3-0) S,Sum. Analysis of principles, strategies and applications of new teaching approaches. Team-teaching, programmed instruction, inductive and reflective oriented teaching, role-playing, simulation and gaming, independent study and block-time organization. Harper,Parramore

ED 545 Improvement of Reading Abilities. Preq: Twelve hours ED or PSY. 3(3-0) S,Sum. Methods used in developing specific reading skills or in overcoming certain reading difficulties; methods used in developing pupil vocabularies and word analysis skills. How to control vocabulary burden of reading material. Fox, Mahmoud

ED 546 Principles and Practices of Secondary School Reading Instruction. Preq: Twelve hrs. ED or PSY. 3(3-0) F,S,Sum. A study of principles and practices of teaching reading at the secondary school level including reading instruction in the content areas. Fox

ED 547 Analysis of Reading Abilities. Preq: ED 545 or 546. 3(3-0) F,Sum. A study of tests and techniques in determining specific abilities; a study of reading retardation and factors underlying reading difficulties. Fox, Mahmoud

ED 548 Theory and Process in Reading and Language Arts. Preq: Twelve hrs. ED or PSY. 3(3-0) S, Alt. yrs. An investigation of theoretical models and processes in reading and language arts with emphasis on the translation of research findings to instructional practice. Fox

Ed 551 Principles and Practices of Supervision 3(3-0) 9-7-78 eff 1/79

ED 552 Industrial Arts in the Elementary School. Preq: Twelve hours ED, CI. 3(3-0) Sum. To help elementary teachers and principals understand how tools, materials and industrial processes vitalize and supplement the child's experiences. Practical children's projects along with the building of classroom equipment. Staff

ED 554 Planning Programs in Agricultural Education. Preq: ED 411 or equivalent. 3(3-0) F,S. Consideration of the need for planning programs in education; objectives and evaluation of community programs; use of advisory group; organization and use of facilities in agricultural education. Bryant, Clary

ED 555 Comparative Crafts and Industries. Preq: Advanced undergrad. or grad. standing, CI. 6. A travel seminar as a cultural appreciations course involving study of indigenous crafts and industries, their materials, processes, products and design in foreign countries. Staff

ED 559 Learning Concepts and Theories Applied to Adult and Community College Education. Preq: Six hours ED. 3(3-0) F,S. Principles in adult education programs including theories and concepts undergirding and requisite to these programs. Emphasis on interrelationship of the nature of adult learning, the nature of the subject matter and the setting in which learning occurs. The applicability of relevant principles and pertinent research findings to adult learning. Glass, Knowles, Parsons

ED (IA) 560 New Developments in Industrial Arts Education. 3(3-0) F,S. (See industrial arts, page 261.)

ED 563 Effective Teaching. Preq: Twelve hours ED including student teaching. 3(3-0) F,S,Sum. Analysis of the teaching-learning process; assumptions that underlie course approaches; identifying problems of importance; problem solution for effective learning; evaluation of teaching and learning; making specific plans for effective teaching. Staff

ED 565 Agricultural Occupations. Preq: ED 411. 3(3-0) F,S. Career development in agricultural occupations is associated with curriculum development needs. Occupational experience in agriculture is seen in relation to curriculum and placement. Miller

Ed 556 Learning Disabilities 3(3-0) 4/20/77 eff 8/77
Ed 557 Methods and Materials in Learning Disabilities 3(3-0) 4/20/77 eff 1/77
Ed 558 Resource Teaching in Special Education 3(3-0) 4/20/77 eff 1/78
Ed 561 Educational Diagnosis and Prescription for Exceptional Children 4/20/77 eff 8/77
Ed 562 Communication Disorders in the Classroom 3(3-0) 4/20/77 eff. 1/77
Ed 564 Classroom Management in Special Education 3(3-0) 4/20/77 eff 8/78

Ed 567 Principles and Strategies of Understanding, Motivating and Teaching Disadvantaged Adults 3(3-0) off 1/77

ED 566 Occupational Experience in Agriculture. Preq: ED 411. 3(3-0) F,S. Implementing new and expanded concepts of occupational experience including how to effect student learning experiences in a real and simulated employment environment. Study of theoretical foundations underlying the new developments in occupational experiences to stimulate individual growth and creativity in implementing further developments. Miller

ED 568 Adult Education in Agriculture. Preq: ED 411 or equivalent. 3(3-0) F,S. Designed for leaders in adult education. Basic problems and values in working with adult groups. Attention to the problem of fitting the education program for adults into the public school program and other educational programs as well as methods of teaching adults.Staff

ED 570 Foundations of Mathematics Education. Preq: ED 471 or equivalent. 3(3-0) Assumptions and justifications underlying prevailing practices in secondary mathematics teaching are identified and examined within the broader context of mathematics education. Judging pedagogical techniques and curricular innovations is based upon a historical overview of the field, psychological considerations relating to mathematics learning, comparison in national and international mathematics education, and research evidence. Staff

ED 575 Foundations of Science Education. Preq: ED 475 or equiv. 3(3-0) S,Sum. Philosophical, historical, sociological, political and economic relationships affecting science education in U. S. schools will be analyzed and evaluated. Psychological theory will be applied to the teaching and learning processes. Emphasis will be directed toward developing skills in planning educational objectives, instructional strategies and evaluation procedures. Multiple positions will be examined regarding current trends, issues and problems in science education. Simpson

ED 590 Individual Problems in Guidance. Preq: Six hours graduate work in department of equivalent and CI. Maximum 6 F,S. Intended for individual or group studies of problems in guidance and personnel work. Problems selected to meet individuals' interests. The workshop procedure will be used whereby special projects, reports, and research will be developed by individuals and by groups. Staff

ED 592 Special Problems in Mathematics Teaching. Preq: ED 471 or equivalent. 1-3 F,S. Investigation of current problems in mathematics teaching, emphasizing curriculum, methodology, facilities, supervision and research. Specific problems will be studied in depth. Opportunities to initiate research studies.

ED 593 Special Problems in Agricultural Education. Preq: ED 411 or equivalent. Credits Arranged. F,S. Study of current problems under staff guidance. Staff

ED 594 Special Problems in Science Teaching. Preq: ED 476 or equivalent. 1-3 F,S. Investigation of current problems with emphasis on curriculum, methodology, facilities, supervision and research. Specific problems will be studied in depth. Opportunities to initiate research studies. Staff

ED (IA) 595 Industrial Arts Workshop. Preq: One or more years of teaching experience. 3(3-0) Sum. A course for experienced teachers, administrators and supervisors of industrial arts. Primarily to develop sound principles and practices for initiating, conducting and evaluating programs. Enrollees will pool their knowledge and practical experiences and do intensive research on individual and group program. Staff

FOR GRADUATES ONLY

ED 505 Public Area Schools. 3(3-0) F,Sum.

ED 510 Adult Education: History, Philosophy, Contemporary Nature. 3(3-0) F,S.

ED 527 Philosophy of Occupational Education. 3(3-0) F,S.

ED 533 Organization and Administration of Guidance Services. Preq: ED 520 or equiv. 3(3-0) S,Sum.

ED 538 Instructional Strategies in Adult and Community College Education. Preq: ED 559. 3(3-0) S.

ED 550 Principles of Educational Administration. Preq: CI. 3(3-0) F,S,Sum.

ED 591 Special Problems in Industrial Education. Preq: Six hrs. grad. cr., CI. Max. 6 F,S.

Ed (PS) 607 The Politics of Higher Education 3(3-0) 11/12/78
Ed 577 Improving Classroom Instruction in Science 3(3-0) 1/78 9/20/78

Ed 632 Applied Research Methods in Education 3(1-4) eff. 1/77
Ed 633 Development and Coordination of School Guidance Programs 3(3-0) eff 1/77
Ed 640 Laboratory Experiences in Counseling 3(3-0) eff-1/77
Ed 641 Practicum in Counseling 2-6 eff 1/77

ED 596 Topical Problems in Adult and Community College Education. Credits Arranged F,S.

ED 597 Special Problems in Education. Preq: CI. 1-3 F,S.

ED 598 ~~**Concepts and Strategies of Understanding, Motivating and Teaching Disadvantaged Adults. 3(3-0) S.**~~ Special Problems in Curriculum and Instruction 1-6 eff 1/77

Ed 599 Research Projects in Education 1-3 eff. 1/77 1/10/77
Ed 699 Thesis and Dissertation Research eff 1/77 1/10/77

Electrical Engineering

EE 201 Electric Circuits I. Preq: PY 205, MA 201; Coreq: PY 208, MA 202. 4(3-3) F,S. Introduction to analysis of electric circuits. Circuit elements and parameters, resistance, capacitance, inductance, impedance, admittance, charge, current, voltage, energy, power. Kirchhoff's voltage and current laws. Superposition, periodic functions, RMS values, phasors, resonance, Q, bandwidth.

EE 202 Electric Circuits II. Preq: EE 201 4(3-3) F,S,Sum. Continuation of EE 201. Analysis of electric circuits by consideration of equivalent circuits which arise in the study of solid state electronics, digital circuits, and AC systems. Transistor equivalent circuits, amplifier frequency response, operational amplifiers, logic gates. Magnetic circuits, transformers, polyphase circuits.

201 and PY 205 7/27/78

EE 211 Electric Circuits I, Theory. Preq: MA ~~102.~~ 3(3-0). Theory part of EE 201. Offered only by correspondence. Enrollment subject to approval of EE undergraduate administrator.

EE 213 Electric Circuits I, Laboratory. Preq: EE 211. 1(0-2) Sum. Laboratory part of EE 201. Enrollment subject to approval of EE undergraduate adminstrator and limited to students who have passed EE 211.

grade of C or better in EE 202 7/27/78

EE 301 Linear Systems. Preq: ~~EE 202, MA 301.~~ 3(2-2). F,S. Introduction to representation and analysis of linear systems. Topics covered include impulse response and convolution, Fourier analysis, and Laplace transforms. The techniques are illustrated by applications from communications and control systems analysis.

EE 302 Numerical Applications in Electrical Engineering. Preq: EE 202. 3(2-2) F. This course introduces the student to modern problem solving techniques in electrical engineering using the computer. The course consists of a series of analysis and design problem examples in electrical engineering.

EE 303 Electromagnetic Fields. Preq: EE 202, MA 301. 4(3-2.5) F,S. Limitations of lumped constant circuit models and the necessity for distributed parameter models. Electromagnetic wave propagation on transmission lines, in waveguides and in unbounded space. Introduction to antennas and propagation.

EE 304 Electromagnetic Fields II. Preq: EE 303, MA 301. 3(2-3) S. (This course will be dropped Spring Semester, 1978). Vector and scalar retarded potentials. Generation and propagation of energy by electromagentic waves. Relationship between field theory and circuit theory. Applications of electro-magnetic theory to devices and to distributed parameter systems.

EE 305 Electric Power Systems. Preq: EE 202 or EE 331. 4(3-2.5) S. Principles performance and characteristics of direct-current and alternating current machinery. Consideration of the components, protective devices and power flow of a typical power distribution system for an industrial plant. Application of digital computers to fault calculations.

EE 314 Electronic Circuits. Preq: EE 202. 4(2-5). F,S. Electronic design fundamentals, including circuit properties of active devices, linear and digital integrated circuits, power and industrial electronics. Emphasis is on the terminal characteristics and circuit applications of integrated circuits and solid-state devices.

EE 331 Principles of Electrical Engineering. Preq: MA 201, PY 208. 3(3-0) F,S. Not available to EE undergraduates. Basic concepts, units and methods of EE analysis. Current-voltage characteristics of linear and nonlinear electrical devices, analysis of d-c and a-c circuits, simple amplifiers and energy conversion devices. Demonstrations of equipment and procedures.

EE 332 Principles of Electrical Engineering. Preq: EE 331. 3(3-0) S. Not available to EE undergraduates. Power distribution systems, motors, feedback, amplifiers, oscilloscopes,

Ed 641A Practicum in Counseling 2-6 eff 8/77
Ed 641B Practicum in Reading 1-6 eff 8/77
Ed 641C Practicum in Special Education 1-6 eff 8/77

voltage meters, digital information, measurement by digital means, presented from the user's viewpoint. Demonstrations of equipment and procedures.

EE 333 Principles of Electrical Engineering Laboratory. Coreq: EE 332. 1(0-3) S. Not open to EE students. Laboratory work in the material covered in EE 332.

EE 339 Principles of Electrical Engineering Laboratory. Coreq: EE 331. 1(0-3) F,S. Not open to EE students. Laboratory work in the material covered in EE 331.

EE 340 Fundamentals of Digital Systems. ~~Prereq: Junior standing.~~ 4(3-3). F,S. The basic concepts involved in the design of digital electronic networks. Topics include discussion of available packages and parameters, specification and design of combinational and sequential networks, digital subsystems, and system organization.

EE 350 ~~Electric Power Utilization in Manufacturing Processes.~~ Prereq: PY 212, MA 201. 3(2-3) F,S. Not available to undergraduates in EE. 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. Examples drawn from the technologies of particular interest to current student.

FOR ADVANCED UNDERGRADUATES

EE 403 ~~Electrical Network Design.~~ Prereq: EE 301 3(3-0) S. Design methods for such electric networks as resonant systems, filters, feedback stabilizers, audio amplifier compensation and dividing networks.

EE 406 Dynamical Systems Analysis. Prereq: EE 202 or 331, ESM 305, MA 301. 3(3-0) F. Dynamic systems in various branches of engineering and science emphasizing similarities among such integrated groups of devices. Analogous elements and quantities in these fields as determined from basic equations. Use of computers to solve systems problems.

EE 431 Electronics Engineering. Prereq: EE 314. 3(2-3) F. Design and analysis of discrete and integrated solid-state electronic circuits which include amplifiers, waveform generators, and feedback. Design is emphasized through projects and through analysis of contemporary electronic circuits.

EE 432 Communication Engineering. Prereq: EE 431. 3(2-3) S. Application of Electronic Circuits to Communication systems employing sine wave and pulse modulation. Elements of complete systems (modulators, demodulators, transmitters and receivers) are designed, analyzed and implemented.

EE 433 Electric Power Engineering. Prereq: EE 305 or 332. 3(2-3) S. Electric power supply for industrial and commercial applications. Control of electric motor drives. Principles of circuit protection and safety. Laboratory experience in testing electric machines.

EE 434 Power System Analysis. Prereq: EE 305. 3(3-0) F. Problems encountered in the long-distance transmission of electric power with emphasis on load flow, economic dispatch, and fault calculations. Applications of digital computers to power-system problems.

EE 435 Elements of Control. Prereq: EE 314; 305. 3(2-3) F. Introductory theory of open- and closed-loop control. Dynamic analysis of error detectors, amplifiers, and motors. Component transfer characteristics and block diagram representation. Analog simulation of a control system.

EE 438 Electronic Instrumentation. Prereq: MA 301; EE 314 or 332. 3(3-0) S. Electrical-electronic measurement techniques and operating principles of electronic instruments. Signal sources and their equivalent circuits, basic electronics including junction and field effect transistors, operational amplifiers, switching logic and data display. Applications including low-level phenomena and noise problems. Lecture demonstrations.

EE 441 Introduction to Electron Devices. Prereq: MA 301, PY 208. 3(3-0) F. The basic physical principles necessary for understanding modern electronic devices. Quantum and statistical mechanic concepts are introduced forming the basis for a discussion of a wide variety of devices used in modern engineering and instrumentation.

EE 442 Introduction to Solid-State Devices. Prereq: EE 441 or PY 407; MA 301. 3(3-0) S. The microscopic phenomena responsible for the operation of solid-state electronic devices. A qualitative description of the band model of solids. A description of the transport properties of charge carriers. P-n junction diodes and transistors, solar cells, controlled rectifiers, tunnel diodes and unijunction transistors, recently developed devices.

EE 443 Digital Systems Design. Preq: EE 340. 3(2-3). F. The practice of solving electronic engineering problems using digital techniques. Includes the application of the concepts of problem specification, organization, and design. Introduction to current technology and state-of-the-art components. Experience in utilizing this background in the design, implementation and testing of a class project.

EE 445 Introduction to Antennas. Preq: EE 303, 314. 3(2-3) F. Consideration of radiation from single-element radiators, radiation patterns, directive properties aperture concepts, gain and impedances. Multi-element antennas and arrays with various amplitude distributions and phasings, and thin linear antennas. Antennas of current usage.

EE 448 ~~Introduction to Microwaves.~~ Preq: EE 303, ~~314~~. 3(2-3) S. The elementary theory and special techniques required at microwave frequencies. Passive and active circuits. Transmission elements, special-purpose components, generators, to include klystrons, magnetrons, traveling wave tubes, and solid-state devices will be discussed. The description of microwave networks by the scattering matrix.

EE 492 Special Topics in Electrical Engineering. Preq: Jr. standing. ~~3(3-0 to 0-9)~~ F,S. Offered as needed to cover new or special subjects.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

EE 503 Computer-Aided Circuit Analysis. Preqs: EE 314, 301, B average in EE and MA. 3(3-0) F. Analysis of electrical circuits with emphasis on computer methods. Steady-state and transient analysis of linear and nonlinear networks; tolerance analysis; programming considerations. Staudhammer

EE 504 Introduction to Network Synthesis. Preq: EE 301, B average in EE and MA. 3(3-0) S. The properties of network functions and the development of the methods of network synthesis of one-port and two-port passive structures.

EE 511 ~~Electronic Circuits.~~ Preq: EE 314, B average in EE and MA 3(3-0) F. Electronic devices and circuits in communications, power and industrial applications. Synthesis of circuits to satisfy system requirements. Staff

EE 512 ~~Communication Theory.~~ Preq: EE 301, B average in EE and MA. 3(3-0) F. Communication signals in the frequency and time domains. Probability and associated functions, random signal theory, modulation and frequency translation, noise, sampling theory, correlation functions, and information theory. Accent on methods and problems unique to the field of digital communication. (Offered F every year and S 1978.) Staff

EE 516 Feedback Control Systems. Preq: EE 435, or 301 and B average in EE and MA. 3(3-0) S. The feedback systems for automatic control of physical quantities such as voltage, speed and mechanical positon. 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. Systems compensation and introduction to design. Staff

EE 517 Control Laboratory. Coreq: EE 516. 1(0-3) S. Feedback systems for automatic control of physical quantities such as voltage, speed and mechanical position. Characteristics of regulating systems and servomechanisms. The laboratory work contributes to understanding theory developed in EE 516. Staff

EE 520 Fundamentals of Logic Systems. Preq: EE 340, B average in EE and MA. 3(3-0) F. A study of algebraic structures as related to logic systems, models for switching circuit behavior and their relation to hardware implementation. Includes theoretical treatment of both combinational and sequential logic systems concepts. Staff

EE 521 Digital Computer Technology and Design. Preq: EE 520. 3(3-0) S. The internal organization and structure of digital systems including gates, toggle circuits, pulse circuitry and advanced machine language theory. Analysis and synthesis of major computer components, including the logic section, storage devices, registers, input-output and control. Staff

EE 530 Physical Electronics. Preq: EE 304, B average in EE and MA.3(3-0) F. A study of the properties of charged particles under the influence of fields and in solid materials. Quantum mechanics, particle statistics, semi-conductor properties, fundamental particle transport properties and lasers. (Offered F every year, Sum. 1977 and S 1979.) Staff

EE 698 Electrical Engineering Design Project 3-6 2/24/77 eff 1/7

Digital Electronics revised 9-7-78 eff 1/79

EE 533 ~~Integrated Circuits.~~ Preq: EE 314/B average in EE and MA. 3(3-0) S. A study of the implementation of solid state circuits in integrated form. Includes thin film, bipolar and MOS technologies and their application to digital and linear systems. Manning

Antenna + Diffraction revised 9-7-78 eff 8/78

EE 540 ~~Electromagnetic Fields and Waves.~~ Preq: EE 304, B average in EE and MA. 3(3-0) F. Laws and concepts of static electromagnetism. Fundamental equations and their applications. Fundamentals, forms and applications of Maxwell's equations. Vector and scalar potentials, relativistic aspects of fields, energy and power. Waves in unbound and bounded regions, radiation, wave-guides and resonators. Geometrical and physical optics. (Offered F every year, S 1977 and Sum. 1979.) Staff

EE 545 Introduction to Radio Wave Propagation. Preq: EE 304, B average in EE and MA. 3(3-0) S. Characteristics of a plan e electromagnetic waves in homogeneous and non-homogeneous media with application to tropospheric and ionospheric propagation. Relationships between electron density, collision frequency and complex refractive index, theory of the formation and dynamics of ionospheric layers and theorems for the prediction of ionospheric propagation. Flood

EE (PY) 552 Introduction to the Structure of Solids. 3(3-0) (See physics, p. 293.)

EE (MAE) 565 Gas Lasers. 3(3-0) F,S. (See mechanical and aerospace engineering, page 275.)

EE 591, 592 Special Topics in Electrical Engineering. Preq: B average in technical subjects. 3(3-0) F,S. A two-semester sequence to develop new courses and explore areas of special interest. Staff

EE 593 Individual Topics in Electrical Engineering. Preq: B average in technical subjects. 1-3 F,S. The student explores topics of special interest under faculty direction.

EE 693 Individual Studies in Electrical Engineering 1-3 eff. 1/77

Engineering

GENERAL COURSES

0-3 eff 8/78

E 101 Engineering Graphics I. 2(~~1-2~~) F,S. Graphically representing and solving spatial problems. Emphasis on development of a logical and analytic approach to problem solution. Conventional methods of graphically describing size and shape, the representation of basic mechanical elements. Practical engineering applications utilized. Staff

E 120 Engineering Concepts. Not open to jrs. and srs. in Engineering. 3(2-1) F,S. Students are involved in realistic freshman design projects. History, fields and functions of engineering, case studies, computational skills, and societal problems are covered. Staff

E 201 Spatial Relations and Vector Applications. Preq: First courses in graphics and physics. 3(2-2) S. Spatial representation of points, lines, and planes and the determination of the lengths, sizes, and angles that exist between these elements, with the application of these studies to vector systems. Webb

E 207 Engineering Graphics II. Preq: E 101. 2(1-3) F,S. Presentation of engineering data for use in the manufacturing process. Production dimensioning, detail and assembly production drawings, and free-hand sketching are covered. Special emphasis on sketching. Webb

E 220 Engineering and Contemporary Society. 3(3-0) F. Investigation of the role of engineering technology in modern life, with emphasis on technological factors involved in solution of national and world problems. Major topics such as energy, communication, materials, and transportation examined in terms of cultural and economic goals for the future. Staff

E 240 Furniture Graphics. Preq: E 101. 3(1-4) F. Furniture drawing and dimensioning. Special practices of furniture industry are covered. Free-hand sketching is emphasized. Freeman

E 301 Graphical Solutions for Numerical Data. Preq: A first course in calculus. 3(2-2) F. Study of available graphic methods to represent and manipulate numerical data. Topics include: proper selection of coordinate systems and axes, empirical equations, curve fitting, graphical calculus, nomography, and design of special purpose slide rules. Computer applications demonstrated. Hammond

E (CSC) 321 Computer Graphics. Preq: MA 202 or 212 and CSC 101 or 111. 3(2-2) S. Presentation of computer-graphic methods of data manipulation; which computer-graphic

EE 550 Power System Operation and Control 3(3-0) 9-7-78 eff 8/78
EE 559 Pattern Recognition 3(3-0) 9-7-78 eff 1/79
EE 632 Power System Stability and Control 3(3-0) 9-7-78 eff 1/79

methods are available; when and how they can be applied. Three-demensional applications covered. Houck

E 432 Patents, Trademarks and Copyrights. Preq: Jr. standing. 3(3-0) S. Review of these laws in relation to engineering, scientific and industrial pursuits; individual inventors, authors, and companies; and Patent Office procedures and practice. Mills

E 492 Special Topics in Engineering. Preq: Jr. Standing. 1-3 F,S. Offered as-needed for subject matter of a non-departmental nature.

E (OR) 531 Dynamical Systems and Multivariable Control. 3(3-0) F. (See operations research, page 287.)

Engineering Honors

EH 346 Fluid Mechanics. Preq: ESM 200 or 205; membership in Eng. HP or CI.* 3(3-0) S. 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. Preq: Membership in Eng. HP or CI.* 3(3-0) F. Basic principles and concepts. Emphasis on first and second laws, their implications and applications. Properties of actual and real gases. Also inter-relationships between the properties as given by the general equations of thermodynamics.

EH 372 Thermodynamics II. Preq: Membership in Eng. HP or CI.* 3(3-0) S. Statistical approach to thermodynamics and application to determination of specific heats. Entrophy and probability. Thermodynamics of fluid flow including supersonic flow. Basic laws of heat transfer. Ideal gas and vapor cycles. Introduction to chemical thermodynamics.

EH 391 Contemporary Trends in Engineering and Science. Preq: Membership in Eng. HP or CI.* 1(1-0) F. Representatives from various fields of engineering or science discuss current topics.

EH 491 Engineering Honors Seminar. Preq: Sr. standing in the Eng. HP or CI.* 1(1-0) S. Presentation by students of their projects.

EH 496 Special Topics in Engineering. Preq: Membership in the Eng. HP or CI.* 1-4 F,S. Individual projects of a research or design nature.

EH 500 Engineering Analysis. 1.4 F,S. Students work in small groups or individually with faculty advisers to solve realistic problems requiring integration of knowledge from engineering fields, physical sciences, mathematics, and occasionally life sciences. Aimed at synthesis rather than mere analysis.

Engineering Operations

EO 491 Seminar in Engineering Operations. Preq: Sr. standing. 1(1-0) F. Assists seniors in EO in making the transition from a college environment to that of industry through lectures, guest speakers and class discussion. Schedule during the last fall semester in residence. Easter

Engineering Science and Mechanics

ESM 200 Introduction to Mechanics. Coreq: MA 202. 3(3-0) F,S. Principles and concepts which form the basis for students in dynamics, solid 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. CE Staff

ESM 205 Principles of Engineering Mechanics. Preq: PY 205; Coreq: MA 202. 3(3-0) F,S. Basic concepts, forces and equilibrium, distributed forces, virtual work, and inertial properties; application to machines, structures and systems. MAE Staff

ESM 206 Introductory Applications in Mechanics. Coreq: ESM 205. 1(0-2) F. Principles of mechanics applied to practical problems of engineering science in which numerical techniques of computation are emphasized. MAE Staff

*Eng. HP or CI—engineering honors program or consent of instructor.

ESM 211 Introduction to Applied Mechanics. Coreq: MA 212, PY 212. 3(3-0) F,S. The concepts of particle and rigid body mechanics. The fundamentals of equilibrium, kinematics and kinetics are applied to engineering problems involving structures and machines. CE Staff

ESM 212 Mechanics of Engineering Materials. Preq: ESM 211. 3(3-0) F,S,Sum. An introduction to the mechanics of solids. Analysis of the stresses, strains, and deformations occurring in loaded structural and machine members (including buckling loads). CE Staff

ESM 301 Mechanics of Solids. Preq: ESM 200. 3(3-0) F,S. For CE students. Development of the equations which describe the linear elastic solid. Approximate solutions and comparison with the theory of elasticity to problems involving axial, torsional and flexural loading. CE Staff

ESM 303 Fluid Mechanics I. Preq: ESM 200 or 205. 3(3-0) F,S. Development of the basic equations of fluid mechanics in general and specialized form. Application to a variety of topics including 1) fluid statics, 2) inviscid, incompressible fluid flow and 3) viscous, incompressible fluid flow. MAE Staff

ESM 304 Fluid Mechanics II. Preq: ESM 303. 3(3-0) F,S. Further applications of the basic equations of fluid mechanics to 1) boundary layers and analysis, 2) laminar and turbulent flows and 3) compressible fluid flow. Introduction to experimental methods in fluid mechanics. MAE Staff

ESM 305 Engineering Dynamics. Preq: ESM 205; Coreq: MA 301. 3(3-0) F,S. Equations of motion; kinematics, kinetics of mass points and systems of mass points; kinematics and kinetics of rigid bodies; dynamics of nonrigid systems. MAE Staff

ESM 307 Solid Mechanics I. Preq: ESM 205; Coreq: MA 301. 3(3-0) F,S. Stresses, strains, constitutive laws, yield and fracture; application to axial, bending, torsional and plane stress states; deflection and stability analyses. MAE Staff

ESM 308 Solid Mechanics II. Preq: ESM 301 or 307. 3(3-0) F,S. Equations for thin plates. Introduction to the theory of plasticity and experimental methods in solid mechanics. Plastic stress-strain relationships and two-dimensional problems in plastic behavior, and fracture. CE Staff

ESM 311 Experimental Engineering Science I. Coreq: ESM 303, 305, 307. 3(1-6) F. The experimental analysis concept starting with the question of how observations and measurements are made. Illustrations of experimental methods which enable the inference of one physical variable by the observation of another but related one. Bingham

ESM 312 Experimental Engineering Science II. Preq: ESM 311. 3(1-6) S. The ESM 311 background is utilized in broader problems which require the synthesis from several experimental methods as well as mathematical and/or numerical methods of an analytical system. Bingham

ESM 411, 412 Engineering Cybernetics I, II. Preq: Sr. standing in ESM or equivalent background. 3(3-0) F,S. A year course of formal lectures on topics which include dynamics of linear and nonlinear systems; hereditary and feedback couplings; continuous, discrete, random and stochastic inputs; system stability; reliability; optimization; and the ultra-stable autonomous system. Student participation, in either individual or collective form, in extra-class work of personal character in the design of particular engineering systems. McDonald

ESM 413 Engineering Science in Contemporary Design. Preq: Sr. standing in ESM. 2(1-3) S. Draws upon student's background in engineering science to analyze current problems. Case histories and evaluation of selected designs. Bingham, Douglas

ESM 495 Special Studies in Mechanics. 1-3 F,S. Offered as needed to treat new or special subject matter. CE & MAE Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ESM 501, 502 Continuum Mechanics I, II. Preq: ESM 307, ESM 303, MAE 301, MA 405. 3(3-0) F,S. The concepts of stress and strain are presented in generalized tensor form. Emphasis on the discussion and relative comparison of the analytical models for elastic, plastic, fluid, viscoelastic, granular and porous media. Underlying thermodynamic principles presented, the associated boundary value problems formulated and selected examples used to illustrate the theory. Chang, McDonald

ESM 503 Theory of Elasticity I. Preq: ESM 307; Coreq: MA 511 or 401. 3(3-0) F. The fundamental equations governing the behavior of an elastic solid are developed in various curvilinear coordinate systems. Plane problems, as well as the St. Venant problem of bending, torsion and extension of bars are covered. Displacement fields, stress fields, Airy and complex stress functions are among the methods used to obtain solutions. Bingham, Douglas

ESM 504 Mechanics of Ideal Fluids. Preq: ESM 304; Coreq: MA 513. 3(3-0) F. Basic equations of ideal fluid flow; potential and stream functions; vortex dynamics; body forces due to flow fields, methods of singularities in two-dimensional flows; analytical determination of potential functions; conformal transformations; free-streamline flows. MAE Staff

ESM 505 Mechanics of Viscous Fluids I. Preq: ESM 304; Coreq: MA 532. 3(3-0) S. Equations of motion of a viscous fluid (Navier-Stokes equations); general properties of the Navier-Stokes equations; some exact solutions of the Navier-Stokes equations; boundary layer equations; some approximate methods of solution of the boundary layer equations; laminar boundary layers in axisymetric and three-dimensional flows; unsteady laminar boundary layers. MAE Staff

ESM 506 Mechanics of Compressible Fluids I. Preq: ESM 304, MAE 302, Coreq: MA 532. 3(3-0) F. Introduction to the flow of a compressible fluid: thermodynamics and one-dimensional energy equation for a compressible gas. Acoustics, normal shock waves and expansion waves, shock tube theory, general one-dimensional flow and flow in ducts and channels. MAE Staff

ESM 507 Systems Analysis. Preq: ESM 305, MA 405. 3(3-0) F. The principles and concepts underlying systems analysis. Major topics are: finite-dimensional vector spaces, matrices and linear operators, state space and state equations, linear differential systems, and equilibrium and stability. Illustrations and applications from the broad areas of engineering mechanics and dynamical systems theory. The state variable approach is emphasized. MAE Staff

ESM 508 Systems Synthesis. Preq: ESM 507. 3(3-0) S. The design of engineering systems in which mechanics dominates. MAE Staff

ESM 509 Space Mechanics I. Preq: ESM 305. Coreq: MA 511. 3(3-0) F. The applications of mechanics to the analysis and design of orbits and trajectories. Trajectory computation and optimization; space maneuvers; reentry trajectories; interplanetary guidance. MAE Staff

ESM 510 Space Mechanics II. Preq: ESM 509, MA 511. 3(3-0) S. The analysis and design of guidance systems. Basic sensing devices; the characteristics of an inertial space; the theory of stabilized platforms; terrestrial inertial guidance. MAE Staff

ESM 511 Theory of Plates and Shells. Preq: ESM 307, MA 511. 3(3-0) F. Bending theory of thin plates; geometry of surfaces and stresses in shells. Methods of analysis discussed and illustrated. Bingham, Gurley

ESM 521, 522 Properties of Solids I, II. Preq: ESM 307, MAT 301, PY 413. 3(3-0) F,S. Micro and macro principles are applied toward an introductory understanding of material properties. The concepts of kinetic distribution and ensemble average of atomic behaviors are employed to characterize and interrelate material properties. Phenomenological behaviors and coupled effects are described within the continuum concept. Horie

ESM 551 Advanced Strength of Materials. Preq: ESM 307. 3(3-0) F. 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. Gurley

ESM 552 Elastic Stability. Preq: ESM 551, MA 301, MA 405. 3(3-0) S. 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. Gurley

ESM 555 Dynamics I. Preq: ESM 305, MA 405. 3(3-0) F. 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 propagations in solid bodies. MAE Staff

ESM 556 Dynamics II. Preq: ESM 305, MA 405. 3(3-0) S. 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, constraints, Euler's angles, the spinning top, the gyroscope, precession, stability, phase space and nonlinear oscillatory motion. MAE Staff

Eng 110 Developmental English 3(3-1) 1/25/78 eff 8/78

English

FRESHMAN ENGLISH

Required of All Freshmen

ENG 111 Composition and Rhetoric. 3(3-0) F,S. Basic forms and principles of expository communication; conferences. Staff

ENG 112 Composition and Reading. Preq: A grade of C or better in ENG 111. 3(3-0) F,S. Expository writing; introduction to literary types; collateral reading; conference. Staff

NOTE: ENG 111 and 112 must be scheduled in successive semesters until they are completed satisfactorily.

NOTE: Qualified students will be allowed to register for ENG 112H and will be given credit for ENG 111 upon successful completion of the course. Eligibility for ENG 112H is based on the student's predicted grade in English, employing a formula determined by Counseling, plus a composition to be written at the first or second class meeting of the ENG 112H section.

NOTE: The prerequisite for all advanced courses in writing, language, or literature is the completion of ENG 111 and 112. Desirable preparation for literature courses of the 300 level or above is ENG 205, 206, 207, 208, or any semester of ENG 261, 262 or ENG 265, 266.

WRITING

Prereq. revised 9/26/78 eff 1/79

ENG 200 Composition Laboratory. 0(0-2) F,S. The Compositon Laboratory is a noncredit course in composition designed for upperclassmen in any curriculum who are deficient in spelling, mechanics, sentence structure, and general organization. The Laboratory is not a substitute for courses in advanced composition.

ENG 214 Copyediting. 3(3-0) F. Basic writing and editorial skills needed to work effectively with material produced by others. It emphasizes mechanical editing (e.g., consistency and correctness of punctuation, capitalization, spelling, hyphenation, parallelism, bibliographical references, illustrations, and headings) and substantive editing (rewriting, reorganizing, or suggesting other ways to present material). Bolch

ENG 215 Principles of News and Article Writing. 3(3-0) F,S. Introduction to the techniques of conducting interviews and writing news stories (including feature articles) for a variety of news media. Bolch

ENG 298 Special Projects in English. 1-3 F,S. Staff

ENG 315 Reporting and Editing. Preq: ENG 215. 3(3-0) S. A journalism course in techniques of analyzing sources and readership; planning, organizing, and writing various kinds of articles; and editorial processes such as copyediting headline writing, and page layout. Bolch

ENG 321 The Communication of Technical Information. 3(3-0) F,S. Intensive training in the fundamentals of business and industrial expository and persuasive writing.

revised eff 1/78 Blackman, Dandridge, Spears, Seidel

Advanced Writing: Persuasion and Argument course cl eff 8/78

ENG 322 ~~Advanced Expository Writing.~~ 3(3-0) F. Examines the rhetoric of the sentence, the paragraph and the whole discourse in order to develop awareness of the relationship between structure and effect in expository writing. Blackman

ENG 323 Creative Writing. 3(3-0), Maximum 6. F,S. For students who have demonstrated ability. Emphasis on short prose fiction or poetry. Students may register in this course for a maximum of six hours. Barrax, Jeffers, Owen, Walters

ENG 324 Modern English. 3(3-0) F,S. A study of modern English primarily intended for candidates for teaching certificates. Attention given to problems of composition, dialect, and usage. Myers, Short

Eng 221 Communication for Business and Management 3(3-0) eff 8/78

LITERATURE

ENG 205 Studies in Great Works of Literature.* 3(3-0) F,S. Literary masterpieces from the Classical Period to the present. Emphasis on reading for understanding and enjoyment both of the works themselves and the cultural contributions to Western civilization of the periods from which the works are drawn. Staff

ENG 206 Studies In Drama.* 3(3-0) F,S. Selected drama from the Classical Period to the present. Emphasis on reading for enjoyment as well as understanding theory and development of tragedy, comedy, and other modes of dramatic expression.

ENG 207 Studies in Poetry.* 3(3-0) F,S. Analysis of poetry and the critical approaches to it. Emphasis on appreciation of the nature of poetry and the critical approaches to it. Emphasis on appreciation of the nature of poetry, and understanding features and techniques. The importance of both historical context and new criticla techniques. Staff

ENG 208 Studies In Fiction.* 3(3-0) F,S. Representative examples from the Renaissance to the present, emphasizing understanding and appreciation of fiction as a genre, a knowledge of the features and techniques of fiction, and a sense of the historical development of this genre. Staff

ENG 261 English Literature I. 3(3-0) F,S. Beginnings to 1660 Staff

ENG 262 English Literature II. 3(3-0) F,S. 1660 to present. Staff

ENG 265 American Literature I. 3(3-0) F,S. Beginnings to Civil War. Staff

ENG 266 American Literature II. 3(3-0) F,S. Civil War to present. Staff

ENG 290 Classical Backgrounds of English Literature. 3(3-0) F. Acquaints student with the central story-matter of the ancient world—Greek, Roman and Hebrew—which has exerted such a profound influence on the civilization, and especially on the literature, of the Western world. Moore, F. Moore, Wall

ENG 305 Women in Literature: Female Characterization from Chaucer to the Present. 3(3-0) S. This course will explore the nature of female characters as artistic entities to see these characters as part of literary and social convention. Emphasis will be given to the feminist or antifeminist attitude of each work. Baines

ENG (REL) 325 Religion and the Modern Literary Imagination. 3(3-0) F. (See religion, page

Eng 326 History of the English Language 3(3-0) 3/18/77 eff 8/77

ENG 346 Literature of the Western World I. 3(3-0) F,S. The Search for Self: Readings from the earliest Hebraic and Greek literature to Dante. Smoot, Smith

ENG 347 Literature of the Western World II. 3(3-0) S. Crisis and Confrontation: Readings from the European Renaissance to Tolstoi. Smoot

362 The British Novel of the 18th Century 3(3-0) eff 8/77 2/10/77

ENG 369 American Novel of the 19th Century. 3(3-0) F. Analysis of selected romantic, realistic and naturalistic novels. Revised eff 8/77 J. Clark, Kilby and West

ENG 370 The British Novel of the 18th and 19th Centuries. 3(3-0) F. Background of the English novel from its beginnings to the end of the 19th century. Analysis of the novel as a form. C. Moore, Durant

eff 8/77 2/10/77

ENG 371 The Modern Novel. (3-0) S. Background and pattern, and an analysis of major examples of the 20th century novel. C. Moore, Reynolds

ENG 372 Modern Poetry. 3(3-0) S. Defining the "modern temper" by comparison of contemporary poetry with that of the past. Reading and analysis of individual poems. Owen, Reynolds

ENG 375 The Film: A Literary Medium. Preq: Jr. standing. 3(3-0) Hargrave

ENG 376 Fantasy and Science Fiction. 3(3-0) S. A study of representative works, both novels and short stories, in the genre of Fantasy and Science Fiction. Emphasis is placed on those works written in the twentieth century, although some attention is given to the history and development of the genre. Meyers

ENG 391 Introduction to American Folklore. 3(3-0) S. Principal types of folklore, combined with field work in collecting and assimilating materials from various cultural traditions. Emphasis on American folklore and its origins. Betts, Owen

*The courses ENG 205, 206, 207 and 208 are designed for students not enrolled in Liberal Arts.

Eng 390 Classical Backgrounds of English Literature eff 8/77

363 The British Novel of the 19th Century 3(3-0) eff 8/77 2/10/77

ENG 395 Black American Literature. 3(3-0) F,S. A survey from significant beginnings to the present. Lucas, Barrax, Jeffers

~~**ENG 397 Literature of the Non-Western World.** 3(3-0) F. Translations from the literature of Persia, India, China and Japan.~~ Owen

ENG 398 Contemporary Literature I (1900 to 1940). 3(3-0) F. Imaginative literature from the period 1900-1940 with emphasis upon themes and techniques rather than genre or nationality. Knowles, Reynolds

ENG 399 Contemporary Literature II (1940 to present). 3(3-0) S. Representative French, American and British writers of the period 1940 to the present. Knowles, Reynolds

ENG 439 17th Century English Literature. 3(3-0) S. Major nondramatic literary figures in England during the period 1600-1700. F. Moore, White, Wall

ENG 449 The Renaissance. 3(3-0) F. Nondramatic prose and poetry of the 16th century, with consideration of literary types and movements. Emphasis on the works of major authors. Blank, Hester

ENG 451 Chaucer. 3(3-0) F,S. Introduction to the study of Chaucer through an intensive reading of *The Canterbury Tales* and *Troilus and Criseyde.* Holley, Koonce, Short

ENG 453 The Romantic Period. 3(3-0) F. The poetry of Wordsworth, Coleridge, Byron, Shelley and Keats, with reading in the prose of Lamb, DeQuincey and others.
P. Williams, Hargrave, Harrison, Engel, Lentz, King

ENG 462 18th Century English Literature. 3(3-0) F. The major figures in English literature between 1660 and 1790 in the light of social, cultural, and religious change.
Durant, White

ENG 463 The Victorian Period. 3(3-0) S. Major poets and selected prose writers studied against the social, economic, scientific, and theological background of the century.
Hargrave, Harrison, Lentz, King, Engel-

ENG 468 American Romanticism. 3(3-0) F. Major American writers from 1825 to 1865.
E. Clark, J. Clark, Stein, West, Grimwood

ENG 469 American Realism and Naturalism. 3(3-0) S. Major American writers from 1865 to 1935. E. Clark, J. Clark, Stein, West, Grimwood

ENG 480 Modern Drama. 3(3-0) F. Major plays from Ibsen to Albee.
Halperen, Reynolds

ENG 485 Shakespeare. 3(3-0) F,S. Principal plays with emphasis on the development of the playwright. Blank, Hester, Wall, P. Williams, M. Williams, Baines

ENG 486 Shakespeare, The Earlier Plays. 3(3-0) F. May be taken (in conjunction with ENG 487) as alternate for ENG 485 in LAN and LTN curricula. A study of Shakespeare's major works before 1600 with emphasis on the development of the playwright. Credit will not be given for both ENG 485 and 486.
Baines, Blank, Hester, Wall, M. Williams, P. Williams

ENG 487 Shakespeare, The Later Plays. 3(3-0) S. May be taken (in conjunction with ENG 486) as alternate for ENG 485 in LAN and LTN curricula. A study of Shakespeare's major works after 1600 emphasis on the development of Shakespeare's tragedy and the end of his career. Credit will not be given for both ENG 485 and 487.
Baines, Blank, Hester, Wall, M. Williams, P. Williams

ENG 496 Seminar in Literature. Preq: Junior standing and consent of department. 3(3-0) F,S. Designed to provide closely supervised small-group study of a topic in literature resulting in a substantial essay or series of essays by each student on an aspect of the topic. Topics vary each semester; consult department for details. Staff

ENG 498 Special Topics in English. Preq: Six hours ENG above the fr. level. 1-6 F,S. Detailed investigation of a topic in language or literature. Topic and mode of study determined by faculty member in consultation with English department head. Staff

Eng 499 Honors in English 3(3-0) 8/77

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ENG 504 Problems in College Composition. Preq: Appointment as a teaching assistant in English. 0(0-0) F. Directed study of the development of rhetorical skills in composition in classroom situations. Smith

ENG 524 Modern English Usage. Preq: Upper division or grad. standing. 3(3-0) S. English grammar, with attention to new developments in structural linguistics and with emphasis on current usage. Meyers, Short

ENG 526 History of the English Language. Preq: Upper division or grad. standing. 3(3-0) S. Growth and development of the language from its Indo-European beginnings to the present. Offered in alternate years. A section designated 526H, restricted to Teacher Certification English majors, will be offered every semester. Holley, Meyers, Short

ENG 561 Milton. Preq: Upper division or grad. standing. 3(3-0) S. Intensive reading of Milton with attention to background materials in the history and culture of 17th-century England. F. Moore, White

ENG 575 Southern Writers. Preq: Upper division or grad. standing. 3(3-0) S. Contribution of the South to American literature, with intensive study of selected major figures. Lucas, MacKethan, Reynolds

ENG 578 English Drama to 1642. Preq: Upper division or grad. standing. 3(3-0) F. English drama from its liturgical beginnings to the closing of the theatres, excluding Shakespeare. Meyers, M. Williams, Baines

ENG 579 English Drama of the Restoration and Eighteenth Century. Preq: Upper division or grad. standing. 3(3-0) S. English drama from 1660 to 1800. Durant, F. Moore

ENG 590 Literary Criticism. Preq: Upper division or grad. standing. 3(3-0) S. The critical process as it leads to the definition and analysis of literature, together with attention to the main literary traditions and conventions. Holley, P. Williams

Eng 624 modern English Usage 3(3-0) 3/31/77 eff. 1/79

Entomology

ENT 201 Insects and Man. 2(2-0) F. The ways in which insects affect our lives today and how man deals with them, how they have altered the course of history, and how we may learn from them in studying their ability to adapt to their changing environments. The aesthetic and avocational aspects of insects. Intended for students not in biological sciences.

ENT 203 Bees and Beekeeping 2(2-0) eff 8/77 Moore

ENT 301 Introduction to Forest Insects. Preq: FOR 264. 3(2-2) F. Covers the fundamentals of classification, development, habits and control of forest insects. Farrier

ENT 312 Introduction to Economic Insects. 3(2-2) F,S. The fundamentals of insect classification, development, food habits and controls.

ENT(ZO) 425 General Entomology 3(2-3) 3/1/78 eff 6/78 Moore

FOR ADVANCED UNDERGRADUATES

(BS) eff 8/78

ENT (ZO) 401 Bibliographic Research in Biology. Preq: Advanced undergraduate or graduate standing. 1(1-0) F. A general course intended to acquaint students with literature problems of the scientist, mechanics of the library book classifications, bibliographies, abstract journals, taxonomic indexes and preparation of scientific papers in agriculture, forestry, biology and their subdivisions. Farrier

eff 8/78 3/1/78

ENT (BS) 410 Biology of Insects. Preq: ZO 201 or 202. 3(2-2) F,Sum. Brings together current knowledge concerning major functional, behavioral, adaptive characteristics of insects, stresses the underlying biological principles. Yamamoto

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ENT 502 Insect Diversity. Preq: Twelve hours of biology. 4(2-4) F. The external morphology of insects and a survey of the biology and identification of immature and adult insects. Evolutionary relationships of insects and other arthropods, speciation, nomenclature, and classical and recent approaches to systematics considered. Baker, Neunzig, Young

ENT 503 Functional Systems of Insects. Preq: Twelve hours of biology, nine hours of chemistry, three hours of biochemistry, ENT 301 or equivalent. 4(2-6) S. The morphology,

Eng 626 History of the English Language 3(3-0) 3/31/77 eff 8/77

ENT 572 Advanced Forest Entomology 3(2-2) 2/24/77 eff 1/78

histology and function of the organ systems of insects. Sensory and general physiology lead into basic elements of insect orientation and behavior. Campbell, Hodgson, Yamamoto

ENT 504 Insect Morphology. Preq: ENT 502. 3(1-4) F. External morphology, primary and comparative phases, with emphasis on knowledge and techniques which can be applied to specific problems. (Offered F 1977 and alt. years.) Young

ENT 511 Systematic Entomology. Preq: ENT 301 or 312 or equivalent. 3(1-4) F. A detailed survey of the orders and families of adult insects, to acquaint the student with those groups and develop ability in the use of the taxonomic literature. (Offered F 1978 and alt. years.) Young

ENT 520 Insect Pathology. Preq: Introductory entomology and introductory microbiology. 3(2-3) S. A treatment of the noninfectious and infectious diseases of insects, the etiological agents and infectious processes involved, immunological responses and applications. (Offered S 1977 and alt. years.) Brooks

ENT 531 Insect Ecology. Preq: ENT 502. 3(2-2) F. The environmental relations of insects, including insect development, habits, distribution and abundance. Rabb, Stinner

ENT 541 Immature Insects. Preq: ENT 502 or equivalent. 2(1-3) F. An advanced study of the immature stages of selected orders of insects with emphasis on generic and specific taxa. Primary consideration of the larval stage, but a brief treatment of eggs and pupae. (Offered F 1978 and alt. years.) Neunzig

ENT 542 Acarology. Preq: ENT 301 or 312, or ZO 201. 3(2-3) S. A systematic survey of the mites and ticks with emphasis on identification, biology and control of the more common and economic forms attacking material, plants and animals including man. (Offered S 1977 and alt. years.) Farrier

ENT 550 Fundamentals of Insect Control. Preq: ENT 312 or 301. 3(2-2) F. The principles underlying modern methods for protecting food, clothing, shelter and health from insect attack. Guthrie

ENT 562 Agricultural Entomology. Preq: ENT 301 or 312. 3(2-3) S. The taxonomy, biology and ecology of beneficial and injurious insects and mites of agricultural crops. Advantages and limitations of the advanced concepts for controlling insect and mite populations on different crops. (Offered S 1977 and alt. years.) Bradley, Rock

ENT (PHY, ZO) 575 Physiology of Invertebrates. 3(3-0) F. (See zoology, page 329.)

ENT (ZO) 582 Medical and Veterinary Entomology. Preq: ENT 301 or 312 and ZO 315 or equivalent. 3(2-3) S. The morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission and control. (Offered S 1978 and alt. years.) Axtell

ENT 590 Special Problems. Preq: CI. Credits Arranged F,S. Original research on special problems in entomology not related to a thesis problem. Provides experience and training in research. Staff

ENT 592 Agricultural Entomology Practicum 3(0-9) 9-21-78 eff 6/79

Food Science

FS 201 Food Science and Man's Food. 3(3-0) F,S. An introduction to the science and practice of providing man with a wholesome, nutritious, economical and readily available supply of basic and processed foodstuffs. Topics will include: man's struggle for food; chemical nature of foods; microorganisms and foods; safety of foods; principles of food preservation and processing; organic and health foods; nutrition and the consumer; world food problem. Warren

FS (ANS, NTR) 301 Nutrition and Man. 3(3-0) F,S. (See animal science, page 189.)

FS 331 Food Engineering. Preq: PY 211 or 221. 3(2-3) F. Engineering concepts application to the food industry. Principles of thermodynamics, fluid flow, heat transfer, refrigeration and electricity. Jones

FS 400 Foods and Nutrition. Preq: CH 220. 3(3-0) S. The sources and properties of nutrients for man will be studied. Factors affecting the supply and availability of foods will also be considered. Methods of handling, procuring and preserving foods and the changes in the values and characteristics of nutrients resulting from these processes will be emphasized. Aurand

ENT 570 Behavior of Insects 3(2-3) eff 8/78

ENT 565 (FOR) Advanced Forest Entomology 3(2-3) 11/16/78 eff 1/79

FS 402 Food Chemistry. Preq: CH 220 or 221. 3(3-0) F. Introduction to the biochemistry of foods emphasizing basic composition, structure, properties and nutritive value. The chemistry of changes occurring during processing and utilization of foods. Giddings

FS (PO) 404 Poultry Products. Preq: CH 220 or 221. 3(2-3) F. The composition, quality, processing and preservation of poultry meat and eggs. Ball

FS (MB) 405 Food Microbiology. Preq: MB 401. 3(2-3) F. The micro organisms of importance in foods, and their cultural and metabolic activities. The physical and chemical destruction of microorganisms in foods and kinetics involved. The conversion of raw foods by microorganisms into altered foods, and the nutrition, growth and preservation of the culture involved. Foods as vectors of human pathogens. The evolution of microbiological standards for foods. Speck, Gilliland

FS (ANS) 409 Meat and Meat Products. Preq: CH 220. 3(2-3) S. The basic principles involved in processing beef, pork and lamb from the live animal to the various representative cured, fresh, canned and comminuted meat items currently produced. Blumer

FS (BAE) 432 Food Engineering II. Preq: FS (BAE) 331. 3(2-3) S. The theory and principles of evaporation, drying and distillation with emphasis on applications in food processing. Instrumentation and control systems used in the food industry. Jones

FS 490 Food Science Seminar. Preq: Sr. standing. 1(1-0) F. A review and discussion of scientific articles, new developments and topics of current interest. Roberts, Warren

FS 491 Special Topics in Food Science. Preq: Sr. standing or CI. 1-6 F,S,Sum. Topics are selected or assigned. Study of current topics and/or problems to gain additional knowledge and interpretative experience in a specific area. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

FS 503 Food Analysis. Preq: CH 315, BCH 351, FS 402. 3(1-6) S. The principles, methods and techniques necessary for quantitive physical and chemical analyses of food and food products. Results of analyses studied and evaluated in terms of quality standards and governing regulations. Staff

FS 504 Food Proteins and Enzymes. Preq: FS 402 or BCH 351. 3(2-3) F. An advanced course in food chemistry with emphasis on proteins and enzymes of particular importance to foods will be presented. Protein interactions and their effect on the physical-chemical characteristics of a product will be discussed. Particular emphasis will be given to the preparation and kinetic properties of immobilized enzymes and their use as biochemical reactors in processing operations or as specific electrodes for analytical purposes. Swaisgood

FS (MB) 506 Advanced Food Microbiology. Preq: FS 405 or equivalent. 3(1-6) S. The interactions of microorganisms in foods and their roles in food spoilage and bioprocessing. Cellular and molecular relationships in bacterial injury, repair and aging resulting from environmental stresses. Bacterial sporulations, germination, and physiological properties of bacterial spores. Gilliland

FS 511 Food Research and Development. Preq: FS (BAE) 331, FS 402, FS (MB) 405. 3(2-3) S. A study of the scientific principles underlying the development of new and improved food products and processes. The study of scientific food industry problems by the case method. Special emphasis on the application of research and development principles to meat, poultry, and fisheries industries. Webb

FS 516 Quality Control of Food Products. Preq: FS 331, 402, 405. 3(2-3) S. Quality control fundamentals in the food industry including specifications and standards, testing procedures, sampling, statistical and quality control and organization. Food products and industry problems used in the presentation with emphasis on dairy products. Hansen

FS (HS) 521 Food Preservation. Preq: MB 401 or FS 405, FS 402 or BO 421. 3(2-3) F. Principles and methods in food preservation. Emphasis on thermal, freezing, drying and fermentation processes and their relationship to physical, chemical and organoleptic changes in product. The relationship of these preservation techniques to the development of an overall processing operation. Carroll

FS (HS) 562 Post-Harvest Physiology. 3(3-0) S. (See horticultural science, page 259.)

FS (BAE) 585 Biorheology. (See biological and agricultural engineering, page 193.)

FS 591 Special Problems in Food Science. Preq: Grad. or sr. standing. 1-6 F,S,Sum. Analysis of scientific, engineering and economic problems of current interest. The scientific appraisal and solution of a selected problem. Problems designed to provide training and experiences in research. Staff

Foreign Languages

NOTE: All students with previous knowledge of French, German or Spanish must take the placement test upon entering the University. They will be given advanced standing and receive credit according to their score.

CLASSICS

GRK 101 Elementary Greek I. 3(3-0) F. Introduction to Classical Greek. A study of the Greek alphabet, three declensions, conjugation of regular and some irregular verbs. Readings based on Greek mythology, philosophy and literature.

GRK 102 Elementary Greek II. Preq: GRK 101. 3(3-0) S. After a brief review of conjugations and declensions, this course takes up the study of the middle voice, uses of optative and subjunctive, infinitive, aorist, future tenses and genitives, plus other syntactical and morphological phenomena. Readings from Plato, the New Testament, Xenophen, Herodotus.

GRK 201 Intermediate Greek I. Preq: GRK 102. 3(3-0) F. An introduction to Greek prose, with emphasis on increasing reading skill through vocabulary acquisition and the study of complex grammatical structures. Plato's *Apology*, Crito, and selections from the *Phaedo* are read. The relationship of the Platonic writings to other Greek literature is examined through reading in translation selections from the Greek orators, historians, poets, and playwrights.

GRK 202 Intermediate Greek II. Preq: GRK 201 3(3-0) S. A study of the techniques of oral poetry, the use of myth, and the literary and historical significance of Homer's *Iliad* and the New Testament. An analysis of differences between classical and Koine Greek.

310 Classical Mythology 3(3-0) 2/22/78 eff 8/78

GRK 320 Greek Tragedy in Translation. 3(3-0) S. A study of the tragedies of Aeschylus, Sophocles, and Euripides in translation. Discussions of the literary and social aspects of the individual plays and of the tragic genre in the fifth century. Examination of selections in Aristophanes, Plato, Aristotle and Seneca which discuss or reflect Greek tragedy.

LAT 101 Elementary Latin I. 3(3-0) F. Introduction Classical Latin. Study of five declensions, present and perfect systems of four conjugations, some irregular verbs and basic syntax. Readings from Roman and Greek mythology.

LAT 102 Elementary Latin II. Preq: LAT 102. 3(3-0) F. Continuation and expansion of LAT 101. Various subjunctive uses, active and passive periphrastic conjugations, conditional sentences. Readings from various classical writers.

LAT 201 Intermediate Latin I. Preq: LAT 102. 3(3-0) F. An introduction to Latin prose and poetry. The emphasis is on increased reading skill. A review of grammar fundamentals and an introduction to more complex syntactical structures. The cultural significance of the various readings is examined. An oral report, short paper, and translation exercise are required.

LAT 202 Intermediate Latin II. Preq: LAT 201. 3(3-0) S. A study of the lyric poetry of Catullus and Horace emphasizing vocabulary, syntax, and techniques of Latin verse. The traditions and the evolution of lyric poetry and the social role of the Roman poet are discussed.

NOTE: Following courses conducted in the target language, except where otherwise stated.

FLF 301, 302; FLG 301, 302; FLR 303, 304; FLS 301, 302, 303, 304 may be used to satisfy the literature requirement in undergraduate degrees. FL 250 courses may be used to satisfy the area elective in Liberal Arts.

ENGLISH FOR FOREIGN STUDENTS

eff 8/78 deleted eff 8/78

FLE 101 Foreign Language English: Review Grammar. Preq: ~~Departmental placement tests.~~ 3(3-1) F,S. Emphasis is on pronunciation, grammar and comprehension of American English.

FCL 300 Studies in Genres and Modes 3(3-0) eff 8/77

revised 6/23/78 eff 8/78

FLE 102 Foreign Language English: Writing. Preq: ~~Departmental placement tests.~~ 3(3-1) F,S. Emphasis is on writing, through the study of American English syntax with extensive written exercises; additional practice in spelling.

revised 6/23/78 eff 8/78

FLE 103 Foreign Language English: Conversation. Preq: ~~Departmental placement tests.~~ 3(3-1) F,S. For foreign students who have studied English but need additional conversational practice. Emphasis on correct pronunciation, intonation and idiomatic expressions. Oral drills, class discussions and laboratory practice.

revised 6/23/78 eff 8/78

FLE 104 Foreign Language English: Reading Improvement. Preq: ~~Departmental placement tests.~~ 1(1-0) S. This course is designed for foreign students who need to improve their reading speed and comprehension in order to perform effectively in other academic courses. Timed drills and practices teach the students to respond rapidly and accurately to increasingly longer units of writing. Use of the dictionary and vocabulary building exercises are also included.

FOREIGN LANGUAGES AND LITERATURES

FL 101 Self-Instructional Elementary Language I. Preq: Consent of coordinator. 3(6-2) F,S,Sum. Study through self-instructional methods of a foreign language not otherwise taught in the department. Students work with native speakers and proceed at their own pace. Admission to the program is limited to highly motivated students and is determined by a language aptitude test and an interview with the program coordinator.

FL 102 Self-Instructional Elementary Language II. Preq: Consent of coordinator. 3(6-2) F,S,Sum. (See course description under FL 101).

FL 201 Self-Instructional Intermediate Language II. Preq: Consent of coordinator. 3(6-2) F,S,Sum. (See course description under FL 101).

FL 202 Self-Instructional Intermediate Language II. Preq: Consent of coordinator. 3(6-2) F,S,Sum. (See course description under FL 101).

FL 298 Special Topics in Foreign Languages and Literatures. Preq: Consent of department. 1-3 F,S. A special projects course to be utilized for supervised work in language and literature when no scheduled course is appropriate.

FL 498 Special Topics in Foreign Languages and Literatures. Preq: Consent of department. 1-6 F,S. A detailed investigation of a special topic in language and/or literature. Topic, mode of study and variable credit to be determined by the faculty member in consultation with the head of the Department of Foreign Languages and Literatures.

FRENCH

FLF 101 Elementary French I. 3(3-0) F,S. The beginning course for developing language skills. Oral and written practice in classroom and language laboratory.

FLF 102 Elementary French II. Preq: FLF 101 3(3-0) F,S. A continuation of FLF 101, with oral and written practice in classroom and language laboratory.

FLF 201 Intermediate French I. Preq: FLF 102. 3(3-0) F,S. The third of four consecutive courses to build skills of speaking, understanding, reading and writing French. Oral and written practice in classroom and language laboratory.

FLF 202 Intermediate French II. Preq: FLF 201. 3(3-0) F,S. Last of the foundation courses in French. Greater emphasis on reading and writing.

FLF 203 French Conversation. Preq: FLF 102. 1(1-0) F,S. Practice in spoken French, emphasizing active use of the language in a variety of situations. The student is encouraged to increase vocabulary, while developing greater fluency and ease in the structural patterns of the language. May be repeated to a maximum of three credit hours.

content revised eff 8/78

FLF 251 Exoticism and the Fantastic in French Literature. Preq: FLF 102. 3(3-0) F,S. Readings in English and in French translation of selected works, with stress on critical, philosophical and entertainment value. Detailed *explication de texte* of short passages.

Modern French Drama

revised eff 1/79

FLF 257 ~~Conventional and Avant-Garde in Contemporary French Drama. Preq: FLF 102~~ 3(3-0) F,S. Readings in English and in French translation of selected plays ~~of the 20th~~ century, with stress on works assimilated from Greek Tragedy, the Avant-Garde and Conventional Theater.

FLF 105 Elementary Intensive French 6(6-0) 3/3/77 eff 8/77

FLF 205 Intermediate Intensive French 6(6-0) 3/3/77 eff 8/77

FLF 103 Elementary French I Conversation 1(1-0) 9/14/78 eff 1/79.

FLF 301 Survey of French Literature, Origins to 1800. Preq: FLF 202. 3(3-0) F. Readings of representative works with analytical and critical emphasis. Lectures, written and oral reports.

FLF 302 Survey of French Literature, 1800 to Present. Preq: FLF 202. 3(3-0) S. Readings of representative works with analytical and critical emphasis. Lectures, written and oral reports.

FLF 309 Advanced French Conversation and Phonetics. Preq: FLF 202. 3(3-0) F,S. Study of sound production and phonological terminology. Daily conversational practice in classroom. Prose and poetry readings.

FLF 310 Advanced French Grammar. Preq: FLF 202. 3(3-0) F,S. Thorough and in-depth study of French syntax with extensive written practice. Required of French majors.

FLF 315 French Civilization and Culture. Preq: FLF 202. 3(3-0) F. Taught in French. This course provides a background in French civilization and culture, through reading, discussion and presentation of the social, economic and political structures of France, along with its geography, history, music and art.

FLF 322 French Novel Before World War II. Preq: FLF 202. 3(3-0) F,S. Readings of French novelists from 1900 to 1940. Lectures, written and oral reports.

FLF 323 Contemporary French Novel. Preq: FLF 202. 3(3-0) F,S. Readings of French novelists from 1945 to the present. Lectures, written and oral reports.

FLF 324 Contemporary French Theater. Preq: FLF 202. 3(3-0) F,S. Representative plays with stress on ideas, philosophies, and trends in France and other countries.

FLF 350 Modern European Literary Criticism. Preq: Six hours of literature. 3(3-0) F,S. A study of modern European literary criticism paralleling the major modern philosophical systems, as theoretical bases, and based on an examination of major French critics, as applied methods. These methods are applied to several texts by French authors covering various genres. Taught in English.

FLF 411 French Literature of the 17th Century. Preq: CI. 3(3-0) F,S. Analytical and critical study of writings of French Classicism. Lectures, written and oral reports.

FLF 412 French Literature of the 18th Century. Preq: CI. 3(3-0) F,S. Analytical and critical study of writings of the Age of Rationalism and Revolution. Lectures, written and oral reports.

FLF 491 Special Topics in French Studies. Preq: Consent of the department. 3(3-0) F,S. A concentrated study of a special period, author or genre, to be determined as needed in the major program.

FLF 492 Special Topics in French Studies. Preq: Consent of department. 3(3-0) F,S. A concentrated study of a special period, author or genre, to be determined as needed in the major program.

FOR GRADUATE CERTIFICATION

This course does not carry undergraduate credit.

FLF 401 French for Graduate Students. 3(3-0) F. Designed to prepare students for graduate certification, this course will introduce students to basic vocabulary and structures. Frequent practice in translation. Certification is granted on satisfactory completion of the course.

GERMAN

FLG 101 Elementary German I. 3(3-0) F,S. The first in a four-course sequence intended to teach the student to understand, speak, read and write everyday German. Emphasis on speaking and understanding with additional reading of cultural materials. Intensive practice in the language lab.

FLG 102 Elementary German II. Preq: FLG 101. 3(3-0) F,S. Strong emphasis is placed on understanding and speaking, but increasing attention is given to syntax and vocabulary building.

FLG 201 Intermediate German I. Preq: FLG 102. 3(3-0) F,S. The third of four consecutive courses. Intensive conversational drill to build the students' ability to understand and speak everyday German. Supplementary readings in German literature.

FLG 210 German Practicum I 3(3-0) 6/21/78 eff 1/79
FLG 211 German Practicum II 3(3-0) 6/21/78 eff 8/79
FLG 212 German Practicum III 3(3-0) 6/21/78 eff 1/79

FLG 202 Intermediate German II. Preq: FLG 201. 3(3-0) F,S. Last of four sequential courses. Continued use of everyday spoken German but greater emphasis on reading and writing.

FLG 254 The Novelle From Goethe to the First World War. Preq: FLG 102. 3(3-0) F,S. Study of a major form of German prose fiction from Goethe to Thomas Mann. Class conducted in English with readings in German and in English translation.

FLG 255 ~~Twentieth Century Germanic Drama.~~ ~~Preq: FLG 102.~~ 3(3-0) F,S. Significant plays of Central and Northern Europe during the 20th century especially as they reflect socio-economic changes. Class conducted in English with readings in German and in English translation.

FLG 301 Survey of German Literature: Middle Ages to 1800. Preq: FLG 202. 3(3-0) F,S. Readings of representative works with analytical and critical emphasis. Lectures, class discussions, papers.

FLG 302 Survey of German Literature: 1800 to World War I. Preq: FLG 202. 3(3-0) F,S. Readings of significant authors, including the Romantic, Realist and Impressionist periods.

FLG 309 Advanced German Conversation and Phonetics. Preq: FLG 202. 3(3-0) F,S. Intensive conversational practice in class and language laboratory based on current topics, and a study of sound production and linguistic terminology.

FLG 310 Advanced German Syntax and Composition. Preq: FLG 202 or equivalent. 3(3-0) F. A study of advanced points in German syntax not normally studied in depth during the two years of beginning and intermediate courses. Students write controlled exercises and assigned and free compositions. Includes a bibliographical practicum.

FLG 322 Major German Modern Writers. Preq: FLG 202. 3(3-0) F. A study of major authors of the 20th century whose reputation was established prior to World War II, including Hauptman, Schnitzler, Hofmannstahl, Hesse, Mann, Kafka, Brecht.

FLG 323 Contemporary German Literature. Preq: FLG 202. 3(3-0) S. A study of German-speaking authors whose reputation has been established since the Second World War and those whose works are now gaining attention.

GRADUATE CERTIFICATION

This course does not carry undergraduate credit.

FLG 401 German for Graduate Students. Not open to undergrads. 3(3-0) F. Designed to prepare students for graduate certification, this course will introduce students to basic vocabulary and structure. Completion of the course will certify the student's reading knowledge.

FLH 101 Elementary Biblical Hebrew I 3(3-0) 3/9/77 eff 8/77
FLH 102 Elementary Biblical Hebrew II 3(3-0) 3/9/77 eff 1/78

ITALIAN

FLI 101 Elementary Italian I. 3(3-0) F,S. Concentrating on listening and speaking, this course begins the development of a balanced foundation on all four language skills. Idiomatic, everyday Italian is emphasized. Class and laboratory practice, written homework.

FLI 102 Elementary Italian II. Preq: FLI 101. 3(3-0) F,S. Emphasis mainly of acquisiton of oral skills through class practice and use of audio aids. Readings of simple Italian prose.

FLI 201 Intermediate Italian I. Preq: FLI 102. 3(3-0) F,S. The third of four consecutive courses. Its principal aim is to teach everyday, idiomatic Italian. Selected readings from contemporary Italian authors.

FLI 202 Intermediate Italian II. Preq: FLI 201. 3(3-0) F,S. Study of more advanced aspects of Italian, completing the learning of the foundation of the language. Readings from contemporary Italian authors; practice in intermediate composition.

PORTUGUESE

FLP 105 Elementary Intensive Portuguese. 6(6-0) F. Intensive introduction to Brazilian Portuguese, with emphasis on the speaking and listening skills.

FLP 205 Intermediate Intensive Portuguese. Preq: FLP 105. 6(6-0) S. Intensive study of Brazilian Portuguese on the intermediate level with refinement of the listening and speaking skills and introduction of the reading and writing skills.

FLP 201 Intermediate Portuguese I 3(3-0) 12/6/77 eff 1/78

FLH (Rel) 201 Intermediate Biblical Hebrew I 3(3-0) 2/22/78 eff 8/78

FLS 105 Elementary Intensive Spanish 6(6-0) eff 8/77 3/3/77
FLS 005 Intermediate Intensive Spanish 6(6-0) eff 8/77 3/3/77

RUSSIAN

FLR 101 Elementary Russian I. 3(3-0) F,S. The first of four sequential courses. Students are introduced to the basic language skills: understanding, speaking, reading and writing. Initial emphasis is on the two first, or oral, skills. Class and laboratory practice; written assignments.

FLR 102 Elementary Russian II. Preq: FLR 101. 3(3-0) F,S. Main emphasis on acquisition of basic oral skills, with complementary reading and writing exercises. Class and laboratory practice; written assignments.

FLR 201 Intermediate Russian I. Preq: FLR 102. 3(3-0) F,S. The learning of basic skills is continued. More emphasis than previously will be given to writing, but conversational practice is essential. Readings in Russian prose of intermediate level. Class and laboratory practice; written assignments.

FLR 202 Intermediate Russian II. Preq: FLR 201. 3(3-0) F,S. Study of more advanced aspects of Russian syntax through reading of prose of Russian writers. Continued attention to conversational practice and vocabulary building.

FLR 303 Russian Literature in Translation I. 3(3-0) F,S. This course offers an introduction to Russian writers of the 19th century, such as Turgenev, Gogol, Lermontov, Pushkin, Dostoevsky, Tolstoy. Class conducted in English.

FLR 304 Russian Literature in Translation II. 3(3-0) F,S. An introduction to Russian writers of the 20th century: Gorky, Pasternak, Solzhenitsyn, Babel, Sholokov, Maiakovsky, etc. Class conducted in English.

SPANISH

FLS 101 Elementary Spanish I. 3(3-0) F,S. Concentrating on listening and speaking, this course begins the development of a balanced foundation in all four language skills. Idiomatic, everyday Spanish is emphasized. Class practice, laboratory and written homework.

FLS 102 Elementary Spanish II. Preq: FLS 101. 3(3-0) F,S. This course expands use of Spanish through past tenses, regular and irregular, and various morphological and syntactical aspects. Emphasis on oral skills. Written work and laboratory practice assigned daily.

FLS 201 Intermediate Spanish I. Preq: FLS 102. 3(3-0) F,S. The third of four consecutive courses. As with 101 and 102, its aim is mainly to teach idiomatic, spoken Spanish. Reading and writing skills receive greater attention than previously. Class practice, laboratory and written assignment.

FLS 202 Intermediate Spanish II. Preq: FLS 201. 3(3-0) F,S. Last of four sequential courses, completing the learning of the foundations of the language. Writing will receive greater attention.

FLS 203 Spanish Conversation. Preq: FLS 102 1(1-0) F,S,Sum. Practice in spoken Spanish.The student is required to actively use the language in a variety of situations and is encouraged to acquire a wide range of immediately practical words and expressions suitable for business or travel purposes. The course may be repeated to a maximum of three times for credit.

Content revised eff 8/76

FLS 252 The Theme of Desengano in Spanish Literature. Preq: FLS 102. 3(3-0) F,S. Comprehensive study of theme of *desengano* in its different manifestations, mainly through the picaresque novel, barogue poetry and drama, Don Quixote, Unamuno and A. Machado. Course conducted in English with readings in Spanish and in English translation.

revised 3/28/79 eff

FLS 256 Alienation in the Modern Hispanic World. Preq: ~~FLS 102~~. 3(3-0) F,S. A study of cultural attitudes in the Hispanic countries through readings of selected Spanish and Spanish-American essays, novels and stories. Course conducted in English with readings in Spanish and in English translation.

FLS 301 Survey of Spanish Literature Through Golden Age. Preq: FLS 202. 3(3-0) F. Analysis of major literary works through 1700. The study will have two main projections: aesthetic, through consideration of elements of artistic creation, criticism and genres; cultural, in relating works to spatial and temporal circumstance.

FLS 302 Survey of Spanish Literature: 1700 to Present. Preq: FLS 202. 3(3-0) S. Introduction to the study of Spanish Neoclassicism, Romanticism, Realism, and subsequent literary production. Special attention to the quest for new values in contemporary literature.

FLS 104 Elementary Spanish II Conversation 1(1-0) eff 9/14/78 eff 1/79

FLS 103 Elementary Spanish I Conversation 1(1-0) 9/14/78 eff 1/79

FLS 303 Latin American Literature I. Preq: FLS 202. 3(3-0) F. Survey of literary production in Spanish-American countries from pre-Hispanic to 1800. Special attention to the Baroque and the Romantic periods to 1800. Lectures, class discussions, papers.

FLS 304 Latin American Literature II. Preq: FLS 202. 3(3-0) S. Introduction to the study of American literature in the Spanish language from Modernism to Garcia Marquez. Lectures, class discussions, papers.

FLS 309 Spanish Phonetics and Advanced Conversation. Preq: FLS 202. 3(3-0) F,S. Through discussions on relevant topics, class will concentrate on improving students' fluency in spoken Spanish. Study of main phenomena of sound production and relevant linguistic terminology.

FLS 310 Spanish Syntax and Composition. Preq: FLS 202. 3(3-0) F,S. A thorough study of the more advanced aspects of the grammar of the Spanish language, with extensive practice in writing. Lectures, discussion, compositions.

FLS 315 The Culture and Civilization of Spain and Portugal. Preq: FLS 202. 3(3-0) F. Taught in Spanish. The study of the Iberian Peninsula as a crossroads of civilization from early times to the present. The emergence of Spain as a nation, the rise and fall of the Spanish Empire, the contemporary political situation in Spain and Portugal. Films, recordings, slides, and visiting speakers illustrate those cultural characteristics unique to the Iberians.

FLS 316 The Culture and Civilization of Latin America. Preq: FLS 202. 3(3-0) S. Taught in Spanish. This course surveys the rich cultural traditions of Latin America. Through readings, slides, films, and recordings, the variety and complexity of the Latin Americans' cultural heritage is demonstrated.

FLS 323 Contemporary Spanish Literature. Preq: FLS 302. 3(3-0) F. An in-depth study of Spanish prose writing from the Generation of 98 through the present. Special attention to post-Civil War authors such as Laforet, Cela, Goytisolo, etc. Lectures, discussions, term paper.

Spanish Prose Fiction to 1900 2/23/78 eff 8/78 Gordon Jelveed

FLS 403 ~~Cervantes.~~ Preq: CI. 3(3-0) F. Around the central consideration of Don Quixote's definition of his role as knight errant, this course considers the works of Cervantes and related writers. The development of the novel as a genre is examined as part of the question of human personality and of its social determinants in the Renaissance.

Spanish Drama not delveed 2/23/78 eff 8/78

FLS 404 ~~Drama of the Golden Age.~~ Preq: CI. 3(3-0) S. After a brief introduction to medieval and early Renaissance drama, this course considers the rise and development of the Spanish stage from Lope de Vega to the late 17th century. Lectures, discussion, term paper.

FLS 362 delveed 2/23/78 eff 8/78

FLS 491 Special Topics in Hispanic Studies. Preq: ~~FLS 309, 310~~ or consent of the department. 3(3-0) F. A concentrated study of a special period, author or genre, to be determined as needed in the major program.

Seminar Junior Standing revised 2/23/78 eff 8/78

FLS 492 ~~Special Topics~~ in Hispanic Studies. Preq: ~~FLS 309, 310~~ or consent of the department. 3(3-0) A concentrated study of a special period, author or genre, to be determined as needed in the major program.

GRADUATE CERTIFICATION

This course does not carry undergraduate credit.

FLS 401 Spanish for Graduate Students. Not open to undergrads. 3(3-0) F. Designed to prepare students for graduate certification, this course introduces students to basic vocabulary and structures. Frequent practice in translation. Certification is granted on satisfactory completion of the course.

Forestry

FOR 101 Introduction to Forestry. 1(1-1) F. Introduction to the School of Forest Resources, to the profession of forestry and to career opportunities in forestry. Staff

FOR 201 Introduction to Forest Mensuration. 2(1-2) F,S. Theory, principles and techniques of instrumentation relative to the collection and presentation of forest data. Staff

FOR 204 Silviculture. Summer camp. ~~Preq: Jr. standing in FOR.~~ 2(0-6) Sum. Field exercises to enable the student to describe and measure factors of the forest environment, the

11/3/77 eff 6/77

ecology of forest communities, tree structure and growth, and tree and stand response to treatments which are normal parts of forest management operations. Staff

FOR 210 Dendrology-Gymnosperms. Preq: BO 200. 2(1-2) S. Identification, relationships and distribution of gymnosperm trees, emphasizing characteristics of genera and higher taxonomic groups. Duffield

FOR 211 Dendrology-Angiosperms. Preq: BO 200. 2(1-2) F. Identification, relationships and distribution of angiosperm trees, emphasizing characteristics of genera and higher taxonomic groups. Staff

FOR (WPS) 219 Forest Economy and its Operation. Preq: EB 212 or 201. 3(2-2) F. Multiple use concept of forestry; economic principles underlying production; investment problems; factors which influence demand for forest products. Steensen

FOR 263 Dendrology. Summer camp. Preq: FOR 210, 211. 1(0-3) Sum. Identification of trees, shrubs and woody vines of the Piedmont and mountain regions of North Carolina, principally by bark, foliage, flowers and developing fruits. Staff

FOR 264 Forest Protection. Summer camp. Preq: Jr. standing in FOR. 2(0-6) Sum. Identification and control of forest insects and diseases. Behavior of fire and the meteorological factors affecting fire behavior, suppression of a large simulated fire, including use of modern ground equipment, aircraft and communications systems. Staff

FOR 272 Forest Mensuration. 3(2-2) S. Scientific basis for the measurements and estimates required in forest resources management and goods and services derived from forest land. Includes theory of measurements, the required procedures, instrumentation and statistical prerequisites, with emphasis on sampling problems. Steensen

FOR (WPS) 273 Quantitative Methods in Forest Resources. Preq: Soph. standing. 3(2-2) F,S. Problem solving techniques in forestry, wood technology, pulp and paper technology and recreation resources. Historical development of past techniques, assessment of present technology, and an evaluation of problem solving tools, including an introduction to computers. Gemmer

FOR 274 Mapping and Mensuration. Summer camp. Preq: FOR 272. 4(0-12) Sum. Use of surveying instruments and graphic methods in preparation of topographic and planimetric maps of forested areas. Measurement of height, diameter, bole form and age of trees. Study of stand density, growing stock levels and financial maturity. Stem analysis sampling and site index determination. Jervis, Steensen

FOR 284 Utilization. Summer camp. Preq: Jr. standing in FOR. 1(0-3) Sum. Inspection of wood industries; expositions on manufacturing processes. Staff

FOR (PP) 318 Forest Pathology. 4(3-2) S. (See plant pathology, page 297.)

FOR 353 Air Photo Interpretation. Preq: Jr. standing. 3(2-3) S. Theory, principles and techniques of utilizing air photos as data sources for planning and management of renewable resources. Particular attention to stereoscopic identification and examination of the bioecological factors of terrain, plants, growing conditions, water, wildlife and the changes brought about by man's activities. Lammi

FOR 405 Forest Land Management. Preq: FOR 272, 452. 5(2-6-2) F. Management of forest lands for multiple benefits. Principles and techniques in regulating regeneration, species composition, growth and quality of woody vegetation; use of planting, seeding, cutting, herbicides and fire in vegetation management. Application of financial principles to decisions regarding investments in forest management. Bryant

FOR 406 Forest Land Inventory and Planning. Preq: FOR 405. 6(2-12) S. Applications of land management systems, including silviculture, protection, utilization and related problems in evaluation of assigned forest areas. Students complete a resource inventory and submit individual plans for management of the assigned tract. Bryant

FOR 411 Forest Tree Improvement. Preq: Junior or senior standing in forestry. 3(3-0) F. Emphasis is on the value and implementation of tree improvement in forest management. Study is made of genetics of forest trees, natural variation and evolution of plants, use of indigenous vs. exotic species, tree selection and propagation, seed orchard establishment and management, progeny testing, hardwood regeneration and management, site preparation, variation in wood properties and methods of maximizing fiber production. Kellison

Engineering Applications in Forest Resources 6/24/78 - ff 8/28

FOR (WPS) 423 ~~Logging and Milling~~. 3(2-3) F. (See wood and paper science, page 326.)

FOR (WPS) 435 ~~Systems Analysis in Forest Products.~~ 3(3-0) S. (See wood and paper science, page 326.)

FOR 452 Silvics. Preq: BO 200, CH 103, PY 221 or 212, mathematics through calculus. 4(3-2) S. Forest production can be increased by manipulating the physical environment, the genotype and plant competititon. The theoretical bases for these manipulations in applied ecology. Perry

FOR 462 Artifical Forestation. 2(1-2) S. Biology of seed production by forest trees; forest tree seed collection, extraction, storage and testing; biology of tree seedling growth; soil aspects of nursery management; forest nursery operation; soil aspects of site preparation, planting and direct seeding; reforestation operations. (Offered S 1978 and alt. years.) Davey

FOR 472 Renewable Resource Management. Preq: A basic course in biology and economics; jr. or sr. standing. 3(3-0) S. Concepts and problems of coordinated use and management of renewable resources — soil, water, vegetation and fauna. Man as a biological factor interacting with other components of terestrial ecological systems, particularly forests and related communities. Consideration of interrelationships of forests, water, range-land, wildlife and outdoor recreation and their aesthetic and economic values. Inventory and management techniques and economic policies relating to renewable resources. (Not open to FOR majors.) Staff

FOR 491 Senior Problems in Forestry. Preq: Consent of department. Credits Arranged. Faculty-approved problems in management or technology. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

FOR 501 Forest Influences and Watershed Management. Preq: Advanced undergrad. or grad. standing. 3(3-0) F. The effects of vegetation on climate, water and soil, with applications of forest influences to management of forest land resources, including conservation and yield of water, stabilization of streamflow and soils, reduction of sedimentation and general improvement of the environment. Maki

FOR 512 Forest Economics. Preq: Basic course in economics. 3(3-0) S. The setting and functioning of the forest economy. Topics include: supply and demand of industrial forest products and timber raw material; competition and pricing in the forest industries; competitive advantage of major forest regions; optimum rotation decision and financial returns to forest management; problems of timber production on non-industrial woodlands; economic analysis of non-timber forest products. Holley

FOR 571 Advanced Forest Mensuration. Preq: FOR 272, ST 311. 3(2-2) S. The development of mathematical models to describe forest resources phenomena; criteria for evaluating the "goodness" of such models; and methods of data collection for use in the evaluation. Hafley

FOR 572 Conservation Policy Issues. Preq: Advanced undergrad. or grad. standing. 3(3-0) S. Analysis of attitudes of selected private groups and public agencies toward multiple resource development. Attention to trends in development of forest resource policies, timber management objectives, private industry activity in forest development, recreation and multiple use, education, research, watersheds, governmental activity, interaction in international forestry affairs and the role of professional foresters and related specialists in multiple use resource management. Lammi

FOR 591 Forestry Problems. Preq: Advanced undergrad. or grad. standing. Credits Arranged. Assigned or selected problems in silviculture, harvesting operations, lumber manufacturing, wood science, pulp and paper science, wood chemistry or forest management. Staff

FOR 599 Methods of Research in Forestry. Preq: Advanced undergrad. or grad. standing. Credits Arranged. Research procedures, problem analysis, working plan preparation, interpretation and presentation of results; evaluation of studies by forest research organizations; techniques and constraints in sample plots use. Staff

Genetics

GN 301 Genetics in Human Affairs. 3(3-0) F,S. Fundamental principles of genetics presented at a level not requiring courses in biological sciences but sufficient for understanding the relation of genetics to society and technology. A survey of current knowledge of inheritance of human traits. McKenzie

FOR ADVANCED UNDERGRADUATES

GN 411 The Principles of Genetics. Preq: BS 100, Jr. standing. 3(3-0) F,S. An introductory course. The physical and chemical basis of inheritance; genes as functional and structural units of heredity and development; qualitative and quantitative aspects of genetics variation. Mettler

GN 412 Elementary Genetics Laboratory. Preq. or Coreq: GN 411. 1(0-2) F,S. Experiments and demonstrations provide an opportunity for practical experience in crossing and classifying a variety of genetic materials, particularly *Drosophila*.
Mettler, Graduate Assistants

FOR GRADUATES AND ADVANCED UNDERGRADUATES

GN 504 Human Genetics. Preq: GN 301 or 411, or equivalent. 3(3-0) S. The basic principles needed for an understanding of the genetics of man. Current knowledge and important areas of research in human genetics. Schaffer, McKenzie

GN 505 A,B,C,L Genetics I. Preq: GN 411 or equivalent. 1-4 F. Lectures in genetic principles presented as a series of five-week minicourses: GN 505A, qualitative genetics; GN 505B, microbial and biochemical genetics; GN 505C, cytogenetics. The laboratory, GN 505L, will involve experimental techniques in genetics, and will extend throughout the semester. Majors and minors must enroll for the entire series. Others may enroll for specific minicourses, and attend first lecture of semester for schedule. Staff

GN 506 A,B,C,L Genetics II. Preq: GN 411 or equivalent. 1-4 S. Lectures in genetic principles presented as a series of five-week minicourses: GN 506A, developmental genetics; GN 506B, quantitative genetics; GN 506C, population genetics. The laboratory, GN 506L, will involve experimental techniques in genetics and will extend throughout the semester. Majors and minors must enroll for the entire series. Others may enroll for specific minicourses, and attend first lecture of semester for schedule. Staff

GN (ANS) 508 Genetics of Animal Improvement. 3(3-0) S. (See animal science, page 189.)

GN (PO) 520 Poultry Breeding. 3(2-2) F. (See poultry science, page 302.)

GN (ZO) 532 Biological Effects of Radiations. Preq: BS 100 or GN 301 or CI. 3(3-0) S. 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. Grosch

GN (ZO) 540 Evolution. Preq: Nine credits in biological sciences. 3(3-0) F. The facts and theories of evolution in plants and animals. The causes and consequences of organic diversity. Smith

GN (CS, HS) 541 Plant Breeding Methods. 3(3-0) F. (See crop science, page 210.)

GN (CS, HS) 542 Plant Breeding Field Procedures. 2(0-4) Sum. (See crop science, page 210.)

GN (CS) 545 Origin and Evolution of Cultivated Plants. 2(2-0) S. (See crop science, page 210.)

GN (ZO) 550 Experimental Evolution. Preq: GN 506 or CI. 3(3-0) F. Processes examined at the inter- and intra-population levels. A review of the results from experimental population studies and analyses of natural populations concerning variation patterns and adaptation, natural selection, polymorphism, hybridization, introgression, population breeding structure, isolating mechanisms, etc., is made and interpreted in relation to Darwinian and modern concepts of the origin of species. (Offered 1975-76 and alt. years.) Staff

GN (BCH, MB) 561 Biochemical and Microbial Genetics. Preq: BCH 351 or 551, GN

GN 560 Molecular Genetics 3(3-0) 3/31/77 eff. 8/78

411 or 505, MB 401 or equivalent. 3(3-0) S. The development of the fields of biochemical genetics and microbial genetics emphasizing both techniques and concepts currently used in research. Lectures and discussions of current research publications. Armstrong

GN 650 Developmental Genetics 3(3-0) eff 1/78 4/27/77
Geology GN 651 Somatic Cell Genetics 3(3-0) 3/31/77 eff 8/77

GY 101 General Physical Geology. Credit may not be considered for both GY 101 and 120. 3(3-0) F,S. Systematic consideration of processes operating on and below the earth's surface and the resulting features of landscape, earth structures, and earth materials. Occurrences and utilizatioon and below the earth's surface and the resulting features of landscape, earth structures, and earth materials. Occurrences and utilization of the earth's physical resources. Recommended that GY 110 be taken concurrently.

GY 110 Physical Geology Laboratory. Coreq: GY 101 or 120. 1(0-2) F,S. The common rock forming minerals, the common rocks, topographic maps, geological structures and geologic maps. Field trips.

GY 120 Elements of Physical Geology. Credit may not be obtained for both GY 101 and 120. 2(2-0) F,S. Basic principles of physical geology. Major earth processes, principal geologic features, earth materials, and their interrelationships. Primarily intended for majors in disciplines requiring a minimum practical working knowledge of geology. Recommended that GY 110 be taken concurrently.

GY 201 Historical Geology 3(3-0) 4/6/78 eff 1/79

GY 208 Environmental Physical Geography. 3(3-0) F,S. Study of man's physical environment and his relation to it. Topics include atmospheric and oceanic structure and circulation; weather and climate soils and landforms; volcano and earthquake hazards; interaction of air, sea and land; interaction of man and his environment; air and water pollution.

GY 210 Historical Geology Laboratory 1(0-2) 4/6/78 eff 1/79

GY 222 Historical Geology. Preq: GY 101 or 120. 3(2-2) S. Chronologic account of the geologic events during the development of the earth's crust, mainly in North America. Evolution and environmental significance of the principal fossil animal and plant groups. Field trips.

GY 323 Paleontology. Preq: GY 222. 3(2-3) F. Fossil life forms, with emphasis on classification and structure of the invertebrate animals and their application to problems of correlation of strata. Lecture, laboratories and field trips.

GY 330 Crystallography and Mineralogy. Coreq: GY 101 or 120. 3(2-3) F. The elements of morphological crystallography. Space lattices, crystal symmetry, systems and classes. Stereographic projection of common forms. Identification of minerals by crystallographic features, cleavage, fracture, luster, color, streak, hardness, specific gravity, etc. Chemical composition, varieties, occurrence, associations, important localities and uses. Crystal structures of selected minerals.

GY 331 Optical Mineralogy and X-Ray Diffraction. Coreq: GY 101 or 120. 4(2-4) S. Techniques and underlying optical theory for identifying minerals with the polarizing microscope. Determination of index of refraction and birefringence; isotropic, uniaxial or biaxial character, optical sign and orientation. Adjunct apparatus for statistical and petrographic studies. Generation of x-rays, techniques and underlying theory for identifying by x-ray diffraction.

4(3-3) 3/30/78 eff 1/79

GY 351 Structural Geology. Preq: GY 222 and 330. ~~3(2-3)~~ S. Basic principles of rock mechanics; stress-strain analysis of deformed rocks. Nature and mechanisms of formation of joints, cleavage, faults, folds and other structural features of the earth's crust. Introduction to geotectonics. ~~Field trips.~~ Required field trip 1/8/79

GY 400 Environmental Geology. Preq: GY 101 or 120. 3(2-1) S. Man's effect upon and interaction with such processes as mass-wasting soil development, erosion, transport and deposition of sediments, surface waters, groundwater, volcanism and earthquakes. Environmental aspects of mineral and petroleum usage and waste disposal as affected by geologic processes and materials.

GY 415 ~~Mineral Exploration and Evaluation~~ Geology of metalliferous deposits Preq: GY 440, 452. 3(2-3) S. Application of the principles of geology, geophysics and geochemistry to the discovery and evalution of mineral deposits. Design of mineral exploration and development programs based on knowledge of the unique thermodynamic, geochemical and tectonic features that control

content revised eff 1/79

GY 423 Invertebrate Paleontology and Biostratigraphy 4(3-3) 3/2/78 eff 8/78

GY 470 Principles of Geophysics 3(3-0) eff 8/77 a/21/77
GY 481 Principles of Geomorphology 3(2-2) eff 1/79 6/23/78

mineral formation and concentrations in well-known mining districts, especially those yielding ferrous, base and precious metals. Review of economic and technological factors governing the value of mineral deposits. Field trips.

GY 440 Igneous and Metamorphic Petrology. Prereq: GY 331. 4(3-3) F. Rocks that are formed at high temperatures and pressures by crystallization or solidification of molten magma or by solid-state recrystallization of older rocks. Application of principles of phase-rule chemistry, and of the results of modern high pressure-temperature laboratory research on the stability fields of crystalline phases to an understanding of igneous and metamorphic rocks. Identification, classification, occurrence, and origin of the principal igneous and metamorphic rocks.

GY 452 Sedimentary Petrology. Coreq: GY 331 and Stratigraphy eff 1/77. 4(3-3) S. Identification, classification, geologic occurrences, origin and economic value of minerals, rocks and mineral deposits formed by physical, chemical and biological processes at low temperatures and pressures at and near the earth's surface. Hydrodynamics of sediment transport and deposition, settling velocities, and size sorting, chemical and biochemical precipitation from aqueous solutions. Principles of divisions of stratified terrains into natural units, correlation of strata, identification of depositional environments, and facies analysis.

revised eff 1/78

GY 461 Engineering Geology. Prereq: GY 101 or 120. 3(3-0) F. Applying geologic principles to engineering practice; analysis of geologic factors and processes affecting specific engineering projects. (Offered F 1977 and alt. years.)

GY 462 Field Geology. Prereq: GY 351. 3(1-5) F. Methods of collecting geologic data and samples in the field. Introduction to the use of geologic surveying instruments. Basic geologic mapping. Preparation of geologic maps, cross sections, and geologic reports.

GY 465 Geologic Field Camp. Prereq: GY 351, 440, 452. 3 1-8-79 eff 6/79. Sum. Six weeks summer field course. Field procedures and geologic instruments. Geological mapping of various geologic structures and terrains. Field trips.

GY 466 Regional field camp II 3(0) 1/8/79 eff 6/79 Content revised 8/77

GY 491, 492 Seminar on Selected Geologic Topics. 1-3 F,S. Reports and discussion of geological topics of current interest with attention to methodology, bibliography and research techniques.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

GY 500 Regional Geology of North America. Prereq: GY 101 or 120, sr. standing. 1-6. Field study of classic geologic localities and geomorphic processes not indigenous to North Carolina. Typical areas are New England and adjacent Canada, northern Mexico and southwestern United States, and the Pacific Northwest. Representative subjects include the Canadian Shield, Precambrian mineral deposits, the San Andreas fault, desert geomorphology, Grand Canyon stratigraphy, modern and ancient reefs, and glaciated volcanoes. Mineral, rock, and fossil collecting. Student reports required.

GY 521 Introduction to Subsurface Well Evaluation. Prereq: CH 103, GY 120. 3(2-3) F, Alt. yrs. Principles, uses and interpretation of commonly used wireline technique for structural, lithologic and fluid evaluation of wells. Oriented towards petroleum reserve/evaluations.

GY 522 Petroleum Geology. Prereq: GY 452. 3(3-0) S. Properties, origin, and modes of occurence of petroleum and natural gas. Geologic and economic features of the principal oil and gas fields, mainly in the United States. (Offered S 1978 and alt. years.)

GY 524 Continental Evolution. Prereq: GY 222, 351, 440, 452. 3(3-0) F. The stratigraphic and tectonic events which have shaped the continents, with emphasis upon North America; field trips. (Offered F 1978 and alt. years.)

GY 532 Ore Microscopy. Prereq: GY 331. 3(0-6) F. The theory and technique of microscopic investigation of opaque ore minerals, ores and mill products produced by benefication of ores. Studies of compositions and textures of materials in polished surfaces are based on observations of optical and physical properties, etch reactions and microchemical tests. (Offered F 1977 and alt. years.)

Intermediate Petrographic Analysis 2(05)

GY 542 ~~Microscopic Petrography.~~ Prereq: GY 440. ~~3(1-4)~~ F. Systematic study by microscopic techniques of the constitution and origin of consolidated rocks.

Content revised 3/16/78 eff 8/78

GY 545 Advanced Igneous Petrology. Preq: GY 440. 3(2-2) S. Physico-chemical principles related to igneous petrogenesis. General principles and specific problems including the origin, differentiation and emplacement of magmas and the possible relationships of igneous processes to global tectonics. (Offered S 1977 and alt. years.) content revised 12/8/77

GY 546 Advanced Metamorphic Petrology. Preq: GY 440. 3(3-3) S. The petrogenesis of metamorphic rocks including factors of metamorphism, metamorphic facies concept, metamorphic facies series, contact metamorphism, regional dynamothermal metamorphism, burial metamorphism. ACF-AKF diagrams and feldspars of metamorphic rocks. (Offered S 1978 and alt. years.) eff 1/78

GY 551 Advanced Structural Geology 3(2-3) 12/8/77 eff 8/77

GY 552 Exploratory Geophysics. Preq: GY 351, PY 208 or 212. 3(3-0) S. Fundamental principles underlying all geophysical methods; procedure and instruments involved in gravitational, magnetic, seismic, electrical and other methods of studying geological structures and conditions. Spontaneous potential, resistivity, radioactivity, temperature, and other geophysical logging methods. Study of applications and interpretations of results. (Offered S 1977 and alt. years.)

GY 563 Applied Sedimentary Analysis. Preq: GY 452, ST 361. 3(2-2) F. Extension of GY 452, with emphasis on coarser grained detrital and chemical sedimentary rocks. Sampling of sedimentary population, critical study of assumptions underlying standard measurement techniques; treatment, testing and evaluation of sedimentary data; application to problems in sedimentology. (Offered F 1978 and alt. years.)

GY 564 ~~Sedimentary Environments of Deposition.~~ Preq: GY 452 or grad. standing. 3(2-3) S. Fabric of large sedimentary basins in terms of the spatial distribution of component major rock facies; current litho-genetic models illustrating internal lithic relationships, variability, and predictability; evolution of litho-genetic units; comparison with recent equivalents; field trips. Depositional Environments and Lithostratigraphy eff. 1/77

GY 565 Hydrogeology. Preq: GY 452. 3(3-0) S. Occurrence and sources of surface and subsurface water. Relationships of surface water to subsurface water. Rock properties affecting infiltration, movement, lateral and vertical distribution, and quality of ground water. Determination of permeability, capacity, specific yield, and other hydraulic characteristics of aquifiers. Principles of well design, legal aspects of water supplies. (Offered S 1977 and alt. years.)

GY 567 Geochemistry. Preq: CH 331 or 433. 3(3-0) F. The quantitative distribution of elements in the earth's crust, the hydrosphere and the atmosphere. Application of the laws of chemical equilibrium and resultant chemical reactions to natural earth systems. Geochemical application of Eh-pH diagrams. Geochemical cycles. Isotype geochemistry. (Offered F 1978 and alt. years.)

570 Exploration and Engineering Geophysics 3(3-0) eff 1/78 2/10/77

GY 581 **Geomorphology.** Preq: GY 101 or 120 plus appropriate background. 3(2-3) F. Land forms and their relations to processes, stages of development, and adjustments to structure. Emphasis on mass-wasting, fluvial geomorphology of humid and arid climates, coasts, karst, and eolian processes. Lectures, map interpretations, and field trips. Revised 9-7-78 eff 1/79

GY 582 Quaternary Geology. Preq: GY 101 or 120, sr. standing. 3(3-0) F. Glaciology, glacial geology. Pleistocene stratigraphy, periglacial geomorphology; Quaternary volcanism, tectonism, and sea-level fluctuations; late Cenozoic climate changes; field trips. (Offered S 1977 and alt. years.)

GY 583 Photogeology. Preq: GY 101 or 120. 3(2-2) S. The stereoscopic study of aerial photographs to obtain geologic information. The construction of bedrock and surficial geologic maps from aerial photographs. Aspects of remote sensing useful in geologic interpretation.

GY (MAS) 584 Marine Geology. Preq: GY 452, or 101 or 120 plus appropriate background. 3(3-0) S. Morphology, structure and origin of ocean basins with their diverse features and their relations to the continents. Physical and chemical properties of the oceans, sedimentation in the marine environment and near-shore features. The economic potential of mineral resources derived from oceanic areas. (Offered S 1978 and alt. years.)

GY 593 Advanced Topics in Geology. Preq: CI. 1-6 F,S. Special study of some advanced phases of geology.

GY 571 Geophysical Field Methods 2 eff 6/77 11/27/77

GY 588 Regional Tectonics 3(3-0) 12/8/77 eff 1/78

GY 630 Neotectonics 3(3-0) 12/8/77 eff

HA 298 Special Topics in History of Art 3(3-0) 2/8/77 eff 8/77
HA 203 History of American Art 3(3-0) eff 1/80 6/27/78

History

INTRODUCTORY COURSES: (200 level) Open to all students without prerequisite. Previous course work in any particular field of history is not necessary in order to take any introductory course. eff 8/78

HI 204 Western Civilization to 1400. 3(3-0) F,S. A survey from earliest times to the end of the medieval era, treating the major civilizations which contributed to the development of Western Civilization.

HI 205 Western Civilization Since 1400. 3(3-0) F,S. A survey of Western Civilization from the Renaissance to the present.

HI 207 The Ancient World to 180, A.D. 3(3-0) F,S. The ancient cultures of the Middle East and Graeco-Roman civilization, including Egyptian, Minoan, Mycenean, Greek, and Roman societies and cultures.

HI 208 The Middle Ages. 3(3-0) F,S. Medieval civilization as it emerged from the declining Roman Empire through its apogee in the 13th century. The transition from the classical to the medieval world, the impact of the Germanic influx, and the political, economic, and social institutions of the High Middle Ages.

HI 209 Renaissance to Waterloo 1300-1815. 3(3-0) F,S. A survey of all aspects of the period of transition from the medieval to the modern world. Includes the decline of medieval institutions, the Renaissance, the Reformation and Counter-Reformation, rise of Absolutism, the English 17th-century revolution, the French Revolution and Napoleonic era.

HI 210 Europe ~~in the Nineteenth Century~~. 3(3-0) F,S. A study of the major political, economic and cultural developments in Europe ~~from~~ 1815 to Present eff 1/79 6/2/78 revised eff 1/79 World War I.

HI 211 War, Revolution and Reconstruction: Europe Since 1914. 3(3-0) F,S. This course will stress the political, economic and social development of Europe from World War I to the present. Emphasis will be placed on the problems of creating stable political institutions under the impact of two world wars, left- and right-wing revolutions, the withdrawal from overseas empires and technological and industrial growth. 3/15/77 eff 8/79

HI 215 Latin America to 1826. 3(3-0) F,S. The origins and development of social, political, economic and religious institutions from pre-conquest times to the achievement of independence. The ancient American cultures; Spain and Portugal before 1492; the conquest and settlement; Spanish rule in theory and practice; economic life; the Church; land and labor; the African contribution; the Portugese in Brazil; the independence movements.

HI 216 Latin America Since 1826. 3(3-0) F,S. Social, political, economic and intellectual life in the 19th and 20th centuries. Major attention to Mexico, Argentina, Brazil, Peru and Cuba. Topics include the social structure of the new nations; 19th century liberalism; the force of tradition; relations with Europe and the United States; the Monroe Doctrine and U.S. intervention; economic change; caudillo rule; 20th century upheavals; the Mexican Revolution; Peron's Argentina; Castro and Latin America.

HI 233 The World in the 20th Century. 3(3-0) F,S. National and international problems in the Western and non-Western World, including institutions and ideas at the turn of the century, origins and effects of the First World War, the post-war challenge to Western democratic supremacy from within and without, the Second World War, and problems of the post-war period.

HI 241 United States to 1783. 3(3-0) F,S. The European background of American history; establishment of English colonies in America; colonial historical development; the conflict with England, the securing of independence and the establishment of independent government.

HI 242 United States 1783-1845. 3(3-0) F,S. Inauguration of the new nation; territorial expansion and the westward movement; growth of democracy and social reform; development of national feeling and sectional tensions.

HI 243 United States 1845-1914. 3(3-0) F,S. The coming of the Civil War; the war and the reconstruction; the rise of industrialism and the Populist and Progressive response; the emergence of the United States as a world power.

HI 244 United States, Since 1914. 3(3-0) F,S. The United States and the First World

HI 221 An Introduction to British History to 1688 3(3-0) 3/18/77 eff 8/77
HI 222 An Introduction to British History Since 1688 3(3-0) 3/18/77 eff 8/77

War; the society in the 1920's; the Great Depression and the New Deal; the Second World War and post-war international problems; the Truman and Eisenhower years; America in the 1960's and 1970's.

HI 263 Traditional East Asia: Prehistory to 1800. 3(3-0) Introduction to the civilizations of China, Japan and Korea prior to the penetration of Western institutions and ideas.

HI 264 Modern East Asia: 1800 to Present. 3(3-0) The western impact and the responses in China, Japan and the smaller nations of East and Southeast Asia.

HI 265 Introduction to South Asian Civilizations. 3(3-0) A general introduction to the traditional civilizations of South Asia using a broad cultural approach. Concentration is on religious and social institutions and values.

HI 266 Modern South Asia 1700 to Present. 3(3-0) Deals with the history of South Asia from the British conquest to the present. Emphasis is on the rise of nationalism and changes in society in India, Pakistan, and Bangladesh since independence.

HI 272 The Afro-American in America. 3(3-0) A brief consideration of his African background, and the particular role, experience and influence of the Afro-American at various stages in the development of the United States.

HI 281 Introduction to the History of Science and Technology. 3(3-0) An Introduction to the study of the history of science and the history of technology; consideration of the basic methods and types of data used by historians in each field; examination of problems and schools of historical interpretation through selected case studies. eff 1/77 2/8/77

HI 298 Special Projects in History. 1-3 F,S. Utilized for guided research or experimental classes at the soph. level. Staff

FOR ADVANCED UNDERGRADUATES

NOTE: Prerequisite for 300 and 400 level courses: Three hours of history.

HI 321 Ancient and Medieval Science. 3(3-0) F. Selected topics to examine how pre-modern "science" differed from the science that emerged after the "Scientific Revolution" of the 17th century. The relations of science to social and economic factors, technology, magic, and religion. Examples from pre-history, Mesopotamia, Egypt, China, India, Greece, Rome, Islam and the Medieval and Renaissance West. Sylla

HI 322 Rise of Modern Science. 3(3-0) F,S. The "Scientific Revolution" of the 16th and 17th centuries. Analysis of Newton's System. The origins of modern chemistry, geology and evolution theory. The radical revision of Newtonian theory in the 20th century. These developments are considered within the context of the great historical movements of their time. Mulholland, Sylla

HI 341 Technology in History. (3-0) S. The role of technology in society from earliest times to the present. The achievements of technology and their impact on society as a whole are examined along with the social status, education, sources of support, and relationships to church and government of scientists and engineers in various periods. Mulholland

HI 351 English History (to 1688). 3(3-0) The evolution of the English constitution and the political, social and economic background of English cultural development. eff 8/77

Hi 343 U.S. Urban History, 1607-Present 3(3-0) eff 8/77 2/25/77 Carlton, Downs

HI 352 English History (since 1688). 3(3-0) The evolution of the English constitution and the political, social, and economic background of English cultural development. eff 8/77

Hi 365 The American West 3(3-0) 1/79 eff 6/23/78 Carlton, Downs

HI (EB) 370 The Rise of Industrialism. 3(3-0) F. (See economics and business, page 216.)

HI (EB) 371 Evolution of the American Economy. 3(3-0) F. (See economics and business, page 216.)

Hi 372 Afro-American History through the Civil War 1619-1865 3(3-0) 2/27/78 eff 8/78

HI 400 Civilization of the Ancient Near East. 3(3-0) The civilization of Mesopotamia and Egypt from earliest times to the fall of Babylon in 539 B.C. Sack

HI 403 Ancient Greek Civilization. 3(3-0) The history of the Hellenes from the Minoan civilization through Alexander's legacy, with readings in Herodotus and Thucydides. Sack

HI 404 Rome to 180 A.D. 3(3-0) Roman development from the Estruscans through Em-

Hi 372 Afro-American History 3(3-0) eff 8/77 1/17/77

Hi 315 History of the Crusades: Conflict and Culture in the Mediterranean 3(3-0) 2/27/78 eff 8/78

Hi 348 History of Women in the United States 3(3-0) 2/27/78 eff 8/78

Hi 373 Afro-American History Since 1865 3(3-0) 2/27/78 eff 1/79

porer Marcus Aurelius (180 A.D.). Examines through readings in Livy and Tacitus the great political achivement which saw Rome rise from a cattletown on the Tiber to the head of an Empire. Riddle

HI 406 From Roman Empire to Middle Ages. 3(3-0) Using primarily translated Latin sources the course deals with the decline of Imperial Rome, and its succession by new Christian, Germanic, and Islamic civilizations. Riddle, Newby

HI 407 Islamic History to the Crusades 3(3-0) eff 8/77 2/7/77

HI 410 Italian Renaissance. 3(3-0) Renaissance humanism, an educational ideal and an awareness of man as the sole creator in the historical world, will be examined in its relationship to the Italian republics and princedoms of the 14th through the 16th century. Banker

HI 411 The Protestant and Catholic Reformation of the Sixteenth Century. 3(3-0) The conditions and criticisms which led to reform and the nature of the institutional and theological changes affected by the various churches and sects. Special attention to Luther and Calvin. Banker

HI 414 The Age of Absolutism. 3(3-0) Concentrates on the development of royal absolutism in 17th century Europe, the nature of the institutions which supported it, the particular cultural forms and patterns which it generated, and the reasons for its decline in the 18th century. Greenlaw

HI 415 Revolutionary Europe. 3(3-0) A broadly based analysis of Europe's first revolutionary era. The revolution in thought called the Enlightenment, the causes and character of the Revolution in France, the impact of these events in France and Europe. Greenlaw

European Life and Work, 1750-1850 4/9/78

HI 416 ~~The Social Transformation of Europe,~~ 1750-1850. 3(3-0) An historical examination of social traditions and change in Europe (esp. England, France and Germany) from the mid-eighteenth to the mid-nineteenth century, including both rural and urban life. The course emphasizes population growth and its effects, changes in lower and middle class family life, the evolution of labor, the experience and perception of poverty, types of popular protest. LaVopa

HI 418 Fascism in Germany and Italy, 1919-1945. 3(3-0) Hitler and Mussolini: Two aspects of European Fascism in the interwar period. Suval

HI 425 Tudor and Stuart England. 3(3-0) The permanent political crisis set into motion by the Reformation culminating in the English Civil War. Emphasis on certain key developments in social, political and economic life such as the development of a new concept of kingship, the growing independence of Parliament, the search for religious uniformity and the changing status of the aristocracy and gentry. Carlton

HI 428 England in the Age of the American Revolution. 3(3-0) English political, economic, social and imperial ideas and institutions between 1763 and 1783 with emphasis on how these affected and were affected by the War of the American Revolution. Downs

HI 429 Twentieth Century Britain. 3(3-0) British political, social and economic history since 1914, with reference to the effects of two world wars, the growth of the welfare state, British decline as a power, and the search for a new role in the world. Carlton

HI 430 Modern France. 3(3-0) The major trends since the downfall of Napoleon I with a short preliminary survey of the old regime and the revolutionary period 1789-1815. Cultural, economic, social and intellectual trends are stressed as well as the political. The ways in which France has been a seedbed for new movements in Europe. Brown

HI 432 Germany Since 1848. 3(3-0) German history from the revolutions of 1848 to the present, concentrating on problems of nationalism and political and social reform. Suval

HI 436 European Thought and Society, 1750-1900. 3(3-0) A study of major figures in European thought and letters since the Enlightenment and their influence on European and world culture, society and politics. Staff

HI 438 History of Russia to 1881. 3(3-0) F. The social, political, economic and cultural history of Kiev Rus., Muscovy and Imperial Russia through the emancipation of the serfs and the fundamental reforms that followed. Emphasis on internal developments; some attention to foreign policy. Wheeler

HI 439 History of Russia Since 1881. 3(3-0) S. The history of Russia and the Soviet Union

HI 424 England from the Celts to 1485. 3(3-0) eff 8/77

HI 426 England in the 18th and 19th Centuries 3(3-0) eff 8/77

from the great reforms of the 19th century to modern times, emphasizing political, religious, and cultural trends that underlie the development of the Russian state and society and the position of the U.S.S.R. in the world today. (Some attention to foreign policy with emphasis on Soviet period.) Wheeler

HI 441 The United States: The Colonial Period. 3(3-0) An intensive analysis of the English Colonization of the New World, the motives for settlement, the growth of political institutions, the development of imperial-colonial relations, the rise of slavery, the role of religion and ideas in colonial life, and the process of Americanization from 1606 to 1763. Constantin

HI 442 The United States: Revolution to Constitution. 3(3-0) The conflict with Great Britain after 1763 leading to the declaring of independence; the war for American independence in its military and diplomatic aspects; the domestic problems; the foreign relations in the post-war years; the establishment of government in the new nation. Constantin, Elliott

HI 443 The Age of Jefferson. 3(3-0) The political, social, economic, intellectual and diplomatic aspects of United States history from the adoption of the Constitution in 1789 through the second Madison administration. Establishment of the federal government; implementation of Hamilton's financial system; foreign affairs during the Wars of the French Revolution; rise of political parties; triumph of the Jeffersonian Republicans; territorial expansion of the United States; War of 1812. Wishy

HI 444 The Age of Jackson, 1815-1850. 3(3-0) Political, social, cultural and economic developments from the Era of Good Feelings to the Compromise of 1850. Readings organized around four major interpretations of the period. King

HI 445 American Social Ideals and Institutions Before the Civil War. 3(3-0) F. Investigation in selected periods before the Civil War of the structure and role of the American family, organization of voluntary societies (such as reform groups) of professions and occupations and the development of social ideals and attitudes in both workaday and highbrow culture. Readings include diaries, letters and advice manuals. Scott

HI 446 Civil War and Reconstruction. 3(3-0) S. The period of sectional strife and war. Examination of the impact of the war on the United States and the efforts to reconstruct the South on a national basis. . Harris

HI 447 American Social Ideals and Institutions Since the Civil War. 3(3-0) S. Study of American social and cultural life since the Civil War and focusing on changes in the nature of social ties, in the institutions surrounding work, in sex roles and the function of the family, and in agencies of education and communication. Scott

HI 448 Populism and Progressivism. 3(3-0) The two most important general reform movements in the United States during the late 19th and early 20th centuries, the "agrarian crusade" and the Progressive movement, are examined in the context of the economics, politics, society, and ethics of their time. O'Brien

HI 450 The United States in Prosperity and Depression, 1919-1939. 3(3-0) F. The domestic history of the United States between the World Wars, emphasizing the social and political responses to economic, demographic, and organizational change. Collins

HI 452 Recent America. 3(3-0) Some of the major problems in American life since 1939. Hobbs

HI 454 U.S. Foreign Relations. 3(3-0) F. The origins of American foreign policy and the conduct of diplomacy in the era since the United States became a world power. Stresses complex array of personalities, ideas, institutions and forces involved in shaping and implementing policy. Beers

HI 455 Christianity and Its Critics in American History. 3(3-0) Analysis of major challenges to conventional or established belief and orthodoxy from Anne Hutchinson and Roger Williams to the age of Darwin. Concentration on the major intellectual debates about the foundations of traditional faith as well as on alterantives to Christianity and attempts to restate its claims. Constantin

HI 458 Significant Figures in 20th Century America. 3(3-0) The impact on American life in the 20th century of important people in fields of politics, war and peace, sports and various forms of communication. Hobbs

HI 462 The New South in America 3(3-0) off 8/77 2/23/77

HI 461 Civilization of the Old South. 3(3-0) The distinctive features of the Old South as part of the regional development of United States history. Consideration of colonial factors in the making of the South, development of the plantation system and Negro slavery, Southern social order, intellectual and cultural life, economic development, and rise of Southern nationalism. Elliott, Crisp

HI 463 North Carolina to 1860. 3(3-0) F. North Carolina history from the earliest explorations through the 1850's. Elliott

HI 464 North Carolina Since 1860. 3(3-0) S. North Carolina history from the eve of the Civil War to the present. O'Brien

HI 465 The American West. 3(3-0) A history of the American frontier with emphasis on the trans-Mississippi West. The course surveys the cycles of exploration, conquest, and settlement of this region, giving special attention to the contracts and conflicts among the native American Indians and the various European cultures which penetrated the continent. This survey is supplemented by an examination of the Turner thesis and other theories of Western and frontier influence on the development of the United States. Crisp

HI 467 Modern Mexico. 3(3-0) F. Major developments in Mexican national life since 1821. The 19th century: the era of Santa Anna, the war with the United States, the Reform, the French intervention, and the dictatorship of Porfirio Diaz. The 1910 Revolution and the resulting transformation of Mexico's political, social and economic institutions. Reading knowledge of Spanish helpful, but not required. Beezley

HI 469 20th Century Latin American Revolutions. 3(3-0) The variety of revolutionary changes in certain 20th century Latin American republics. Concentrates on Argentina, Bolivia, Peru and Cuba, but includes some other nations. Examines movements dedicated to the overthrow of traditional liberal institutions and their replacement by other political, social and economic systems. Beezley

HI 471 Revolutionary China. 3(3-0) The failure of traditional Chinese society to find means of accommodation with the West. The emergence of the revolutionary Communist state and society. Staff

HI 472 Modern Japan, 1850 to Present. 3(3-0) Japan's emergence as a nation and world power. Staff

HI 473 20th Century Asian Revolutionaries. 3(3-0) Use of psycho-historical techniques for the comparative study of the lives and works of great figures in 20th century Asia: Sun Yat-sen, Mao Tse-tung, Mohandas Gandhi and Jawarharlal Nehru. Staff

HI 477 British Empire and Commonwealth. 3(3-0) The evolution of colonial self-government and the transformation of imperial relationships in the former British dependencies in Canada, the West Indies, Africa, Asia, and the Pacific Islands. Downs

HI 491 Seminar in History. 3(3-0) F,S. Open to srs. in history, other srs. and grad. students with departmental permission. Staff

HI 492 Seminar in History. 3(3-0) F,S. Open to srs. in history, other srs. and grad. students with departmental permission. Staff

HI 498 Special Topics in History. 1-6 F,S. Extensive readings on predetermined topics focused around a central theme. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

NOTE: Prerequisite for all history courses at the 500 and 600 level is six hours of advanced history or equivalent.

HI 515 High Middle Ages. 3(3-0) An analysis of medieval culture. Topics such as the revival of the Roman Empire, monastic and papal reform, the rise of universities, the evolution of representative bodies, the Gothic style, troubadour and goliardic poetry, scholasticism, and the revival of Roman law. Riddle

HI 530 Era of the French Revolution and Napoleon. 3(3-0) Aspects of the French Revolution and the Napoleonic era which are currently subject to differing interpretations. Greenlaw

HI 528 England in the Age of the American Revolution 3(3-0) 2/23/77

HI 475 History of the Republic of South Africa: Race, Class, and Politics in Historical Perspective 3(3-0)

11/2/78 eff 8/79

HI 532 History of Great Britain, 1820-1914. 3(3-0) Great Britain from the Regency of George IV to the outbreak of World War I with emphasis on the most significant developments in constitutional, religious, and economics ideas and institutions. Downs

HI 536 History of International Relations Since 1870. 3(3-0) European diplomatic history and world international relations from the Franco-Prussian War through both World Wars up to the present. Emphasis on policies and attempts to solve international problems. Brown

HI 545 The American Civil War. 3(3-0) F. Events that led to the disruption of the union and intensive study of the war, emphasizing non-military aspects. Only the major military campaigns are discussed. Harris

HI 546 Reconstruction of the American Union. 3(3-0) S. The difficulties involved in the restoration and readjustment of American society after the Civil War. Attention to social and economic conditions in the defeated South, military reconstruction and Republican ascendancy in the region. Harris

HI 548 The American Response to Industrialism. 3(3-0) The industrialization of the American economy and efforts to deal with the ensuing transformation of American life through politics, social institutions and ideals. O'Brien

Hi 550 Principles and Practice of Applied History 3(3-0) 9-21-78 eff 1

HI 551 History and Principles of the Administration of Archives and Manuscripts. 3(3-0) F. The nature, importance and use of original manuscript resources; the history and evolution of written records, and the institutions administering them. Mitchell

HI 552 Application of Principles of Administration of Archives and Manuscripts. Preq: HI 551. 3(3-0) S. Internship training applies principles and practices of archival management. Mitchell

HI 561 U.S. Far Eastern Relations. 3(3-0) S. American expansion into the Pacific and involvement in Asian affairs. Both official diplomatic relations and unofficial contacts (by missionaries, educators, businessmen, and the like) which influenced Americans. Beers

HI 565 The History of Urban Life in the U.S., 1607-1865. 3(3-0) F. Designed to give the student an understanding of the historical background of today's urban problems. King

HI 566 The History of Urban Life in the U.S., 1865-Present. 3(3-0) S. Designed to give the student an understanding of the historical background of today's urban problems. King

HI 572 History of Soviet Russia Since 1930. 3(3-0) An analysis of the domestic and foreign policies of the Soviet Union since 1930 with emphasis on the position of the Soviet Union in the world since 1945. Wheeler

HI 598 Special Topics in History. 1-6 F,S. Topics of interest to advanced students under faculty direction on a tutorial basis. Staff

Horticultural Science

HS 101 Plants for Home and Pleasure. 3(2-3) F,S. A general course concerned with the basic uses of plants and flowers in and around the home. Topics studied will be indoor plants, flower arranging, home landscaping, and flower, vegetable and fruit gardening. Kimmins

HS 201 Principles of Horticulture. 3(3-0) F,S. Basic principles of production, processing and utilization of fruit, vegetable, flower, and ornamental crops. The economic importance and distribution of horticultural enterprises. The roles of horticulture in world nutrition and food supply, improvement of environmental quality in the landscape, aesthetic values, and medicinal uses. Cochran

HS 211, 212 Ornamental Plants. Preq: BS 100. 3(1-5) F(211), S(212). Identification, distribution, growth characteristics, adaptation, and usage of ornamental trees, shrubs, vines, and herbaceous plants in the landscape. Southall

HS 301 Plant Propagation. Preq: BS 100, or BO 200. 3(2-2) F,S. The principles, methods, and practices in seedage, cuttage, division, budding, grafting, and other methods of propagation. Influence of hereditary, environmental, and pathological variations on the plant products. Staff

HS 352 Landscape Design Presentation 2(1-2) 5/77 off 8/77

HS 342 Landscape Horticulture. 3(2-3) F,S. Application of design principles to landscaping small properties and selecting and planting trees, shrubs, flowers, and lawn grasses. Students will work out detailed landscape plans. Field trips to homes and gardens. Staff

HS 411 Nursery Management. Preq: BS 100, SSC 200. 3(2-3) F,S. Principles and practices of production, management, and marketing of field-grown and container-grown nursery plants. Field trips. Raulston

HS 414 Residential Landscaping. Preq: HS 211, 212, SSC 200. 4(2-6) F,S. Landscape planning and development of residential properties to create an aesthetic and functional composition to complement the home. Required completion of planting plans including design, plant lists, planting details, and technical specifications. Staff

HS 421 Tree Fruit Production. Preq: BS 100 or BO 200, SSC 200, HS 201. 3(2-3) F. Identification, adaptation, production and marketing methods of the principal tree fruit and nut crops of the United States. Fundamental principles underlying perennial plant culture will be applied to the production of specific fruit crops with emphasis on the crops of commercial importance in North Carolina. Ballington

HS 431 Woody Ornamentals I 3(3-0) 1978 off 8/79 8/79

HS 432 Vegetable Production. Preq: BS 100, SSC 200. 3(2-3) F. The origin, importance, distribution, botanical relationships, and principles of production and marketing of the major vegetable crops. Commercial production stressed. (Offered F 1976 and alt. years.) Miller

HS 440 Greenhouse Management 3(2-3) 2/16/77 off 8/77

HS 441 Floriculture I. Preq: BS 100, SSC 200. 3(2-3) F. Greenhouse site selection and construction. The influence and control of environmental factors affecting growth and flowering of floricultural crops. Larson

HS 442 Floriculture II. Preq: BS 100, SSC 200. 3(2-3) S. Cultural requirements and marketing procedures for floricultural crops. Acquaintance with these crops through classroom and laboratory experiences. Larson

HS 471 Arboriculture. Preq: BS 100, SSC 200. 3(2-3) S. Principles and practices for care and maintenance of ornamental trees and shrubs. Transplanting, fertilization, control of insects and diseases, bracing and cabling, and control of tree growth by chemical or pruning techniques. Staff

HS 491 Senior Seminar in Horticultural Science. Preq: Consent of department. 1(1-0) F. Presentation of scientific articles, progress reports in research, and special problems in horticulture and related fields. Department Head

HS 495 Special Topics in Horticultural Science. 1-6 F,S. Study in one or more of the following: an intensive literature review, experimental investigation with instructor guidance, or new course development on a trial basis. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

HS (CS) 514 Principles and Methods in Weed Science. Preq: CS 414 or equivalent. 3(2-2) S. Losses caused by weeds, the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques used in herbicide work and to field research techniques supplemented by laboratory and field exercises. Monaco

HS (FS) 521 Food Preservation. 3(2-3) F. (See food science, page 240.)

HS 531 Physiology of Landscape Plants. Preqs: BO 421 or CI. 3(2-3) F. Designed to cover relationships of plants to landscape environments. Study of plant function, basic climatology and plant physiological principles involved in the selection, utilization and maintenance of physical landscape environments in exterior and interior landscape plantings. Raulston

HS (CS, GN) 541 Plant Breeding Methods. 3(3-0) F. (See crop science, page 210.)

HS (CS, GN) 542 Plant Breeding Field Procedures. 2(0-4) Sum. (See crop science, page 210.)

HS 552 Growth of Horticultural Plants. Preq: BO 421. 3(2-3) F. Exercises in tissue culture principles and techniques as they relate to horticulture. Emphasis on endogenous controls of plant growth and the role of growth regulating compounds in horticultural research and production. Graduate Staff

HS (FS) 562 Post-Harvest Physiology. Preq: BO 421. 3(3-0) S. Chemical and physiological changes that occur during handling, transportation, and storage which affect

the quality of horticultural crops. Preharvest and postharvest conditions which influence these changes. Graduate Staff

HS 599 Research Principles. Preq: CI. 1-6 F,S. Investigation of a horticultural problem under faculty direction. Practice in experimental techniques and procedures, critical review of literature and scientific writing. The problem may last one or two semesters with credits determined by the nature of the problem. A written report and final oral exam are required. Graduate Staff

Industrial Arts

IA 111 Introduction to Industrial Arts. 1(1-0) F,S. A basic course designed to orient the student 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 113 Technical Drawing I. Credit will not be allowed for students who have credit in E 101. 3(1-4) F,S. This course covers theory and practice in the area of technical communication through the sketching and drafting media. The student will get practice in both sketching and instrument drawing in orthographic projection, pictorial drawing, sections, revolutions and sheet metal development. Troxler

IA 115 Wood Processing I. 3(1-4) F,S,Sum. An introductory course in the design and construction of wood products. The uses of basic hand tools, basic woodworking machines, fasteners and finishes, and the nature of wood as a construction material are included. Leeper

IA 122 Metal Technology I. 3(1-4) F,S,Sum. An introductory course in the basic design and construction of metal products. Sheet metals, bench metals, foundry, welding, turning, drilling, and cutting are included. Emphasis is upon the nature of the materials with respect to design and machining practices. Baker

IA 231 Industrial Arts Design. Preq: E 101 or IA 113; IA 115 and 112. 3(1-4) F,S. Principles of design, functional and aesthetic, as applicable to the creation of products in materials. Emphasis is on individual student experiences and expression. Troxler

IA 233 Metal Technology II. Preq: IA 122. 3(1-4) F,S. This course derives its content from the concepts of machining metals based on the five basic chip-removal metalworking arts of planing, turning, drilling, milling, and grinding. Baker

IA 246 Graphics Technology. Preq: High school technical drawing course. 3(1-4) F,S,Sum. An introductory course providing basic experiences in letterpress, offset printing, silk screen printing, photography, binding, and finishing. Leeper

IA 351 General Ceramics. 3(1-4) F,S,Sum. 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. Troxler

IA 359 Electrical Technology I. Preq: MA 111, PY 212 or 221. 3(1-4) F,S,Sum. A beginning course in electricity-electronics with special emphasis upon understanding the basic concepts of the phenomena of electricity-electronics, technical vocabulary and symbols; the use of formulas in reasoning and computation; securing, organizing, and treatment of data; and the methodology of logical problem solving are stressed. Young

IA 360 Electrical Technology II. Preq: IA 359. 3(2-2) F,S. Continuation of electricity-electronics with special emphasis upon the application of electrical principles in consumer and industrial products. Each student is required to design, develop, and construct at least one product as a part of the laboratory experience. Fault analysis will be stressed. Young

IA 364 Wood Processing II. Preq: IA 115. 3(1-4) F,S. Advanced study of woods technology with emphasis on machine processes, materials, and techniques of furniture production. Student work will be concerned with problem-solving activities in design, construction and furniture finishing. Leeper

IA 368 Technical Drawing II. Preq: E 101 or IA 113. 3(1-4) F,S. The second course in a

two-course sequence to provide the industrial arts education student with the additional content and skill necessary to teach drawing courses with confidence and flexibility at the middle school or senior high school level. Troxler

IA 476 Power Technology. Preq: MA 111, PY 221. 3(1-4) F,S. Power technology is concerned with the development of an understanding of the principles of the creation, transfer and utilization of power. Special emphases are given to both physical concepts and application. Included are: electrical generators and motors, electrical controls, internal combustion engines, hydraulic systems and pneumatic systems. General analysis of faults and their corrections is included. Staff

IA 480 Modern Industries. Preq: Junior standing. 3(3-0) S. 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 the consumer are considered. Attention is focused on contributions of technology to specific industrial processes in machining, forming and fabricating. Young

IA 490 Special Problems in Industrial Arts. Preq: Junior standing; CI. 6 max. F,S,Sum. This course enables the student to obtain additional competence in particular areas of industrial arts. The student is assigned an advisor who has special knowledge and skill in the area. The student is expected to define his special interest and to outline the procedures he will follow in meeting it. The advisor approves or asks for modification of the proposal, makes arrangements for laboratory time, and holds regular conferences with the student for purposes of counsel, demonstration and evaluation. Staff

IA 510 Design for Industrial Arts Teachers. Preq: Six hours drawing, IA 205 or equivalent. 3(2-2) Sum. New developments in design emphasizing the relationship of material and form in the selection and designing of industrial arts projects. Staff

revised eff 8/78

IA (ED) 560 New Developments in Industrial Arts Education. Preq: ~~12 hours ED, teaching experience.~~ 3(3-0) F,S. Assists teachers and administrators in developing new concepts and new content based on the changes in technology.They will be required to reevaluate their programs considering new concepts and content. Staff

IA 590 Laboratory Problems in Industrial Arts. Preq: Sr. standing, CI. Maximum 6. Based on individual problems and designed for advanced majors in industrial arts education. An opportunity to broaden or intensify knowledge and abilities through investigation and research in metals, plastics or ceramics. Staff

IA 592 Special Problems in Industrial Arts. Preq: One term of student teaching or equivalent. Maximum 6. Purpose is to broaden the subject matter experiences in industrial arts. Problems involving experimentation, investigation and research in one or more industrial arts areas will be required. Staff

IA (ED) 595 Industrial Arts Workshop. Preq: One or more years of teaching experience. 3(3-0) Sum. For experienced teachers, administrators and supervisors of industrial arts to develop sound principles and practices for initiating, conducting, and evaluating programs. Enrollees will pool their knowledge and practical experiences and will do intensive research work on individual and group programs. Staff

Industrial Engineering

1(0-2) revised eff 8/78

IE 200 Introduction to Industrial Engineering. ~~2(1-3)~~ F. Introduction to industrial and management engineering practice and concepts, including activity planning and control, human performance, resource allocation, operations improvement, and management systems. Illustrations of such functions in manufacturing, commercial, government or service organizations. Site visits, discussions and problems which relate to the design and operation of integrated systems of humans, machines, information and materials. Problem analysis, logic and application of the computer. Staff

IE 241 Furniture Manufacturing Processes I. Preq: E 240. 3(3-0) S. Survey of furniture manufacturing technology, emphasizing equipment and its relationship to furniture product engineering. Clark

IE 301 Engineering Economy. Preq: MA 111. This course not open to students scheduling IE 311. 3(3-0) F,S,Sum. Criteria and techniques for management and engineering decisions

in relation to economy of design, selection and operation. Effects of depreciation policies and machine replacement consideration. Problem solving and development of detailed project economy studies. Canada, Myers

IE 308 Control of Production and Service Systems. Prereq: ~~IE 321, ST 372; Coreq: IE 452.~~ 4(3-1) S. An intensive study of the strategy for planning and control of production and service system. Taught from a total systems viewpoint, drawing on student's prior experience in statistics, information processing, and cost accounting. Topics include production organization, flow and inventory accumulation. Quality control as well as quantity control is stressed. Emphasis on applications. Blair, Llewellyn

IE 311 Engineering Economic Analysis. Prereq: Soph. standing. 3(3-0) F,S. Engineering and managerial decision making. The theory of interest and its uses. Equivalent annual costs, present worths, internal rates of return, and benefit/cost ratios. Accounting depreciation and its tax effects. Economic lot size and similar cost minimization models. Sensitivity analysis. Cost dichotomies: fixed vs. variable, and incremental vs. sunk; use of accounting data. Replacement theory and economic life. Engineering examples. Bernard, Canada

IE ~~321~~ Business Data Processing. Prereq: ~~Course in computer programming~~ 3(3-0) F,S. Introduction to data processing principles and functions. Analysis and representation of data flow, logic, and procedures. Development of computer-based business applications; processing modes and controls; administrative methods and procedures. Llewellyn

IE 328 Manufacturing Processes. Prereq: MAT 201. 3(2-3) F,S. Manufacturing operations for mechanical component parts and assembled products emphasizing: 1) capabilities and limitations of the various processes; 2) the concept of manufacturability, i.e. the interaction between product design, material, process, machine, man, and cost. These points illustrated experimentally. Harder

IE 332 Motion and Time Study. Prereq: ST 361. 4(3-3) F,S. Principles and methodology of operation process charting; methods and analysis; motion and micromotion study; and man-machine relationships. Use of predetermined time data; time study procedures, including performance rating, determination of allowances based on workplace, and environmental factors; and applications of wage incentives. Blair

IE (PSY) 338 Human Factors in Equipment Design. Prereq: PSY 337 or IE 332. 3(2-2) F. Methodology including equipment design, biomechanics, and accident study. Man's sensory, motor, and decision-making abilities are related to problems of systems design, operator efficiency, and safety as these involve displays, controls, work-place layout, and environmental stressors. Pearson

IE 340 Furniture Manufacturing Processes II. Prereq: IE 241 and WPS 205. 4(2-6) F. Survey of technology, emphasizing sequence of operations, production rate and the integration of many types of equipment into a manufacturing system. Prak

IE 341 Furniture Plant Layout and Design. Prereq: IE 340. 3(1-6) S. Problems in furniture manufacturing plant design; building structures, equipment location, space utilization, layout for operation and control, allied topics in power utilization light, heat, ventilation and safety. Myers

IE 343 Plant Layout and Materials Handling. Prereq: IE 328, 332. 3(1-4) F,S. Location and design of a production facility, considering factors affecting production and impact on environment and community. A major design project based on an operational situation. Includes market analysis; plant location, manufacturing process layout, and economic analysis. Alvarez

IE 345 Principles of Upholstery. Prereq: IE 241. 2(2-0) F,S. An examination of product function, frame design principles, upholstery constructions, material properties, and manufacturing processes. A study of the unique problems of upholstery merchandising, order processing, labor utilization, inventory control and costing. Clark

IE 346 Furniture Design and Construction. Prereq: IE 340. 2(2-0) S. Selected topics. Emphasis is on panel construction, panel manufacturing and finishing methods and the application in knock down furniture construction (Offered in alt. years.) Prak

IE 351 Manufacturing Engineering. Prereq: MAT 201. 3(2-3) F. Operations employed in the manufacture of mechanical component parts and assembled products with emphasis on: 1) capabilities and limitations of the various processes in practice; 2) the concept of manufac-

turability, i.e. the interaction between product design, material, process, machine, man and cost; and 3) the theories associated with these processes. Laboratory periods illustrate and verify points. Harder

IE 352 Work Analysis and Design. Preq: Course in mathematical statistics. 3(1-4) S. Work methods and production processes to improve operator effectiveness and reduce production costs. Techniques studies include those successfully applied in industry such as operation analysis, notion study, value engineering, predetermined time systems, time study and line balancing. The engineering approach to man-machine relationships, methods improvement, standardizing work procedures, and accurate measurement of labor content. Data obtained provide the basis for managerial controls. Blair

IE 355 Introduction to Occupational Safety & Health. Preq: Soph. standing. 3(3-0) F,S. Provides a basic understanding of safety and health practices of contemporary concern to the plant manager, safety engineer, etc. Emphasizes the applications of human factors, biomechanics, work physiology, toxicology, statistics, and engineering in accident prevention and control. Specific instruments used in the measurements of safety and health problems. Ayoub

IE 361 Deterministic Models in Industrial Engineering. Preq: MA 202. 3(3-0) F. Introduction to mathematical modeling, analysis techniques, and solution procedures applicable to decision-making problems in a deterministic environment. Methodologies covered are classical optimization, linear, and dynamic programming. Applications relate to problems in inventory control, production planning and scheduling, project planning, resource allocation, transportation, and personnel assignment. Magazine, Nuttle

IE 371 Furniture Quality and Production Control. Preq: IE 321, 340; ST 361. 4(3-3) S. An introduction to statistical techniques applied to industrial problems. Control chart techniques, sampling plans, design of quality standards. Forecasting, inventory control, production planning and scheduling. Organization of quality control and production control. Examples from the furniture industry will be used throughout. Prak

IE 401 Stochastic Models in Industrial Engineering. Preq: An introductory course in probability and/or math statistics. 3(3-0) F,S. Introduction to mathematical modeling, analysis, and solution procedures applicable to decision-making problems in an uncertain (stochastic) environment. Methodologies covered include dynamic programming, simulation. Markov chains, and classical optimization. Applications relate to problems such as inventory control, waiting lines, and system reliability and maintainability. Stidham

IE 402 Quantitative Methods and Optimization. Preq: IE 361. 3(3-0) F. Treatment of decision-making problem structures and quantitative methods beyond those covered in IE 361. Topics covered include linear programming, non-linear programming, integer programming, implicit enumeration, game theory, flow networks, and activity networks, presented from a problem-solving orientation. Nuttle, Stidham

IE 403 Quantitative Methods Practicum. Preq: IE 361, 401. 3(1-2) S. Application of quantitative methods in industrial engineering to problems originating via case studies, site visits, and/or visits from practitioners. Emphasis on modeling or realistic decision-making problems with every attempt made to analyze and solve problems using quanititative techniques. When applicable, computer codes used as aid to solution. Communication of results of studies an integral part of the course. Stidham, Nuttle

IE 420 Manufacturing Controls. Preq: IE 301. 3(3-0) F,S. 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. Staff

IE 421 Information and Control Systems. Preq: Senior standing, course in computer programming. 3(1-4) F,S. Investigation, analysis and development of integrated information processing systems, including management requirements, economic justification, and implementation approaches. Emphasis is on team projects which require analysis of management functions and specification of computer-based procedure design. Llewellyn

IE 432 Methods Engineering. Preq: IE 352. 3(2-3) S. Intensive study of methods analysis and work-design procedures used in manufacturing and service industries. Micro-motion

IE 488 Production & Inventory Control 1(3-0) 5/12/78 eff 8/79
IE 489 Labor Relations for Engineers 1(3-0) 5/12/78 eff 1/79

study techniques and development of basic time data. Derivation of standard data and application to work load determination; use of the computer for setting time standards. Applications to assembly line balancing, machine tending assignments, and managerial controls of production operations studied through the use of real-world production problems in project work. Staff

IE 440 Furniture Management Analysis. Preq: IE 341. 3(1-4) F. Economic decision making applied to the furniture industry. The selection of equipment, materials, methods and strategy, from several feasible alternatives is studied with the aid of actual case histories. Prak

IE 443 Quality Control. Preq: ST 361. 3(2-2) F,S,Sum. Statistical methods in quality control; control charts for variables and attributes; inspection sampling plans and procedures. Industrial applications. Prak

IE 452 Ergonomics. Preq: Senior standing. 3(2-2) F. Introduction to man-machine-environment systems design and evaluation; applications to consumer products, tools, equipment, and the workplace. Overview of ergonomic research methodologies. Consideration of man's anatomical, physiological, and psychological capabilities and limitations as related to systems design and human performance. Use of anthropometric data in design. Display and control systems design. Effects of environmental stress upon work performance, safety, and health. Pearson, Ayoub

IE 453 Facilities Design. Preq: Sr. standing in IE. 3(1-4) F. Project of an industrial plant to be designed by small groups of students taking complete initiative and responsibility in procuring the information required by the realistic design for industrial enterprise. Charts of the facilities and a report justifying the design feasibility from the technical, economic, and environmental impact viewpoint produced by each group. Tompkins

IE 454 Modeling of Man-Machine Systems. Preq: IE 401. 3(2-1) S. Design, improvement, and installation of man-machine systems with emphasis upon the integration of operations research, engineering economy, and ergonomics for the analysis and assessment of systems performance. Analysis of systems typically found in industry; health care and safety fields; and government. Ayoub

IE 470 Furniture Manufacturing Organization. Preq: IE 371. 2(2-0) F. The course is a summary of how management of a furniture company organizes for the most efficient combination of people, materials, machines and financial resources. The emphasis is on organization, interrelations. Ekwall, Clark

IE 471 Furniture Manufacturing Organization Laboratory. Coreq: IE 470. 3(0-6) F. Senior "capstone" project requiring the design of a detailed organization structure and information systems for a furniture manufacturing situation. Ekwall, Clark

1-6 eff 8/79

IE 495 Project Work in Industrial Engineering. Preq: Sr. standing. 2-6 F,S. Special investigations and research related to furniture construction and processing, and other assigned problems. Staff

FOR GRADUATE AND ADVANCED UNDERGRADUATES

IE (OR, MA) 505 Mathematical Programming I. Preq: MA 405. 3(3-0) F,Sum. Mathematical methods applied to problems of planning, especially linear programming. Rigorous and complete development of the theoretical and computational aspects; discussion of applications. Staff

IE (OR) 509 Dynamic Programming. Preq: MA 405, ST 421. 3(3-0) S,Sum. Theory and computational aspects of dynamic programming and its application to sequential decision problems. Elmaghraby, Nuttle

IE 511 Advanced Engineering Project Analysis. Preq: IE 311, ST 421. 3(3-0) F. Analysis of project economy models with certainty assumed; advantages and limitations of models, effects of income tax and depreciation methods. Risk analyses employing probability concepts; sensitivity studies and measures of utility. Estimation techniques and use of accounting information, time series analysis and judgment factors. Planning and use of capital funds. Canada

IE 515 Advanced Manufacturing Processes. Preq: IE 351 and EE 331 or equivalent. 3(3-0) F. The course examines manufacturing processes which involve chemical, electrochemical,

IE 490 Special Topics in Industrial Engineering (1-3) 5/13/78 eff 1/79
IE 481 Engineering Economics 1(3-0) 5/12/78 eff 1/79
IE 482 Work Methods & Measurement 1(3-0) 5/12/78 eff 8/79
IE 485 Manufacturing Engineering 1(3-0) 5/12/78 eff 1/79
IE 487 Information Systems 1(3-0) 5/12/78 eff 8/79

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electrical thermo-electric and non-conventional mechanical, energy modes. Each process is investigated as to its underlying theory, state-of-the-art technology, interaction with the workpiece material, geometric capability and economics. Harder

IE 517 Computer-Aided Manufacturing. Preq: IE 351 or equivalent and computer programming. 3(3-0) S. This course is concerned with the integration of the elements of production processes into a Computer Aided Manufacturing system (CAM). Students will generate programs for parts production in the APT language, for plotter verification, and for 3-axis machining. The benefits of computer aided design and graphics in designing products for CAM are stressed. Industry case examples of machining, assembly and continuous process operations are studied. Harder

IE 521 Management Decision and Control Systems. Preq: IE 421, CSC 421 or equivalent. 3(3-0) S. The problems and techniques required for systematic control of the production process and the business enterprise. Determination of control factors; collection and recording of data; and processing, evaluation and use of data. Illustrations of the applications and use of data processing equipment. Case problems. Smith

IE (OR) 522 Organizational Systems Dynamics. Preq: ST 371, IE 421. 3(3-0) F. A study of the behavior of large organizations as simulated on a large digital computer and driven by suitable exogenous inputs. Basic theory of feedback control of systems; methods of modeling for continuous simulation, including aspects of management policy. Projects cover study, modeling and simulation of industrial, business, political, social organizations and systems; methods of changing system behavior by modifying parameters and model structure. Llewellyn

Production Planning, Scheduling and Inventory Control

Content Revised 8/1/78

IE 523 ~~Inventory Control Methods I.~~ Preq: ST 421, ST 515, OR 501. 3(3-0) S. Inventory policy with respect to reorder sized, minimum points and production schedules. Simple inventory models, models with restrictions, price breaks, price changes, analysis of slow-moving inventories. The smoothing problem in continuous manufacturing. Applications of linear and dynamic programming. Alvarez

IE 525 Organizational Planning and Control. Preq: Three credit hours in operations management (such as EB 325, IE 308). 3(3-0) S. Organization theory and systems approaches to administrative functions. Human and social influences on management systems for planning and control of activity. Policy, structure and procedure related to industrial engineering activities. Effects of automation. (To be taught alt. years.) Smith

IE (PSY) 540 Human Factors in Systems Design. Preq: IE (PSY) 338 or IE 452; Coreq: ST 507 or 515. 3(3-0) S. Problems of the systems development cycle, including man-machine function allocation, military specifications, display-control compatability, the personnel subsystem concept, and maintainability design. Man as an information processing mechanism. Pearson

IE 541 Systems Safety Engineering. Preq: IE 452, ST 371. 3(3-0) F,Sum. Problems in occupational safety and health; preventative aspects involving product and work design, and personnel selection. Consideration of the methods used in accident-injury study, including field investigation, experimental engineering and biomedical research, statistical studies, and fault tree analysis. Managerial aspects of safety accountability. (To be taught in alt. years.) Pearson, Ayoub

~~**IE 546 Advanced Quality Control.** Preq: ST 421. 3(3-0) S. The statistical foundations of quality control and its economic implications. Mathematical derivations. Sampling techniques are treated extensively with applications.~~ Staff

2/24/77 all 3/77

Reliability and Quality Assurance

~~**IE 547 Engineering Reliability.** Preq: ST 421. 3(3-0) S. Methodology including application of discrete and continuous distribution models and statistical designs; reliability estimation, structure models, demonstration and decisions, and growth models. Examples of reliability evaluation and demonstration program.~~ Staff

Content revised 1/78

IE (OR) 561 Queues and Stochastic Service Systems. Preq: MA 421. 3(3-0) F. General concepts of stochastic processes. Poisson processes, Markov processes, and Renewal theory are used in the analysis of queues with varied parameters. Applications to engineering problems. Stidham

IE (CSC, OR, MA) 562 Advanced Topics in Computer Simulation. 3(3-0) S. (See computer science, page 207.)

IE 601 Advanced Problems in Management Systems Engineering 1-4 3/31/77 eff 1/78

IE (OR, MA) 586 Network Flows. Prereq: IE (OR, MA) 505 or equivalent 3(3-0) S. Problems in the determination of the shortest chain, maximal flow, and minimal cost flow in networks. The relationship between network flows and linear programming; problems with nonlinear cost functions, multicommodity flows, and network synthesis. (Offered in alt. years.) Staff

IE 591 Project Work. Prereq: Grad. ~~standing~~ revised 12/8/77 eff 8/78. 1-6 F,S,Sum. Investigation and report on an assigned problem oriented to design and application issues. Staff

FOR GRADUATES ONLY

IE 542 Physiological Criteria in Work Measurement. 3(3-0) F.

IE 544 Occupational Biomechanics. 3(2-2) F.

IE (PSY) 593 Area Seminar in Ergonomics. 1(0-2) F.

IE 699 Industrial Engineering Research

International Student Orientation

ISO 100 International Student Orientation. 0(1-0) F,S. Recommended for all foreign students new to the United States. Aims to acquaint them with the Raleigh community, American culture, University academic procedures and U. S. Government regulations. Weaver

Landscape Architecture

(See Design.)

Liberal Arts

HSS eff 1/79 8/14/78

~~LA~~ 298 **Special Projects in Liberal Arts.** ~~1-3~~ 3(3-0) eff 8/78 6/27/78 F,S.

HSS eff 1/79 8/14/79

~~LA~~ (ALS) 490 **International Seminar.** 1(1-0) S. (See agriculture and life sciences, page 189.)

Marine Sciences

FOR ADVANCED UNDERGRADUATES

MAS (OY) 200 Introduction to the Marine Environment. Prereq: High school physics, chemistry, algebra, trigonometry and biology or equivalent. 3(3-0) F,S. The ocean as a part of our environment including interactions between atmosphere and ocean, ocean circulation, physical and chemical properties of sea water, marine geology and marine biology.

MAS (MAE) 471 Undersea Vehicle Design. 3(3-0) F,S. (See mechanical and aerospace engineering, page 275.)

MAS (CE, OY) ~~487~~ Physical Oceanography. ~~3(3-0) S. (See physical oceanography, page 293.)~~ 9/15/78

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MAS (ZO) 529 Biological Oceanography. 3(3-0) F. (See zoology, page 329.) eff 1/79

MAS (OY, CE) 541 Gravity Wave Theory I. Prereq: ~~ESM 303~~ MAE 208 9/14/78 or PY 411. 3(3-0) S. Emphasis on basic mechanics of wave motions, mass transport induced by waves and various conservation laws with their applications in wave study.

MAS (OY) 551 Ocean Circulation. Prereq: ~~ESM 303~~ MAE 208 9/14/78 eff 1/79 or PY 411. 3(3-0) S. The mechanics of ocean circulation with emphasis on various simple models of circulation systems.

MAS 561 Introduction to Physical Oceanography 3(3-0) 9-7-78 eff 8/78

MAS (CE) 581 Introduction to Oceanographic Engineering. 3(3-0) S. (See civil engineering, page 203.)

MAS (GY) 584 Marine Geology. 3(3-0) S. (See geology, page 251.)

MAS 591, 592 Marine Sciences Seminar. 1(1-0) F,S. Seminar gives perspective in the field of oceanology; topics vary. In order to obtain credit a student must deliver a seminar.

MAS(MAE,OY) 563 Geophysical Fluid Mechanics 3(3-0) 6/24/77

MAS(MAE,OY) 663 Advanced Geophysical Fluid Mechanics 3(3-0) 6/24/77

MAS(MAE,OY) 664 Perturbation Method in Fluid Mechanics 3(3-0) 6/24/77 II 267

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MAS(OY) 560 Principles of Physical Oceanography 3(3-0) 12/8/77 eff 8/77

MSE 565 the Physical Dynamics of Estuaries 3(3-0) 9/7/78 eff 8/78

Materials Engineering

MAT 200 Mechanical Properties of Structural Materials. Preq: CH 105 and the first course in ESM. 2(1-3) F,S. The dependence of mechanical properties of structural materials on macro-, micro- and crystalline structure; control of structure through treatment. Staff

MAT 201 Structure and Properties of Engineering Materials. Preq: CH 105. 3(2-3) F,S. The fundamental physical principles governing the structure and constitution of metallic and nonmetallic materials of construction, and the relation of these principles to the control of properties. Staff

MAT 301 Equilibrium and Rate Processes in Materials Science. Coreq: MAE 301. 3(2-2) F. Application of thermodynamic and kinetic principles to engineering materials in the liquid and solid states. Magor

MAT 302 Materials Processing. Preq: MAT 301. 3(3-0) S. Techniques for the processing of ceramic, metallic, and polymeric materials to control properties form, and appearance through considerations of thermal, chemical, mechanical, electrical, magnetic and nuclear energy. Both traditional and exotic processes are covered utilizing fundamental materials science and engineering science principles. Staff

MAT 310 Physical Examination of Materials. Preq: MAT 320 or 200 or 201. 2(0-6) S. Experiments designed to demonstrate basic techniques in crystallography, x-ray diffraction, optical and electron microscopy, and thermal analysis. Staff

MAT 311 Ceramic Processing I. Preq: MAT 201. 4(3-3) F. The basic chemical and physical laws underlying the processes and behavior of diverse ceramic compositions in the sequential manufacturing operations required to produce ceramic materials with controlled properties. Staff

MAT 312 Ceramic Processing II. Preq: MAT 311. 3(3-0) S. Basic principles underlying the thermal processing of ceramics. Appropriate subject materials in basic and engineering sciences with particular reference to obtaining desired microstructures. Staff

MAT 320 ~~Physical Principles in Materials Science~~ I. Preq: ~~PY 208~~. 3(3-0) F. Introduction to the fundamental physical concepts of ceramic, metallic, and polymeric materials. Relation between properties and structure. Staff

MAT 321 ~~Physical Principles in Materials Science~~ II. Preq: MAT 320. 3(2-2) S. Introduction to the fundamental physical concepts of ceramic, metallic, and polymeric materials. Relation between properties and structure. Staff

MAT 322 Phase Diagrams in Materials Engineering. Preq: ~~MAT 320~~. 2(2-0) S. Applications of thermodynamic principles to the construction and use of phase equilibrium diagrams in materials engineering systems. Emphasis is placed on the correlation of phase diagrams with microstructures. Staff

MAT 400 Metallic Materials in Engineering Design. Preq: MAT 200 or 201. 3(3-0) F,S. Relationship of microstructure to the properties of materials. Control of microstructure to meet engineering design requirements. Moazed

MAT 417 Ceramic Subsystem Design. Preq: MAT 312. 3(2-3) S. Individual and team study involving the interdependence of plant layout, processes, equipment and materials in the economic design of engineering systems and subsystems. The interdependence of plant layout, processes, equipment and materials in the economic design of engineering systems and subsystems. Discussion of design principles, sources of data, creativity and economic analysis to encourage original solutions to engineering problems. Harrell

MAT 423 Materials Factors in Design I. Preq: MAT 450. 3(1-6) S. Selection of materials for specific engineering applications. Manufacturing processes and their relation to product use. Austin

MAT 424 Materials Factors in Design II. Preq: MAT 423. 3(3-0) F or S. Selection of materials for specific engineering applications. Manufacturing processes and their relation to product use. Austin

MAT 431 Physical Metallurgy I. Preq: MAT 321. 3(2-3) F. Alloy design; control of properties through microstructures; principles of heat treatment, strengthening mechanisms. Staff

MAT 432 Physical Metallurgy II. Preq: MAT 431. 3(3-0) F,S. Alloy design; control of properties through microstructures; principles of heat treatment; strengthening mechanisms. Staff

MAT 435 Physical Ceramics I. Preq: MAT 321. 3(2-3) F. The physicochemical nature of classical and newly discovered ceramic materials. The course emphasizes the thermodynamics, crystal structure, structural imperfections and non-stoichiometry of ceramic compounds coupled with binary and multiphase equilibria. Effects of these parameters on properties. Davis

MAT 436 Physical Ceramics II. Preq: MAT 435. 3(2-3) S. The physicochemical nature of classical and newly discovered ceramic materials. The first course emphasizes the thermodynamics, crystal structure, structural imperfections and non-stoichiometry of ceramic compounds coupled with phase equilibria. The second course is a detailed study of the thermal, mechanical, electrical and electronic properties of ceramic materials. Davis

MAT 437 Introduction to the Vitreous State. Preq: MAT 301. 3(3-0) S. The formation, structure, physical and chemical modifications of vitreous systems. Practical industrial calculations and the fabrication of glass. Catalyzed nucleation and crystallization of glasses in relation to physical poroperties. Davis

MAT 450 Mechanical Properties of Materials. Preq: ESM 207, MAT 200 or 201 or 310. 3(2-3) F. Elastic, plastic, and fracture phenomena in solids including yielding, strain hardening, brittle fracture, creep and fatigue. Staff

MAT 491 Materials Engineering Seminar. Preq: Sr. standing. 1(1-0) F,S. Literature survey of selected MAT topics. Oral and written reports and discussions. Staff

MAT 493, 494 Ceramic Field Exercises I, II. Preq: Sr. standing. 1(0-3) F,S. Plant visitations, lectures by practicing ceramic engineers, reports on industrial organizations engaged in manufacture or use of ceramics. Discussions of professional organizations and ethics. Harrell

MAT 495 Materials Engineering Projects. Preq: Jr. or sr. standing. 1-6 F,S. Advanced engineering principles applied to a specific project dealing with metallurgy, materials or general experimental work. A seminar period is provided and a written report required. Staff

FOR GRADUATES AND ADVANCED UNGRADUATES

MAT 500 Modern Concepts in Materials Science. Preq: MAT 321. 3(3-0) F. Applications of current theories such as crystal theory, continuum and quasi-continuum theories, phenomenological theories, etc., to the solution of materials problems. Staff

MAT 503 Ceramic Microscopy. Preq: GY 331. 3(2-3) F. Transmitted and reflected light techniques for the systematic study of ceramic materials and products. Staff

MAT 509 High Vacuum Technology. Preq: CH 433 or MAE 301. 3(2-3) F,S. Properties of low-pressure gases and vapors. Production, maintenance and measurement of high vacuum; design, construction and operation of high vacuum high temperature facilities. Properties and reactions of materials which are processed, tested and/or utilized in high vacuum environments. Staff

MAT 510 Structure of Crystalline Materials. Preq: MAT 411; Coreq: MAT 500. 3(3-0) F. The lattice structure of crystals, including group theory applications, reciprocal lattice concept and crystal structure as related to bonding. Staff

MAT 520 Theory and Structure of Materials. Preq: MAT 510. 3(3-0) S. Structure of liquids and crystalline and amorphous solids used in engineering systems. Crystallinity and thermal properties. Ionic crystals in ceramic systems. The metallic state and alloy behavior. Emphasis on the relation between fundamental materials parameters and engineering properties. Staff

MAT 527 Refractories in Service. Preq: MAT 411. 3(3-0) S. The physical and chemical properties of the more important refractories in their environment in industrial and laboratory furnaces. Harrell

MAT 529 Properties of High Temperature Materials. Preq: MAT 201 and MAE 301. 3(3-0) S. Effects of temperature on the physical, mechanical and chemical properties of inorganic materials; relationships between microstructure and high temperature properties; applications of ceramics, metals and composites at elevated temperatures. Staff

MAT 530 Phase Transformations in Materials I. Preq: MAT 500. 3(3-0) S. Kinetic theory of transformations, nucleation theory, homogenous and heterogenous nucleation, growth of crystals, epitaxial thin films. Moazed

MAT (MAE) 531 Materials Processing by Deformation 3(3-0) F. (See mechanical and aerospace engineering, page 275.) Bailey

MAT (MAE) 532 Fundamentals of Metal Machining Theory. 3(3-0) S. (See mechanical and aerospace engineering, page 275.) Bailey

MAT 533, 534 Advanced Ceramic Engineering Design I, II. Preq: MAT 417. 3(2-3) F,S. Analysis and design of ceramic products, processes and systems leading to original solutions of current industrial problems and the development of new concepts of manufacturing. Palmour

MAT 540 Glass Technology. Preq: MAT 437. 3(3-0) F. Fundamentals of glass manufacture including compositions, properties and application of the principal types of commercial glasses. Davis

MAT 541, 542 Principles of Corrosion I, II. Preq: MAT 201 or CH 431 or MAE 301. 3(2-3) F,S. Fundamentals of metallic corrosion and passivity. The electrochemical nature of corrosive attack, basic forms of corrosion, corrosion rate factors, methods of corrosion protection. Laboratory work. Staff

MAT 550 Dislocation Theory. Preq: MAT 450. 3(3-0) F. Structure, energetics, stress and strain fields, interactions and motion of dislocations in solids. Staff

MAT 556 Composite Materials. Preq: MAT 450. 3(3-0) F. Basic principles underlying composite materials properties as related to individual constituents properties and their interactions. Emphasis on the design of composite systems to yield desired combinations of properties. Fahmy

MAT (NE) 562 Materials Problems in Nuclear Engineering. Preq: Advanced undergraduate standing. 3(3-0) F. Reactor design and operating considerations determined by materials properties. The interrelations among materials compatibility effects, corrosion effects and radiation effects in fission and fusion reactors. Staff

MAT (NE) 573 Computer Experiments in Materials and Nuclear Engineering. Preq: Advanced undergraduate standing. 3(3-0) F. How to design and use Monte Carlo and dynamical computer experiments. Beeler

MAT 595 Advanced Materials Experiments. Preq: Sr. or grad. standing. 1-3. Advanced engineering principles applied to a specific experimental project dealing with materials. A seminar period provided. Written report required. Staff

Mathematics

MA 102 Analytic Geometry and Calculus I. Preq: MA 111 or equivalent completed in high school. Credit in both MA 102 and MA 112 is not allowed. 4(3-2) F,S,Sum. First of three semesters of unified analytic geometry and calculus course. Functions and graphs, limits, derivatives of algebraic functions and applications, indefinite integral, definite integral and the fundamental theorem of calculus, areas and volumes, plane analytic geometry.

MA 111 Algebra and Trigonometry. 4(3-2) F,S, Sum. Sets and logic, the real number system, polynominals, algebraic fractions, exponents and radicals, linear and quadratic equations, inequalities, functions and relations, logarithms, plane trigonometry. (Students in Engineering, Physical and Mathematical Sciences, Design, Agricultural Engineering and Mathematics Education who are required to take this course will not receive credit hours for MA 111 toward graduation requirements).

MA 112 Analytic Geometry and Calculus A. Preq: MA 111 or equiv. completed in high school. Credit in both MA 102 and MA 112 is not allowed. 4(4-0) F,S, Sum. Limits and derivatives, techniques of differentiation, applications, logarithmic and exponential functions, higher derivatives, definite integral, applications, integration techniques, multivariate calculus, partial derivatives, multiple integrals, examples and applications in biological and behavioral sciences.

MA 114 Introduction to Finite Mathematics with Applications. Preq: MA 111 or equivalent completed in high school. 3(3-0) F,S, Sum. Introduction to symbolic logic; ele-

MA 113 Introduction to Calculus 4(4-0) 2/4/77 eff. 8/77
270
MA 100 Precalculus Trigonometry 2(2-0) 5/30/78 eff 8/78

mentary probability — probability measures, conditional probability, expected value; elementary matrix algebra; addition and multiplication, inverses, systems of linear equations. Markov chains; introduction to linear programming; applications in the behavioral, managerial, and biological sciences.

MA 115 Introduction to Contemporary Mathematics. Credit in MA 115 is not allowed if student has credit for MA 102, 111, 112 or 114. Credit toward graduation is not given for MA 115 in most curricula. 3(3-0) F,S, Sum. Basic skills are emphasized — addition, subtraction, multiplication, and division of fractions; rules of exponents; solving linear and quadratic equations; graphs; logarithms; "word" problems; right triangle trigonometry. Interwoven in the above topics is material of a less formal nature, indicating some of the recreational and useful aspects of mathematics.

MA 116 Topics in Contemporary Mathematics. Preq: MA 115 or equiv. completed in high school. Credit in MA 116 is not allowed if student has credit for MA 102, 111, 112 or 114. 3(3-0) F,S,Sum. Primarily for Liberal Arts students. Instructors prepare a list of topics, or modules, from which each student chooses four to study for the semester. Examples of modules which are and/or have been offered include: the 4th Dimension, Numbers and Sets, Mathematics in Biology, Puzzles and Graphs, Cryptography, Mathematical Games, Mathematics in Finance, Mathematics in Music, Probability, Statistics, and Computing Machines.

MA 122 Mathematics of Finance. Preq: MA 111 or equivalent, or 115. 3(3-0) F,S,Sum. Simple and compound interest, annuities and their application to amortization and sinking fund problems, installment buying, calculation of premiums of life annuities and life insurance.

MA 127 Recreational Mathematics. Preq: MA 111 or 115 or equiv. completed in high school. 3(3-0) S. Requires only algebra and trigonometry, but student engages in new type of mathematical thought. Games and puzzles, tricks, geometric figures, model building, fallacies, paradoxes, curiosities, anecdotes, conjectures, famous problems, mathematical humor and more. Mathematical treatments involve number theory, set theory, algebra, topology, combinatorics, geometry, probability, analysis, computer science, math history.

MA 201 Analytic Geometry and Calculus II. Preq: MA 102. 4(4-0) F,S,Sum. Second of three semesters of unified analytic geometry and calculus course. Applications of definite integral. Transcendental functions, methods of integration, polar coordinates, parametric equations, introduction to infinite series.

MA 202 Analytic Geometry and Calculus III. Preq: MA 201. 4(4-0) F,S,Sum. Third of three semesters of unified analytic geometry and calculus course. Brief introduction to determinants and matrices, vector functions, analytic geometry of three dimensions and partial differentiation, multiple integration, applications. Line integral and Green's Theorem.

MA 212 Analytic Geometry and Calculus B. Preq: MA 112. 3(3-0) F,S,Sum. Sequences, series, Taylor's Theorem, trigonometric functions, difference equations, differential equations, examples and applications in biological and behavioral sciences.

MA 214 Elementary Probability. Preq: MA 112 or 102. 3(3-0) F,S,Sum,. Basic concepts, elementary counting procedures, conditional probability, discrete random variables, infinite sample spaces, continuous random variables, continuous time stochastic processes, examples and applications in biological and behavioral sciences.

MA 301 Applied Differential Equations I. Preq: MA 202 or equivalent. 3(3-0) F,S,Sum. First order equations, applications, linear equations of higher order, applications to mechanical and electrical systems, series solutions, special functions, Laplace transforms.

MA 312 Introduction to Differential Equations. Preq: MA 201 (202 desirable). 3(3-0) F,S. First order differential equations, basic theory and applications of linear equations. Systems of linear equations, matrix methods, series solutions, Laplace transforms, existence and uniqueness.

FOR ADVANCED UNDERGRADUATES

MA 401 Applied Differential Equations II. Preq: MA 301 or 312 . 3(3-0) F,S,Sum. The wave, heat and Laplace equations. Solutions by separation of variables and expansion in Fourier Series or other appropriate orthogonal sets.

MA 206

MA 403 Introduction to Modern Algebra. Preq: One year of calculus. 3(3-0) F,S,Sum. Sets and mappings; equivalence relations; groups, homomorphisms, cosets, Cayley's Theorem, symmetric groups, quotient groups, rings, integral domains; Euclidean algorithms, polynominal rings, ideals, quotient rings.

MA 404 Affine and Projective Geometry. Preq: MA 403 and 405. 3(3-0) S. Introduction to geometry of Euclidean, affine and projective spaces with emphasis on important groups of symmetrics of these spaces.

MA 405 Introduction to Linear Algebra and Matrices. Preq: One year of calculus. 3(3-0) F,S,Sum. Linear equations, linear dependence and vector spaces, inner products, linear transformations and matrices, operations with matrices, determinants, eigenvalues and reduction of matrices to diagonal forms, introduction to quadratic forms, applications. (A special section, MA 405M, is given for mathematics majors.)

MA 408 Foundations of Euclidean Geometry. Preq: MA 403. 3(3-0) F. A critique of Euclid's Elements, incidence and order properties, congruence of triangles, absolute and non-Euclidean geometry, the parallel postulate, real numbers and geometry.

MA 410 Theory of Numbers. Preq: One year of calculus. 3(3-0) S. Concerned with investigation of arithmetic properties of the integers. Congruences, arithmetic functions, quadratic residues, the quadratic reciprocity Law of Gauss, primitive roots, diophantine equations, and algebraic number fields.

MA 412 Introduction to Combinatorics 3(3-0) off 8/77

MA 421 Introduction to Probability. Preq: One year of calculus. 3(3-0) F,S,Sum. Axioms of probability, conditional probability, combinational analysis, random variables, expectation, simple stochastic processes.

MA 425 Mathematical Analysis I. MA 202 (403 desirable). 3(3-0) F. Real number system, functions and limits, topology on the real line, continuity, differential and integral calculus for functions of one variable. Infinite series.

MA 426 Mathematical Analysis II. Preq: MA 425 and 405. 3(3-0) S. Uniform convergence, calculus of several variables, topology in n-dimensions, limits, continuity, differentiability, implicit functions, multiple integrals, line and surface integrals.

MA (CSC) 427 Introduction to Numerical Analysis I. Preq: MA 301 or 312 and programming language proficiency. 3(3-0) F. Designed for undergraduate students in any department who wish knowledge of theory and practice of computational procedure using a digital computer. Approximation of functions by interpolating polynomials. Numerical differentiation and integration. Solution of systems of ordinary differential equations both initial value and boundary value problems. Computer applications and techniques stressed.

MA (CSC) 428 Introduction to Numerical Analysis II. Preq: MA 405 and programming language proficiency. 3(3-0) S. Designed for students who wish knowledge of computational procedures using digital computers. Solution of linear and nonlinear equations. Matrices and eigenvalue calculations. Orthogonal polynomials and Gaussian quadrature. Curve fitting and function approximation by least squares. Smoothing formulas. Minimax approximations. CSC (MA) 427 is not a prerequisite for this course.

MA 430 Introduction to Applied Mathematics. Coreq: MA 301 or 312 and 405. 3(3-0) S. Formulation of scientific problems in mathematics terms, interpolation and evaluation of the solution. Topics discussed chosen from problems in managerial, behavior and life sciences as well as physical sciences.

MA 432 Mathematical models in Life Sciences and Social Sciences 3(3-0) off 8/77

MA 433 History of Mathematics. Preq: One year of calculus. 3(3-0) F,S,Sum. Development of mathematical thought and evolution of mathematical ideas examined in a historical setting. Biographical and historical content supplemented and reinforced by study of techniques and procedures used in earlier eras.

MA 491 Reading in Honors Mathematics. Preq: Membership in honors program, consent of department. 2-6 F,S.

MA 493 Special Topics in Mathematics. Preq: Consent of department. 1-6 F,S.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MA 501 Advanced Mathematics for Engineers and Scientists I. Preq: MA 301 or equiv. 3(3-0) F,Sum. Survey of mathematical methods for engineers and scientists. Ordinary differential equations and Green's functions; partial differential equations and separation of

variables; special functions, Fourier series. Applications to engineering and science are stressed. This course cannot be taken for credit by mathematics majors.

MA 502 Advanced Mathematics for Engineers and Scientists II. Preq: MA 301 or equivalent. 3(3-0) S,Sum. Determinants and matrices; line and surface integrals, integral theorems; complex integrals and residues; distribution functions of probability. This course cannot be taken for credit by mathematics majors.

MA (IE, OR) 505 Mathematical Programming I. (See industrial engineering, page .) 3(3-0) F,Sum.

MA 511 Advanced Calculus I. Preq: MA 301 or 312. 3(3-0) F,S,Sum. Fundamental theorems on continuous functions, convergence theory of sequences, series and integrals; the Riemann integral.

MA 512 Advanced Calculus II. Preq: MA 301 or 312 (3-0) F,S,Sum. General theorems of partial differentiation; implicit function theorems; vector calculus in 3-space; line and surface integrals; classical integral theorems.

MA 513 Introduction to Complex Variables. Preq: MA 511 or 425. 3(3-0) F,S,Sum. Operations with complex numbers, derivatives, analytic functions, integrals, definitions and properties of elementary functions, multivalued functions, power series, residue theory and applications, conformal mapping.

MA 514 Methods of Applied Mathematics. Preq: MA 511 or 425. 3(3-0) S. Introduction to integral equations, the calculus of variations and difference equations.

MA 515 Linear Functional Analysis I. Preq: MA 426. 3(3-0) F. Metric spaces; Lebesgue measure and integration; L^p and l^p spaces; Reisz-Fischer and Reisz representation theorems; normed linear spaces and Hilbert spaces.

MA 516 Linear Functional Analysis II. Preq: MA 515. 3(3-0) S. Basic theorems in Banach spaces, dual spaces, weak topologies; basic theorems in Hilbert spaces, and detailed theory of linear operators on Hilbert spaces; spectral theorem for self-adjoint completely continuous linear operators.

MA 517 Introduction to Topology. Preq: MA 426. 3(3-0) F,S. Sets and functions, metric spaces, topological spaces, compactness, separation, connectedness.

MA 518 Calculus on Manifolds. Preq: MA 426. 3(3-0) S. Calculus of several variables from a modern viewpoint. Differential and integral calculus of several variables, vector functions, integration on manifolds, Stoke's and Green's Theorems, vector analysis.

MA 520 Linear Algebra. Preq: MA 405. 3(3-0) F,S. Vector spaces, linear mappings and matrices, determinants, inner product spaces, bilinear and quadratic forms, canonical forms, spectral theorem.

MA 521 Fundamentals of Modern Algebra. Preq: MA 403 and 520. 3(3-0) S. Groups, normal subgroups, quotient groups, Cayley's Theorem, Sylow's Theorem. Rings, ideals and quotient rings, polynomial rings. Fields, extension fields, elements of Galois theory.

MA 523 Topics in Applied Mathematics. Coreq: MA 515, 520. 3(3-0) F. Formulation of scientific problems in mathematical terms, interpretation and evaluation of the mathematical analysis of the resulting models. Problems in behavioral and biological sciences and in mechanics of discrete and continuous systems. Discussions of optimization and the calculus of variations.

MA 524 Mathematical Methods in the Physical Sciences I. Preq: MA 405, 512. 3(3-0) F. Green's functions and two point boundary value problems; elementary theory of distributions; generalized Green's functions. Finite and infinite dimensional inner product spaces; Hilbert spaces; completely continous operators; integral equations; the Fredholm alternative; eigenfunction expansions; applications to potential theory. Nonsingular and singular Sturm-Liouville problems; Weil's Theorem.

MA 525 Mathematical Methods in the Physical Sciences II. Preq: MA 524. 3(3-0) S. Distribution theory in n-spaces; Fourier transforms; partial differential equations, generalized solutions, fundamental solutions. Cauchy problems, wave and heat equations, well-set problems. Laplace's equations, the Dirichlet and Neumann problems, integral equations of potential theory, Green's functions, eigenfunction expansions.

MA (CSC) 529 Numerical Analysis I. Preq: MA 511 or equivalent, MA 405. 3(3-0) F. For graduate and advanced undergraduate students who wish to learn the theory of numerical analysis of sytems of linear equations, solutions to nonlinear equations, interpolation theory, and divided differences. Understanding theory behind the various techniques and their error estimates. Illustrations of use and limitations of these methods on the computer.

MA (CSC) 530 Numerical Analysis II. Preq: MA (CSC) 529. 3(3-0) S. Continuation of CSC (MA) 529. Numerical integration, numerical solutions of ordinary differential equations, and numerical solutions of partial differential equations.

MA 532 Theory of Ordinary Differential Equations. Preq: MA 301 or 312, MA 405, advanced calculus. 3(3-0) S. Existence and uniqueness theorems, systems of linear equations, fundamental matrices, matrix exponential, series solutions, regular singular points; plane autonomous systems, stability theory.

MA 534 Introduction to Partial Differential Equations. Preq: MA 425 or MA 511, MA 301 or MA 312. 3(3-0) F. Theory of characteristics and classification of second order equations, existence, uniqueness and representation of solutions for the wave equation, Dirichlet and Neumann boundary-value problems for the Laplace equation, potential theory in two and higher dimensional domains, mean-value theorem and the maximum principle, Green's identities, initial boundary-value problems of heat equation and wave equation. Maximum principle of parabolic equation, method of eigenfunction expansions, Fourier series and Fourier transforms.

MA (CSC) 536 Theory of Sequential Machines. Preq: CSC 412 or grad. standing. 3(3-0) F. Sequential machine identification experiments. Finite-Memory machines. Special classes of machines. Decomposition of sequential machines. Linear sequential machines. Sequential relations of finite-state machines.

MA (CSC) 537 Theory of Computability. Preq: CSC 412 or grad. standing. 3(3-0) S. Turing Machines. Primitive recursion functions. The u-operator, u-recursive functions. Godel numbering. Equivalence of Turing Machines and u-recursion. Undecidable predicates. Universal Turing Machines. Other formulations of effective computability.

MA (ST) 541 Theory of Probability I. Preq: MA 425 or 511. 3(3-0) F,Sum. Axioms, combinatorial analysis, conditional probability, independence random variables, expectation, special discrete and continuous distributions, probability and moment generating functions, central limit theorem, laws of large numbers, branching processes, recurrent events, random walk.

MA (ST) 542 Introduction to Stochastic Processes. Preq: MA 405, 541. 3(3-0) S. (See statistics, page 000.) Markov chains and Markov processes, Poisson process, birth and death processes, queuing theory, renewal theory, stationary processes, Brownian motion.

MAT 545 Set Theory and Foundations of Mathematics. Preq: MA 403. 3(3-0) S. Logic and the axiomatic approach, the Zermelo-Fraenkel axioms and other systems, algebra of sets and order relations, equivalence of the Axiom of Choice, one-to-one correspondences, cardinal and ordinal numbers, the Continuum Hypothesis.

MA (PY) 555 Mathematical Introduction to Celestial Mechanics. Preq: One year of advanced calculus 3(3-0) F. Central orbits, N-body problems, 3-body problems, Hamilton-Jacobi theory, perturbation theory, applications to motion of celestial bodies.

MA (PY) 556 Orbital Mechanics. Preq: MA 301, 405, or knowledge of elementary mechanics and computer programming. 3(3-0) S. Keplerion motion, iterative solutions, numerical integration, differential corrections and space navigation, elements of probability, least squares, sequential estimation, Kalman fields.

MA (BMA, ST) 571 Biomathematics I. 3(3-0) F. (See biomathematics, page 195.)

MA (BMA, ST) 572 Biomathematics II. 3(3-0) S. (See biomathematics, page 195.)

MA 581 Special Topics. Preq: Consent of department. 1-6 F,S.

MA (CSC) 582 Special Topics in Numerical Solution of Linear Algebraic Equations. Preq: MA 405 or equivalent and a knowledge of computer programming. 3(3-0) S. A mathematical and numerical investigation of direct iterative and semi-iterative methods. Methods for the calculation of eigenvalues and eigenvectors of matrices.

MA (CSC) 583 Special Topics in the Numerical Solution of Ordinary Differential Equations. Preq: Knowledge to the level of CSC 427. 3(3-0) S. Numerical methods for initial value problems including predictor-corrector, Runge-Kutta, hybrid and extrapolation methods; stiff systems; shooting methods for two point boundary value problems; weak, absolute and relative stability results.

MA (CSC) 584 Special Topics in the Numerical Solution of Partial Differential Equations. Preq: Knowledge to the level of CSC 427-428. 3(3-0) F. Numerical methods for the solutions of parabolic, elliptic, and hyperbolic partial differential equations including stability and convergence results.

MA (OR, CSC) 585 Graph Theory. Preq: MA 405. 3(3-0) F. (See operations research, page 287.)

MA (OR, IE) 586 Network Flows. Preq: MA (OR,IE) 505 or equiv. S. (See operations research, page 287.)

FOR GRADUATES ONLY

MA 507 Analysis for Secondary Teachers. 3(3-0).

MA 508 Geometry for Secondary Teachers. 3(3-0).

MA 509 Abstract Algebra for Secondary Teachers. 3(3-0).

MA 510 Selected Topics in Mathematics for Secondary Teachers. 3(3-0).

Mechanical and Aerospace Engineering

MAE 200 Mechanical Technology in Contemporary Society. 3(3-0). F,S. The role of mechanical and aerospace engineering in our present technological society with approaches used by engineers in solving problems. Topics include: power generation, modern flight, and transportation vehicles.

MAE 205 Energy: Sources, Uses and Conservation. Preq: Soph. standing. Cannot be taken as a technical elective by students in School of Engineering. 3(3-0) F,S. Broad coverage of the field for concerned and energy conscious students. Sources both current and prospective, and the uses, limitations, and conservation of energy are considered from an individual as well as an institutional point of view. (Technical background not required).

Title 206 Engineering Statics eff 1/1/79 6/21/78

MAE 216 Elements of Mechanical Engineering. Preq: ESM 205, PY 208 or 202. 3(3-0) S. An introduction to mechanical engineering emphasizing the application and extension of chemistry, physics and mathematics to real engineering problems in analysis and design.

MAE 261 Aerospace Vehicle Performance. Preq: MA 201, PY 205. 3(3-0) S. Introduction to the problem of performance analysis in aerospace engineering. Aircraft performance in gliding, climbing, level and turning flight. Calculation of vehicle range and endurance. Simple orbital mechanics.

MAE 301 Engineering Thermodynamics I. Preq: MA 202, PY 208 or 202. 3(3-0) F,S, Sum. Introduction to the concept of energy and the laws governing the transfers and transformations of energy. Emphasis is placed on thermodynamic properties and the first and second law analysis of systems and control volumes. Integration of these concepts into the analysis of basic power and refrigeration cycles is also studied.

MAE 302 Engineering Thermodynamics II. Preq: MAE 301. 3(3-0) S. Emphasis on the application of basic principles to engineering problems with systems involving mixtures of ideal gases, psychrometrics, nonideal gases, chemical reactions, combustion, chemical equilibrium, cycle analysis and one-dimensional compressible flow.

MAE 303 Engineering Thermodynamics III. Preq: MAE 301. 3(3-0) S. For nonmechanical engineering jrs. Thermodynamics of mixtures; thermodynamics of fluid flow, heat transfer, vapor and gas cycles, and applications.

MAE 305 Mechanical Engineering Laboratory I. Coreq: MAE 301. 1(0-3) F,Sum. Introduction to the theory and practice of measurement and experimental data collection. The components of the generalized measurement system are studied and their effects on the final result evaluated. Basic methods of data analysis as well as basic instrumentation for sensing, conditioning and displaying experimental quantities are covered.

MAE 250 Introduction to the Airplane and Its Operation 3(3-0) 4/29/77 eff
MAE 208 Engineering Dynamics 3(3-0) eff 1/1/79 6/21/78
MAE 309 Fluid Mechanics I 3(3-0) eff 1/1/79 6/21/78
MAE 309 Fluid Mechanics II 3(3-0) eff 1/1/79 6/21/78
MAE 314 Solid Mechanics 3(3-0) eff 1/1/79 6/21/78

MAE 306 Mechanical Engineering Laboratory II. Preq: MAE 305, EE 331. 1(0-3) S,Sum. Specific types of measurements. Students evaluate and compare different instrumentation for measuring the same physical quantity on the basis of cost, time required, accuracy, etc.

MAE 307 Energy and Energy Transformations. Preq: MA 201, PY 212. 3(3-0) F. Energy transformation as permitted by the First Law and limited by the Second Law. Properties of ideal gases and actual gases; properties of vapors. Vapor power cycles; vapor refrigerating cycles, gas cycles for internal combustion engines and gas turbines. Elements of heat transfer.

MAE 315 Dynamics of Machines. Preq: MAE 216, ESM 305. 3(3-0) S. A rational application of dynamics to the analysis of machines and mechanical devices to determine the motions resulting from applied loads and the forces and inputs required to produce specified motions.

MAE 316 Strength of Mechanical Components. Preq: ESM 205; Coreq: MAT 201. 3(3-0) F. Stress, strain and deformation analysis of mechanical components and their strength determination based on material behavior under static and dynamic operating conditions. Applications to basic machine components.

MAE 355 Aerodynamics I. Preq: MAE 261, MA 301. 4(3-3) F. Introductory concepts of perfect fluid theory and incompressible boundary layers with application to computing the aerodynamic characteristics of airfoils, wings and flight vehicle configurations.

MAE 356 Aerodynamics II. Preq: MAE 355, 301. 4(3-3) S. Concepts of thermodynamics, compressible fluid flow and compressible boundary layers with application to computing the aerodynamic characteristics of airfoils, wings and flight vehicles configurations at high speed.

MAE 365 Propulsion I. Preq: MAE 355, MAE 301. 3(3-0) S. One dimensional internal flow of compressible fluids, combustion and thermochemistry problems. Applications to air-breathing aircraft propulsion system.

MAE 371 Aerospace Vehicle Structures I. Preq: MAE 261, ESM 205. 3(3-0) F. Theory and concepts required for the analysis and design of flight vehicle structural members. Properties and selection of materials; methods of analysis for axial, torsional, flexural and transverse shear loadings of typical flight structure members.

FOR ADVANCED UNDERGRADUATES

MAE 401 Energy Conversion. Preq: MAE 302. 3(3-0) F,S. Principles of thermodynamics, fluid mechanics, heat transfer and combustion applied to power generation. Principles feasibility, and limitations of conventional and direct energy conversion methods are studied. The economics of energy conversion. Present and possible future energy sources.

MAE 402 Heat and Mass Transfer. Preq: MAE 302, MA 301. 3(3-0) F,S. The fundamental relationships of steady and transient heat transfer by conduction, convection, radiation and during changes of phase: mass transfer by diffusion and convection, simultaneous mass and heat transfer.

MAE 403 Air Conditioning. Preq: MAE 302. 3(3-0) F. Study of the fundamentals involved in the design of summer and winter air conditioning systems. Psychrometrics: load calculations; piping arrangements and sizing; duct layout and sizing; energy sources and disseminators; performance and selection of pumps and fans; temperature and humidity control.

MAE 404 Refrigeration. Preq: MAE 302. 3(3-0) S. Thermodynamic analysis of the vapor compression cycle, absorption refrigeration; optimization of multiple evaporator and multiple compressor systems; commercial refrigeration load calculations; desirable properties of refrigerants and brines, piping arrangement and sizing.

MAE 405 Mechanical Engineering Laboratory III. Preq: MAE 306. 1(0-3) F. The final undergraduate course in the mechanical laboratory sequence emphasizing the experimental investigation of measurement problems involving typical mechanical engineering equipment systems. Also included are statistical treatment of data, experiment planning, engineering report preparation, and experience in oral technical presentations.

MAE 407 Steam and Gas Turbines. Preq: MAE 302, ESM 303, or MAE 355. 3(3-0) S.

MAE 406 Energy Conservation in Industry 3(2-3) -/6 1/78

Fundamental analysis of the theory and design of turbo-machinery flow passages; control and performance of turbomachinery; gas-turbine engine processes.

MAE 408 Internal Combustion Engine Fundamentals. Preq: MAE 302. 3(3-0) F. Fundamentals common to internal combusion engine cycles of operation. The Otto engine: carburetion, fuel distribution, flame and spark timing, and altitude effects; the Diesel engine; injection knock, combustion, precombustion and scavenging as applied to reciprocating and rotary engines.

MAE 409 Particulate Control in Industrial Atmospheric Pollution. Preq: MAE 301 or equivalent. 3(3-0) F. Combustion calculations and analysis of particulate emission and gases from industrial and utility power stations burning various types of fuel. State and Federal pollution codes, requirements for compliance and enforcement. Calculations and design of industrial equipment. Utilization of waste products.

MAE 411 Machine Component Design. Preq: MAE 315, 316. 3(3-0) F. Applying engineering and materials sciences to the analysis and design of machine components including fasteners, springs, bearings, gears, shafts, clutches, brakes, couplings, etc.

MAE 415 Mechanical Engineering Analysis. Preq: MAE 302, 315, 316, EE 331. 3(3-0) F. A logical method of problem solving through the integration of the physical sciences, engineering sciences and mathematics. Training in methods of analysis of real mechanical engineering problems.

MAE 416 Mechanical Engineering Design. Preq: MAE 415. 4(3-2) S. Applying engineering and materials sciences to the total design of mechanical engineering components and systems. Consideration and utilization of the design process including problem definition, solution synthesis, design analysis, optimization and prototype evaluation through design project activity.

MAE 422 Direct Energy Conversion. Preq: MAE 301, EE 202 or 332. 3(3-0) S. Theory and application of direct energy conversion methods, including magnetohydrodynamic and electrogasdynamic generators, fuel cells, and other methods of current interest. Thermodynamic analyses, device characteristics, and design considerations.

MAE 431 Thermodynamics of Fluid Flow. Preq: MAE 301, MA 301, ESM 303. 3(3-0) S. Application of one-dimensional compressible gas dynamics and perfect gas theory to analyze nozzle and diffuser flows, normal shocks, and constant-area frictional flows with and without heat transfer.

Corrected revised eff 1/78

MAE 435 Principles of Automatic Control. Preq: MA 301. 3(3-0) F,S. Study of linear feedback control systems using transfer functions. Transient and steady-state responses. Stability analysis using rootlocus and frequency response techniques (Bode plots and Nyquist diagrams). Active and passive compensation methods. Preliminary design and analysis of typical mechanical and aerospace automatic control systems.

MAE 442 Automotive Engineering. Preq: Senior in engineering. 3(3-0) S. Designed to acquaint the student with the fundamental aspects of automotive engineering. Examines various automotive systems (engine, brakes, etc.) as well as their interactions in such areas as safety. Current practices and development for the future are considered.

MAE 452 Aerodynamics of V/STOL Vehicles. Preq: MAE 355. 3(3-0) F. Introduction to the aerodynamics and performance of vertical take-off and landing (VTOL) and short take-off and landing (STOL) vehicles. The aerodynamics of propellers and rotors. Helicopter aerodynamics. High lift devices. Relationship between design and economics for V/STOL vehicles.

MAE 455 Boundary Layer Theory. Preq: MAE 355. 3(3-0) F. Introduction to the concept of boundary layers and the manner in which the boundary layer affects the lift, drag and heat transfer on aerospace vehicles. Included are discussions of the laminar and turbulent boundary layers in compressible flows.

MAE 462 Flight Vehicle Stability and Control. Preq: MAE 261, 435. 3(3-0) F. Linearized dynamic analysis of the motion of a six degree-of-freedom flight vehicle in response to control inputs and disturbance through use of the transfer function concept. Control of dynamic behavior by vehicle design (stability derivatives) and/or flight control systems.

MAE 465 Propulsion II. Preq: MAE 365. 4(3-3) F. Performance analysis of components

and complete air-breathing propulsion systems. Performance analysis and design of liquid fuel and solid fuel, rocket propulsion systems.

MAE (MAS) 471 Undersea Vehicle Design. Preq: MAE 355 or ESM 303. 3(3-0) F or S. Solution of problems encountered in the design of both submerged and semisubmerged ocean vehicles. Treatment of vehicle drag and lift, bouyancy effects, vehicle propulsion and systems integration.

MAE 472 Aerospace Vehicle Structures II. Preq: MAE 371. 4(3-3) S. A continuation of MAE 371 emphasizing specialized topics such as semi-monocoque structures, deflection of structures, indeterminate structures, torsion analysis. Laboratory demonstration of the theory and application of resistance strain gages, load-stress-deflection tests on typical flight vehicle structure components, the determination of basic materials properties, and correlation of tests and analytical results.

MAE 478 Aerospace Vehicle Design I. Preq: MAE 356, 472; Coreq: MAE 462, 465. 2(2-0) F. A synthesis of previously acquired theoretical and empirical knowledge and application to the design of practical aerospace vehicle systems.

MAE 479 Aerospace Vehicle Design II. Preq: MAE 478. 3(1-6) S. A synthesis of previously acquired theoretical and empirical knowledge and application to the design of practical aerospace vehicle systems.

MAE 495 Special Topics in Mechanical and Aerospace Engineering. 1-3 F,S. Offered as needed to present new or special MAE subject matter.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MAE 501 Advanced Engineering Thermodynamics. Preq: MAE 302; MA 401 or MA 511. 3(3-0) F. Thermodynamics of a general reactive system; conservation of energy and the principles of increase of entropy; the fundamental relation of thermodynamics; Legendre transformations; equilibrium and stability criteria in different representation; general relations; chemical thermodynamics; multi-reaction system; ionization; irreversible thermodynamics; the Onsager relation; applications to thermoelectric, thermomagnetic and diffusional processes.

MAE 502 Advanced Energy Systems. Preq: MAE 401. 3(3-0) F. An engineering examination of energy sources, both conventional and proposed. Review of existing energy conversion systems and a critical examination of advanced systems, such as magnetohydrodynamics, fuel cells, solar, geothermal, wind, tides, thermal gradients in oceans and the hydrogen economy.

MAE 503 Advanced Power Plants. Preq: MAE 401. 3(3-0) F. A critical analysis of the energy balance of thermal power plants, thermodynamics and economic evaluation of alternate schemes of development; study of recent developments in the production of power. 4/1/77

MAE 504 Fluid Dynamics of Combustion I. Preq: MAE 301, MAE 355 or ~~ESM 303~~ MAE 384 4/1/78. 3(3-0) F. Gas-phase thermochemistry including chemical equilibrium and introductory chemical kinetics. Homogenous reaction phenomena. Subsonic and supersonic combustion waves in premixed reactants (deflagration and detonation). Effects of turbulence. Introduction to diffusion flame theory.

MAE 505 Heat Transfer Theory and Applications. Preq: MAE 402 or equivalent. 3(3-0) F. Development of basic equations for steady and transient heat and mass transfer processes. Emphasis is placed on the application of the basic equations to engineering problems in the areas of conduction, convection, mass transfer and thermal radiation.

MAE 506 Advanced Automotive Energy Systems. Preq: MAE 408. 3(3-0) S. A critical study of the various cycles and energy sytems for automotive transportation is carried out. The feasibility of automotive Rankine cycle power plants. Sterling engines, gas turbines and hydrogen-air fueled engines is discussed. Means of improving the efficiency and exhaust emissions of internal combustion engines and the use of alternative fuel sources are considered.

MAE 513 ~~Machine Vibration and Control~~ Vibration of Mechanical and Structural Components Preq: MAE 315 or 472. Coreq: MA 511. 3(3-0) F. Modeling of mechanical systems for vibration analysis and presentation of exact and approximate solution techniques. Techniques of vibration control are presented and experience on the analog computer is provided. 2/24/77 eff 8/77

MAE 514 Industrial Noise Control. Preq: MAE 315. 3(2-3) S. Provides definition of the industrial noise problem, development of analytical problem solving skills, introduction to instrumentation, involvement in design project, laboratory demonstrations.

MAE 517 Instrumentation in Sound and Vibration Engineering. Preq: EE 331. Coreq: MAE 513. 3(3-0) F. This course is devoted to a presentation of measurement techniques and the theory and operation of transducers and amplifiers. An introduction to signal analysis techniques such as power spectral density and correlation is also provided.

MAE 518 Acoustic Radiation I. Preq: MA 301 and MAE ~~356~~ 308 or ~~ESM 303~~ MAE 356. 3(3-0) F. An introduction to the principles of acoustic radiation from vibrating bodies and their related fields. The radiation of simple sources, the propagation of sound waves in confined spaces and transmission through different media are considered. 9/11/78 eff 1.

MAE 519 Theory of Noise in Transportation Systems. Preq: MAE 550. 3(3-0) S. A study of the basic noise generating mechanisms encountered in transportation systems. Coverage includes jet noise, propeller noise, helicopter noise, fan and compressor noise, aircraft induced community noise, surface vehicle noise models and efforts to control noise in transportation systems.

MAE 525 Advanced Flight Vehicle Stability and Control. Preq: MAE 462. 3(3-0) F. Preliminary analysis and design of flight control systems to include autopilots and stability augmentation systems. Study of effects of inertial cross-coupling and nonrigid bodies on vehicle dynamics.

MAE 526 Inertial Navigation Analysis and Design. Preq: MAE 435 or 462. 3(3-0) S. Performance analysis and engineering design of inertial navigation components, subsystems and systems. Development of transfer functions and application of linear system techniques to determine stability, transient response and errors of gyroscopes, accelerometers, stable platforms and inertial alignment systems. Error analysis and its significance. Preliminary analysis and design of typical inertial navigation systems for aircraft and marine vehicles.

MAE (MAT) 531 Materials Processing by Deformation. Preq: Six hours of solid mechanics and/or materials. 3(3-0) F. The course involves a presentation of the mechanical and metallurgical fundamentals of materials processing by deformation. Topics to be discussed include: principles of metal working friction, forging, rolling, extrusion, drawing, high energy rate forming, chipless forming techniques, manufacturing system concept in production.

MAE (MAT) 532 Fundamentals of Metal Machining Theory. Preq: Six hours of solid mechanics and/or materials. 3(3-0) S. The course involves a presentation of the mechanical and metallurgical fundamentals of metal machining. Topics to be discussed include: mechanics of machining, temperatures generated, tool life and tool wear, lubrication, grinding process, electrical machining processes, surface integrity, economics, nomenclature of cutting tools.

MAE 533 Finite Element Analysis of Mechanical and Aeronautical Systems I. Coreq: MAE 415 or Preq: MAE 472. 3(3-0) F. Concepts and applications of the finite element method for stress and deformation analysis. Explanation and application of a general purpose finite element program for stress and deformation analysis of simple structures and load-carrying components.

MAE 534 Finite Element Analysis of Mechanical and Aeronautical Systems II. Preq: MAE 533. 3(3-0) S. This course extends the finite element study, initiated in MAE 533, for stress analysis to other fields of interest in mechanical and aerospace engineering. Topics considered include vibration and frequency analysis, heat transfer, and potential flow. Two topics of advanced stress analysis, thin shells and the bending of plates are also included.

MAE 535 Experimental Stress Analysis. Preq: MAE 316 or 371. 3(2-3) F. Theoretical and experimental techniques of strain and stress analysis with emphasis on electrical strain gages and instrumentation, brittle coatings, grid brittle coatings, grid methods and an introduction to photoelasticity. Laboratory includes an investigation and complete report of a problem chosen by the student under the guidance of the instructor.

MAE 536 Photoelasticity. Preq: MAE 316 or 371. 3(2-3) S. Theory and experimental techniques of two- and three-dimensional photoelasticity including photoelastic coatings, photoplasticity and an application of photoelastic methods to the determination of stress-strain

distributions in loaded members. Laboratory includes an investigation and complete report of a problem chosen by the student under the guidance of the instructor.

MAE 540 Advanced Air Conditioning Design. Preq: MAE 403, 404. 3(3-0) F. The design of heating and air-conditioning systems; the preparation of specifications and performance tests on heating and air-conditioning equipment.

MAE 541 Advanced Machine Design I. Preq: MAE 416. 3(3-0) F. An advanced integrated treatment of stress analysis and materials engineering devoted to current rational methods of analysis and design applicable to mechanical components. Primary attention placed on the determination and prediction of strength, life, and deformation characteristics of machine components as dictated by performance requirements.

MAE 550 ~~Aerothermodynamics.~~ Foundations of Fluid Dynamics 2/24/77 eff 8/77 Preq: MAE 301, MAE 355 or ~~ESM 303~~ MAE 308 9/1/78 eff 1/79 3(3-0) F. Review of basic thermodynamics pertinent to gas dynamics. Detailed development of the general equations governing gas motion in both differential and integral form. Simplification of the equations to those for specialized flow regimes. Similarity parameters. Applications to simple problems in various flow regimes. content revised 3/77

MAE 551 Airfoil Theory. Preq: MAE 355. 3(3-0) S. 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.

MAE 552 Transonic Aerodynamics. Preq: MAE 356. 3(3-0) S. A detailed study of the latest theoretical and experimental findings in transonic aerodynamics, including two-dimensional and axisymmetrical flows.

MAE 553 ~~Supersonic Aerodynamics.~~ Compressible Fluids 2/24/77 eff 8/77 Preq: MAE 356 or MAE 431 or MAE 550 3(3-0) F. Equations of motion in supersonic flow. Prandtl-Meyer turns, method of characteristics, hodograph plane, supersonic wind tunnels, supersonic airfoil theory and boundary layer shock interaction.

MAE 554 Hypersonic Aerodynamics. Preq: MAE 356. 3(3-0) F. A detailed study of the latest theoretical and experimental findings in hypersonic aerodynamics.

MAE 555 Aerodynamic Heating. Preq: MAE 356. 3(3-0) F. 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.

MAE 556 ~~Principles of Fluid Motion.~~ Mechanics of Ideal Fluids MAE 308 9/1/78 eff 1/79 2/24/77 eff 8/77 Preq: MAE 355 or ~~ESM 303~~. 3(3-0) S. Fundamental principles of fluid dynamics. Mathematical methods of analysis are emphasized. Potential flow theory development with introduction to the effects of viscosity and compressibility. Two-dimensional and three-dimensional phenomena are considered.

MAE 557 Dynamics of Internal Fluid Flow. Preq: MAE 356 or ~~ESM 303~~ MAE 308 9/1/78 eff 1/79. 3(3-0) F. A general development of the governing equations of fluid motion with subsequent restriction to incompressible flow. Exact and approximate solutions of the Navier-Stokes equations for internal laminar flow and elementary boundary layer theory. Applications include hydrodynamic lubrication, converging-diverging channel flows, entrance flows and turbulent internal flow.

MAE 558 Plasmagasdynamics I. Preq: MAE 356, PY 414. 3(3-0) F. Study of basic laws governing plasma motion for dense and rarefied plasmas, hydromagnetic shocks, plasma waves and instabilities, simple engineering applications.

MAE 559 Molecular Gas Dynamics I. Preq: MAE 550. 3(3-0) F. Statistical mechanics as applied to the derivation of the equations of gas dynamics from the microscopic viewpoint. Collision processes, treatments of viscosity, heat conduction and electrical conductivity.

MAE (EE) 565 Gas Lasers. Preq: MAE 356 or equivalent, PY 407. 3(3-0) F. Study of the principles, design and potential applications of ion, molecular, chemical and atomic gas lasers.

MAE 570 Theory of Particulate Collection in Air Polution Control. Preq: MAE 409 or grad. standing. 3(3-0) S. Particulate matter is classified and its properties are described. The motion of particles as applied to particulate collection is carefully analyzed. The elements of aerodynamic capture of particles are developed and applications in filtration and liquid scrubbing are considered. Fundamentals of acoustical, electrostatic and thermal precipitation are introduced. Sampling techniques and instrumentation are also considered.

MAE (OR) 545 Variational Methods in Optimization Techniques I 3(3-0) 8/1/77 eff 8/77

MAE(mas, OR) 563 Geophysical Fluid Mechanics 3(3-0) 6/24/77

MAE(mas, OR) 663 Advanced Geophysical Fluid Mechanics 3(3-0) 6/24/77

MAE(mas, OR) 664 Perturbation Method in Fluid Mechanics I 3(3-0) 6/24/77

MAE(mas, OR) 665 Perturbation Method in Fluid Mechanics II 3(3-0) 8/1/77

MAE 615 Nonlinear Vibrations 3(3-0) 2/24/77 eff 8/77

MAE 586 Project Work in Mechanical Engineering. 1-6 F,S. Individual or small group investigaion of a problem stemming from a mutual student-faculty interest. Emphasis is placed on providing a situation for exploiting student curiosity.

MAE 589 Special Topics in Mechanical Engineering. Preq: Advanced undergrad. or grad. standing. 3(3-0) F,S. Faculty and student discussions of special topics in mechanical engineering.

MAE (OR) 646 Variational Methods in Optimization Techniques II 3(3-0) 2/24/77 eff 8/77

Meteorology

MY 201 Atmospheric Environment. Preq: High school physics, chemistry, algebra, trigonometry, or equivalent. 3(3-0) F,S. Nature and processes of the atmosphere, interactions with land, sea, and life at the surface, relations to other components of the solar system; measurements and surveillance of the atmosphere and relations to climatology, weather forecasting, weather modification and air pollution, and applications to various human activities.

MY 386 Climate Near the Ground. Preq: MA 112, PY 221. 3(3-0) S. Analysis of basic physical states and processes at the interface of atmosphere with land surfaces and vegetation in terms of the meteorological controls. Designed to serve needs in the various plant sciences.

MY 411 Introductory Meteorology. Preq: PY 208 or 212; MA 201 or 212. 3(3-0) F. The physical setting: coordinates, planetary motion, gravitation; composition and structure of the atmosphere; insolation and diurnal phenomena; heat balance of the atmosphere; consequent distribution of variables of state, motion and weather.

MY 412 Atmospheric Physics. Preq: MY 411 or CI. 3(3-0) S. Atmospheric effects on electromagnetic and acoustic transmission, and the consequent phenomena; terrestrial radiation; radar meteorology, visibility, atmospheric electricity and magnetism.

Air Properties and Processes PY 208

MY 421 ~~Atmospheric Statics and Thermodynamics.~~ Preq: ~~PY 208 or 212~~; MA 202. ~~3(3-0)~~ 2-2 F. The variables of state and thermodynamics of dry and moist air in the atmospheric system; water phase changes, hydrostatics and altimetry; stability, convection and diffusion; transfers at the surface; natural modification of air. revised eff 8/78

MY 422 Atmospheric ~~Kinematics and Dynamics.~~ Preq: PY 208, MA 202; ~~Coreq: MY 421~~ or CI. ~~3(3-0)~~ F. Properties and fields of atmospheric motion, and variations with time; forces and force fields; equilibrium and accelerated motions; the boundary layer and momentum transfer; continuity, pressure tendency and divergence-vorticity theorems. revised eff 8/78

Motions

MY 435 Measurements and Data Systems. Preq: MY 421. 3(2-3) F. Meteorological instruments, observations and networks; data communications, reduction and presentation; meteorological charts and diagrams, fundamental analysis of physical distributions.

MY 441 Meterological Analysis I. Preq: ~~MY 422, 435~~. 3(3-0) S. Theory and analysis of atmospheric distributions, processes and developments in the three space dimensions and time. 421, 422 revised eff 8/78

MY 443 Meteorological Laboratory ~~I~~ II. Preq: MY 435; Coreq: MY 441. ~~4(0-10)~~ 3-9 S. Analysis of atmospheric distributions, processes and developments, employing regularly available meteorological data and the principles presented in prerequisite and corequisite courses. Student gains working knowledge of integrated atmospheric systems and processes through detailed analyses of natural situations. revised 2/8/78 eff 8/78

MY 444 ~~Meteorological Laboratory II.~~ Preq: MY 443. ~~4(0-10)~~ Weather Forecasting Principles 3(2-3) S. Analysis and application of principles and concepts for predicting developments in the weather.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MY 512 Micrometeorology. Preq: MY 422. 3(3-0) F. Meteorology of the lowest hundred meters of the atmosphere with emphasis on the transport of momentum, heat, water vapor, and effluents and their transfer through the earth's surface. eff 8/78

MY 521 The Upper Atmosphere. Preq: MY 411 or CI. 3(3-0) S. Meteorological conditions in the upper atmosphere from the stratosphere to the ionosphere. Compositions, mean distributions and variabilities, and circulation and transport properties in the region. Physical theories.

my 311 Physical Climatology 3(3-0) 2/10/78 eff 8/78
my 335 Weather Systems and Information 2(1-3) 2/8/78 eff 8/78
my 336 Meteorological Laboratory I 1(0-3) 2/8/78 eff 8/78
my 493 Special Topics in Meteorology (1-3) 2/10/78 eff 8/78
my 455 Micrometeorology 3(3-0) 2/8/78 eff 8/78

MY 525 Numerical Weather Prediction. Preq: MY 524, CSC (MA) 427 or equivalent and some FORTRAN programming experience. 3(3-0) S. Physical and mathematical basis of numerical weather prediction with computer experiments to demonstrate principles and techniques. Topics include basic equations and methods of dynamical prediction, scale analysis, integral constraints on vorticity and energy, consistent sets of prediction equations, filtered equations, finite-difference methods, computational instability, relaxation methods, simple barotropic and baroclinic models, NWS operational models. Watson

MY 555 Meteorology of the Biosphere. Preq: PY 205 or 211; CH 103 or 107; MA 102 or 112. 3(3-0) F. For graduate students in the life sciences. The physical principles governing the states and processes of the atmosphere in contact with earth's surface of land, water, and life. Exchanges of heat, mass, and momentum are analyzed for various conditions of the atmosphere and surface, and as a function of season, time, and geographic location.

MY 556 Air Pollution Meteorology. Preq: MY 555 or equivalent. 3(3-0) S. The meteorological aspects of air pollution, especially for nonmeteorologists engaged in graduate training for work involving air pollution.

MY 593 Advanced Topics. Preq: Consent of Staff. 1-6 F,S. Special topics in meteorology, provided to groups or to individuals.

Microbiology

FOR ADVANCED UNDERGRADUATES

MB 401 General Microbiology. Preq: BS 100, CH 223 or 220. 4(3-3) F,S. Rigorous introduction to basic principles and concepts of microbiology. Recommended for students in biological and agricultural sciences curricula and for all students planning to take further courses in microbiology. Elkan, Luginbuhl

MB (FS) 405 Food Microbiology. 3(2-3) F. (See food science, page 240.)

MB 411 Medical Microbiology. Preq: MB 401. 3(3-0) S. A comprehensive study of the processes by which pathogenic microorganisms cause disease and the biological defense mechanisms by which the host resists. Methods of diagnosis, prevention and therapy of common diseases of microbial origin will be considered. Luginbuhl.

MB 490 Special Studies in Microbiology. Preq: Three courses in microbiology and CI. 1-3 F.S.Sum. Undergraduate students will be given an opportunity to participate in the current research program of a faculty member or to participate in a special study of an advanced undergraduate topic. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MB 501 Advanced Microbiology. Preq: MB 401 ~~(or MB 302)~~. 3(3-0) F. A study in some depth of microbial structure and function, microbial ecology and characterization of important groups of microorganisms. Perry

MB (FS) 506 Advanced Food Microbiology. 3(1-6) S. (See food science, page 240.)

MB 514 Microbial Metabolism. Preq: MB 401, BCH 351 or BCH 551. 3(3-0) S. A study of the physiology and metabolism of microorganisms and their regulatory mechanisms. Dobrogosz

MB 521 Microbial Ecology. Preq: Sr. or grad. standing. 1(1-0) S. A survey of the ecological role of microorganisms in our environment, their interaction with other living organisms and their function in biodegradation and recycling of organic matter in the ecosystem. Perry

MB (SSC) 532 Soil Microbiology. 4(3-3) S. (See soil science, page 314.)

MB 551 Immunology and Serology. Preq: MB 401. 3(2-2) S. A study of the basic concepts and principles of antibody production, antigen-antibody interaction, and the laboratory techniques for their demonstration and study. Lecce

MB (ZO) 555 Protozoology. 4(2-6) S. See zoology, page 329.)

MB (BCH, GN) 561 Biochemical and Microbial Genetics. 3(3-0) S. (See biochemistry, page 192.)

MB (BAE, CE) 570 Sanitary Microbiology. 3(2-3) S. (See civil engineering, page .)

MB 571 Virology. Preq: BCH 551, MB 401. 3(3-0) An introduction to the fundamental aspects of virus-cell interactions. These include virus attachment and penetration, intracellular virus replication, metabolic changes occurring in cells as a result of virus infection and virus-induced cellular transformations. Johnston

MB (BO) 574 Phycology. 3(1-4) S. (See botany, page 196.)

MB (BO, PP) 575 The Fungi. 3(3-0) F. (See botany, page 196.)

MB (BO, PP) 576 The Fungi—Lab. 1(0-3) F. (See botany, page 196.)

FOR GRADUATES ONLY

MB 590 Topical Problems. Preq: CI. Credits Arranged. F,S.

Military Education and Training

AEROSPACE STUDIES (AIR FORCE ROTC)

AS 121 The Air Force Role in the Department of Defense I. 1(1-1) F. Initial course in the four-year AFROTC curriculum. Familarizes student with the mission, organization and doctrine of the U.S. Air Force and U.S. Strategic Offensive Forces. Introduction to U.S. Strategic Defensive Forces. The laboratory, Corps Training, provides experience in drill movements, knowledge of customs and courtesies expected of an Air Force member, knowledge of Air Force career opportunities, and the life and work of the junior officer.

AS 122 The Air Force Role in the Department of Defense II. Preq: AS 121 or equivalent. 1(1-1) S. Continues study of U.S. Strategic Defensive Forces. Familiarizes student with Aerospace Support Forces and U.S. General Purpose Forces, including those of the Army, Navy and Marines. Corps Training stresses fundamentals needed to capably assume and discharge future responsibilities in AFROTC and the U.S. Air Force.

AS 221 The Development of Airpower I. Preq: AS 122 or equivalent. 1(1-1) F. Airpower from the early years of powered flight through World War II. Emphasis on the development of employment concepts. Factors which have prompted research and technological change. Events which show the impact of airpower on strategic thought. Corps Training develops skills and further studies the junior officer environment.

AS 222 The Development of Airpower II. Preq: AS 221 or equivalent. 1(1-1) S. Airpower from the end of World War II to the present. Emphasis on employment concepts, technological change, and the impact of airpower on strategic thought. Leadership experiences and study of junior officer environment in Corps Training.

PROFESSIONAL OFFICER EDUCATION

AS 321 ~~National Security Forces in Contemporary American Society~~ Air Force Management and Leadership I. Preq: Four year AFROTC Cadets, AS 222; Two year non-veteran students, satisfactory completion of a six week field training course (see below). 1(3-1) F. The role of national security forces in contemporary American society. The professional military as it relates to the American political and social system. Formulation of military policy is examined in terms of international and domestic constraints. A treatment of the development of modern defense strategy. The student studies and practices communicative skills. Corps Training provides for advanced leadership experience. Content revised eff 8/77 11/23/77

AS 322 National Security Forces in Contemporary American Society II. Preq: AS 321. 2(3-1) S. Continues the study of national security forces in contemporary American society. Focuses on strategy and management of modern conflict and formulation and implementation of U.S. defense policy. Brief study of the Air Force Officer classification and assignment system. Students develop their communicative skills and participate in advanced leadership situations in Corps Training.

AS 421 ~~Philosophy of Military Leadership~~ American Defense Policy I. Preq: AS 322. 1(3-1) F. Class and laboratory to include exploration and practical experience in the need for leadership and a study of human behavior and relations that affect military leadership. Professional self-discipline, imposed discipline of military law, and an examination of the variables affecting leadership. Emphasis on developing the communicative skills, leadership abilities and basic knowledge required of a future Air Force junior officer. Content revised eff 8/78 11/23/77

American Defense Policy II Content revised eff 1/79 11/23/77

AS 422 ~~Management Applications in the Military Environment.~~ Preq: AS 421. 2(3-1) S. Class and laboratory study of and practical experience with management functions in the military environment. The planning, organizing, directing, controlling and coordinating functions of management; the command and staff functions in advising, problem solving and decision-making situations. Emphasis on developing communicative skills, leadership abilities and basic knowledge required of an Air Force junior officer.

AS 499 Flight Instruction Program Ground School. 0(3-0) S. Develops aeronautical knowledge required by the Federal Aviation Administration for private pilots. It familiarizes students with the appropriate general and visual flight rules of Part 91 of the Federal Aviation Regulations, obtaining and evaulating of flight weather reports and flight planning elements such as plotting courses, estimating time enroute and fuel requirements. Required in the Flight Instruction Program (FIP) for Air Force ROTC cadets.

FIELD TRAINING COURSES

AFROTC field training is offered during the summer months at selected Air Force bases throughout the United States. Students in the four-year program participate in four weeks of field training during the summer after their sophomore or junior year. Students applying for entry into the two-year program must successfully complete six weeks of field training prior to enrollment in AFROTC.

Major study areas in the four-week field training program include junior officer training, aircraft and aircrew indoctrination, career-orientation, survival training, base functions and Air Force environment, and physical training.

The six-week field training program covers all four-week field training program areas plus all of the subject matter received by four-year program cadets during their freshman and sophomore years in the General Military Course, including corps training.

Military Science (Army ROTC)

Military Science I 1-0 Introduction to ROTC and the Army 2/28/77 eff 8/77

MS 101 ~~Military Science I.~~ 1(1-1) F. The mission and organization of the U.S. Army and an introduction to Army ROTC. Advantages, opportunities and benefits of becoming an officer in the Army are examined and discussed. Practical work in marksmanship and other skills such as rappelling is emphasized in Leadership Laboratory. Edgar

Introduction to Leadership and Management 2/28/77 eff 8/78

MS 102 Military Science I. 1(1-0) S. A seminar approach which investigates current topics of interest to the Army. Instruction and practical work in the fields of leadership and management. Leadership Laboratory continues to emphasize MS 101 goals. Edgar

Land Navigation & American Military History 2/28/77 eff 8/77

MS 201 Military Science II. Preq: MS 101 and MS 102 or equivalent credits. 1(2-0) F. A survey of American military history to include an examination of how numerous variables such as the political, social, and economic systems have influenced the military establishment. Leadership Laboratory will continue to emphasize the application of leadership and management techniques during practical exercises. Rowley

Small Unit Tactics & American Military History 2/28/77 eff 1/78

MS 202 Military Science II. Preq: MS 101 or MS 201 or equivalent credit. 1(2-0) S. Planning organization and conduct of small unit operations. The second half of the semester will be devoted to developing land navigational skills. Leadership Laboratory continues to emphasize leadership and management training and in particular focuses upon classroom instruction in a practical field environment. Rowley

Advanced Leadership and Management 2/28/77 eff 8/77

MS 301 Military Science III. Preq: MS I and MS II or prior military service, or completion of ROTC basic camp or its equivalent. 1(2-0) F. Instruction in advanced leadership and management utilizing case studies and a seminar approach. The second half of the semester will be devoted to developing means of communication in an instructional atmosphere. Leadership Laboratory includes practical application of classroom work in a tactical environment.

Military Operations and Instructional Communications 2/28/77 eff 8/78 Lupus

MS 302 Military Science III. Preq: MS I and MS II or prior military service, or completion of ROTC basic camp or its equivalent. 2(2-0) S. Planning, organization, and execution of military operations. A portion of the semester will be devoted to an examination of the numerous officer specialties in the Army. Leadership Laboratory continues to emphasize leadership and management training in addition to the development of practical military skills such as orienteering, rappelling, etc. Lupus

MS 401 ~~Theory and Dynamics of the Military Team.~~ Preq: MS 302. 1(2-0) F. A seminar approach to military management procedures to include organizational theory, operational

MS 305 Application of Military Leadership and Management Techniques 1(1-0) 10/26/77 eff 8/78

techniques, staff planning and implementation, and the fundamentals of military law. Leadership Laboratory emphasizes the practical application of classroom instruction by exercising full command and staff responsibility in planning and executing all phases of field training and leadership development. Kehoe

MS 402 ~~Seminar in~~ Leadership and Management. Preq: MS 401. 2(2-0) S. Seminar approcah to leadership and management in the military environment, the problems of developing nations, world position of the United States, and management of personal affairs. Leadership Laboratory continues to emphasize MS 401 goals, uses field training exercises as the medium for preparation for commissioning and subsequent active Army Service. Kehoe

Music

MUS 100 Instrumental Music. Preq: Satisfactorily passing audition. 1(0-5) F,S. The performance and study of the best in instrumental music. Assignments to various organizations made according to instrument played and individual interests and abilities.

MUS 110 Choral Music. Preq: Satisfactorily passing audition. 1(0-4) F,S. The performance and study of the best in choral music. Assignments to various organizations made according to individual interests and abilities.

MUS 200 Understanding Music. 3(3-0) F,S. To assist students in developing understanding and comprehension of music heard today. Emphasis is upon evaluating musical elements and content, form, style periods, and design.

MUS 210 A Survey of Music in America. 3(3-0) Alt. yrs. A historical survey of music in the United States from colonial times to the present, with emphasis on the major influences which have shaped the musical literature of America. The objective of the course is to develop an awareness and understanding of the indigenous musical forms and styles and of the role this music has played in the development of the important cultural traditions of the United States.

MUS 215 Music of the 17th and 18th Centuries. 3(3-0) Alt. years. Examine selected European music from 1600 to 1800, emphasis on concepts of compositional style, reflections of certain broad cultural tendencies and purely musical phenomena. Study of specific forms and genres as they evolved during this period.

MUS 220 Music of the 19th Century. 3(3-0) Alt. yrs. Course designed to provide an insight into the significant musical forms of the western world in the 19th century. Subject matter will include an analysis of the musical literature of the prevailing forms, its composers and the relation of music to other art forms of the time period.

MUS 301 Basic Music Theory I. 3(3-0) F,S. Introductory course for students with no formal musical background. Basic elements of music. Exercises in notation, ear training, written harmony, and the application through a study of selected compositions from the musical literature.

MUS 302 Basic Music Theory II. Preq: MUS 301, CI. 3(3-0) F,S. Continuation of MUS 301. Musical analysis of representative works. Further study of choral functions through written exercises. Compositions written by students using as a model a piece from the standard musical literature which employs principles studied throughout the course.

MUS 320 Music of the 20th Century. 3(3-0) Alt. years. Traditions and innovations in representative music of this century are examined. Emphasis upon musical ideas and materials.

MUS 401 Music Composition I. Preq: MUS 301 or 302 or CI. 3(3-0) F. Writing course designed to provide non-music majors experience in creating their own musical compositions. Students will learn basic skills in manipulating musical materials which include harmonic, melodic, rhythmic, and contrapuntal characteristics of all periods of music.

MUS 402 Music Composition II. Preq: MUS 401 or CI. 3(3-0) S. Emphasis on 20th century compositional techniques. Study and construction of larger musical phrases and forms and the harmonic and contrapuntal principles employed within their construction. Study in techniques of orchestration.

MUS 495 Special Topics in Music. 1-3 F,S. Offered to focus on new or special subject matter not covered by existing courses.

Nuclear Engineering

NE 201 Applications of Nuclear Energy. Preq: PY 208. 3(3-0) S. An elementary introduction to nuclear energy. Topics include radioactivity, fission and fusion, power production, isotopes, radiation detection, radiation safety, environmental effects and energy resources. The student is given a broad perspective of nuclear engineering and introduced to both fundamentals and applications. Verghese, Stam

NE 302 Fundamentals of Nuclear Engineering. Preq: NE 201, PY 410. 4(3-2) F. An introductory course in nuclear engineering. Topics include neutron physics, reactor theory, and reactor operations. Emphasis on basic principles underlying the design and operation of nuclear systems, facilities and applications. Laboratory sessions include the various techniques of radiation detection and measurement, reactor nuclear instrumentation, and reactor measurements. Stam

NE 401 Reactor Analysis and Design. Preq: NE 302 or 419. 4(3-2) S. Elements of nuclear reactor theory and reactor operation, including neutron slowing down and diffusion, Fermi age theory, multigroup concepts, criticality of homogenous and heterogenous reactors, and reactor dynamics. Observation and measurement of reactor behavior and correlation with theory. Stam

NE 402 Reactor Engineering. Preq: NE 302 or 419. 4(3-2) F. Engineering topics pertinent to the design of reactors are stressed, including heat transfer and fluid flow in reactors, relevant computer codes, power plant thermodynamics, and shielding. Laboratory experiments are included. Verghese

NE 403 Nuclear Engineering Design Projects. Preq: NE 402. 3(2-3) S. Student projects in design of practical nuclear engineering systems. Preliminary designs are developed by teams with advice by faculty as needed, and reports are presented in oral and written form. Current and future systems are emphasized, and use of computers is encouraged. Gardner

NE 404 Radiological, Reactor, and Environmental Safety. Preq: NE 302 or 419. 3(3-0) F. A basic course in health physics and the environmental aspects of nuclear power generation. Topics include: biological effects of radiation, dose-role evaluation, radiation monitoring, and radiological safety; reactor effluents and radioactive waste disposal; regulations governing radiation exposure and the release of radioactivity into the environment; environmental impact of nuclear power plants. Elleman, Kohl, Zumwalt

NE 405 Reactor Systems. Preq: NE 402. 3(3-0) S. Nuclear power plant systems, their design criteria, design parameters, and economics. Topics covered include: PWR, BWR, HTGR, their primary loops, auxiliary and emergency systems; containment; radwaste handling; reactor control systems and reactor operation; quality assurance; cost components of nuclear power. Bohannon, Saxe

NE 412 Nuclear Fuel Cycles. Preq: NE 302. 3(3-0) S. Processing of nuclear fuel with description of mining, milling, conversion, enrichment, fabrication, irradiation, shipping, reprocessing, and waste disposal. Fuel cycle economics and fuel cost calculation; burn-up calculations and design of reload cores; plutonium and thorium utilization. Verghese

NE 414 Nuclear Power Plant Instrumentation. Preq: NE students: EE 331, 332; EE students: NE 419. 3(3-0) S. Treats the instrumentation required for control and safety of a nuclear power plant. The dynamic behavior of a nuclear plant is developed so that the characteristics required of the instrumentation may be stated. Methods for combining the various measured parameters, e.g. neutron flux, coolant flow, coolant pressure, temperature, to achieve safe operation are discussed. Protection against loss-of-power, lightning, etc. are treated. Saxe

NE 419 Introduction to Nuclear Engineering. Preq: PY 202 or 208. 3(3-0) F,S. Nuclear energy applications, including nuclear reactor materials, reactor theory, shielding, thermal and hydraulic analysis, and control. Uses of nuclear fission and its by-products in research, industry and propulsion. Major engineering problems are defined and methods of approach outlined. Course designed for students in other departments. Staff

NE 491, 492 Nuclear Engineering Topics I, II. Preq: CI. Variable credit. 1-4 F,S. Detailed coverage of special topics such as: radiation applications, quality assurance, reactor operation, reactor control, and nuclear measurements. Gardner, Verghese, Bohannon, Saxe, Stam

NE 510 Nuclear Design Calculations 3(2-1) 3/31/77 eff 1/78
NE 514 Principles of Fusion Reactors 3(3-0) 3/31/77 eff 1/78

FOR GRADUATES AND ADVANCED UNDERGRADUATES Radiation and Reactor Fundamentals 4(3-3)

NE 501 ~~Reactor Analysis.~~ Preq: NE 302 or 419. 3(3-0) F. Principles of neutron motion in matter emphasizing the analysis of the nuclear chain reactor, including neutron mechanics, flux distributions, critical mass calculations, time behavior, two group model, and reactivity calculation. Contents revised 3/31/77 eff 8/77 Murray

NE 502 ~~Reactor Design.~~ Preq: NE 501. 3(3-0) S. Elements of design and operation, including reactor materials, thermal and hydraulic analysis, control and safety, and thermal and fast reactor systems. Nuclear Engineering Analysis content revised eff 1/78 Siewert

NE 505 ~~Experimental Methods in Nuclear Engineering.~~ Preq: NE 501, 511, Coreq: NE 502, 512. 3(1-4) S. Laboratory experiments illustrate the principles and concepts covered in NE 501, 502, 511 and 512. Reactor Dynamics & Control revised eff 8/77 Gardner, Stam

NE (PY) 511 Nuclear Physics for Engineers. 3(3-0) F. (See physics, page 293.)

NE 512 ~~Radiation Applications.~~ ~~Preq: NE 511. 3(3-0) S. Applications of radiation interaction principles to practical nuclear problems. Topics include radiological safety, effects of radiation on biological and structural materials, and industrial applications of radioisotopes and radiation.~~ eff 1/78 Zumwalt, Gardner

NE (MAT) 562 Materials Problems in Nuclear Engineering. Preq: Advanced undergrad. standing. 3(3-0) F. Reactor component design considerations determined by materials properties as well as by nuclear function are covered. Emphasis is placed on radiation effects and other concepts pertinent to the selection of materials for nuclear reactors for either terrestrial or space applications. Beeler, Fahmy

NE (MAT) 573 Computer Experiments in Materials and Nuclear Engineering. 3(3-0) S. (See materials engineering, page 268.) Beeler

NE (CE) 574 Environmental Consequences of Nuclear Power. Preq: CI. 3(3-0) S. Environmental consequences resulting from electrical power generation, with emphasis on siting, construction, and operation of nuclear power plants. Kohl, Zumwalt, Smallwood

NE 591, 592 Special Topics in Nuclear Engineering I, II. Preq: CI. 3(3-0) F,S. Topics include fast breeder reactors, nuclear fusion, computer techniques. Staff

NE 601 Reactor Theory and Analysis 3(3-0) 3/31/77 eff 8/77

Nutrition

NTR (ANS, FS) 301 Nutrition and Man. 3(3-0) F,S. (See animal science, page 189.)

NTR (ANS, PO) 415 Comparative Nutrition. 3(3-0) F. (See animal science, page 189, or poultry science, page 302.)

~~NTR (ANS) 416 Quantitative Nutrition.~~ ~~3(1-6) F. (See animal science, page 189.)~~ 4/12/78

NTR 490 Nutrition Seminar. Preq: Sr. standing. 1 F,S. Reviews, analysis and discussions of information and proposals relating to problems in human nutrition and allied areas.

NTR 590 Topical Problems in Nutrition. Preq: Grad. or sr. standing. 1-6 F,S. Discussions, readings and analysis of problems of current interest in nutrition and closely allied fields.

OR 493 Special Topics in Operations Research 1-3 eff 8/78

Operations Research

OR 501 Introduction to Operations Research. Preq: ~~MA 405, 421.~~ revised 1/20/78 3(3-0) F,Sum. OR approach: modeling, constraints, objective and criterion. The problem of Multiple cirteria. Optimization, Model validation. The team approach. Systems Design. Examples. OR methodology: mathematical programming; optimum seeking; simulation, gaming; heuristic programming. Examples. OR applications; theory of inventory; economic ordering under deterministic and stochastic demand. The production smoothing problem; linear and quadratic cost functions. Waiting line problems: single and multiple servers with Poisson input and output. The theory of games for two-person competitive situations. Project management through PERT-CPM. Graduate Staff

OR (IE, MA) 505 Mathematical Programming I. Preq: MA 405. 3(3-0) F,Sum. Mathematical methods applied to planning problems. Linear programming, a rigorous and complete development of the theoretical and computational aspects of this technique and a discussion of applications. Graduate Staff

NE 503 Reactor Analysis 2(2-0) 3/31/77 eff 8/77
NE 504 Reactor Heat Transfer 2(2-0) 3/31/77 eff 1/78
NE 506 Radioisotopes Measurement Applications 2(2-0) 3/31/77 eff 1/78
NE 507 Radiation Effects 2(2-0) 3/31/77 eff 8/77
NE 508 Radiation Safety 2(2-0) 3/31/77 eff 1/78

NE 611 Radiation Detection 3(2-2) 3/31/77 eff 8/77

NE 620 Nuclear Radiation Attenuation 3(3-0) 3/31/77 eff 8/77

NE 621 Radiation Effects on Materials 3(3-0) 3/31/77 eff 8/77

NE 622 Transport of Matter in Nuclear Reactors 3(3-0) 3/31/77 eff 8/77

NE 631 Reactor Kinetics and Control 3(3-0) 3/31/77 eff 8/77

NE 641 Radioisotopes Applications 3(3-0) 3/31/77 eff 8/77

NE 653 Power Plant Engineering & Safety 3(3-0) 9/7/78 eff 8/79

examines the skeptical hostility to rationalist metaphysics of David Hume, the great empiricist of the eighteenth century, then turns to Immanuel Kant's attempts to answer Hume's doubts and to reform metaphysics. The course then proceeds to explore the Post-Humean and Post-Kantian philosophies of the 19th century. Metzger

PHI 319 Roots of Contemporary Philosophy. 3(3-0) F. A critical examination of the most recent history of contemporary Anglo-American philosophy. Following a brief presentation of Nineteenth Century idealism, the course traces in detail the rise and development of realism in the current century. The foci of the course are the historical roots of modern scientific realism, beginning with the naive realism of Moore and Russell and passing successively to Logical Positivism, Ordinary Language philosophy, and Quinean empiricism. Auerbach

PHI 330 Metaphysics. 3(3-0) S. An examination of metaphysical problems and questions, most of which have classical origins but which will usually be treated from a contemporary perspective. Typical problems are those connected with appearance and reality, free-will and determinism, mind and body, and space and time. Carter

PHI 333 Theory of Knowledge. 3(3-0) F,S. This course is concerned with the analysis of such central concepts as knowledge, belief, and truth, and the investigation of the principles by which claims to know may be justified.

PHI 335 Symbolic Logic. 3(3-0) F,S. An introduction to modern symbolic logic. Examination of the procedures for the translation of certain English sentences into logical notation and for the manipulation of that notation, so as to produce correct inferences in it. Also an introduction to the mathematical study of logic, i.e., of the properties of the symbolic system itself. Levin

PHI 336 Topics in the Philosophy of Logic and Language. 3(3-0) F,S. Each year this course will treat one or more of the problems associated with the philosophical investigation of logic and language. Among the many topics covered will be the distinction between sentences, statements, and propositions; referential opacity; the modalities; the nature of grammar; problems in semantics; and the relation between formal and natural language. Staff

PHI 340 Philosophy of Science. 3(3-0) F,S. An examination of the character and function of "explanation" in scientific activity, the concepts of law and theory, the role of inductive confirmation, and the relationship between natural and social sciences. Nagel

PHI 341 Topics in the Philosophy of Science. 3(3-0) S. Provides an opportunity for the detailed investigation of some of the special problems in contemporary philosophy of science. Each year the course will consider at least some of the following problems: explanation and theory, confirmation, philosophy of physics, philosophy of psychology, and the philosophy of the social sciences. Nagel

PHI 402 Advanced Logic. Preq: PHI 335 or CI. 3(3-0) S. A formal study of the notions of truth and provability, this course emphasizes some of the theorems of mathematical logic having philosophical importance — Godel's incompleteness results and Church's theorem, for example. An introduction to recursive function theory. Staff

PHI 490 Seminar in Philosophy. Preq: Six credits in PHI. 3(3-0) F,S. The seminars are devoted to special studies in contemporary philosophy, with emphasis on research and critical analysis. Students are expected to be familiar with the major doctrines of modern western philosophy. Staff

PHI 492 Philosophy Seminars on the Human Condition. 3(3-0) F,S. The seminars will be directed to exploring in a philosophical way the wide range of issues characterizing human experience and the human condition — such issues as capital punishment, abortion, civil rights, automation, and the quality of existence. Staff

PHI 498 Special Topics in Philosophy. Preq: Six credits in PHI. 1-6 F,S. This course is used to offer areas of study which appear only rarely in the curriculum. It will also function as a readings course for honors students in philosophy. Staff

PHI 499 Senior Essay in Philosophy. Preq: Consent of the department. 3 F,S. Individually directed research on a topic chosen in consultation with a staff adviser. The objective is a critical, written analysis of a well-defined topic in the thought of a major philosopher or in the literature of one of the main problems of philosophy. Staff

Physical Education

(All courses are taught for one-half semester unless otherwise noted. For a final grade and one semester credit to be received, the student must complete a full semester of either a full semester course or two one-half semester courses taken in the same semester.)

PRESCRIBED COURSES

PE 100 M, PE 100 W (F,S) Health and Physical Fitness. (Full semester). 1(0-2) F. A lecture laboratory course to assess and improve the individual's physical fitness, and to convey health/fitness knowledge.

PE 112 Beginning Swimming I. (8 or 16 weeks depending upon individual). 1(0-2) F,S,Sum. Teaches nonswimmers the basic swimming skills necessary to demonstrate survival swimming ability.

PE 113 Beginning Swimming II. 1(0-2) F,S. Prepares weak swimmers for the intermediate swimming course.

PE 118 Restricted Activity I. 1(0-2) F,S. Meets the needs of individuals who have temporary or permanent physical impairments. Students enrolled in this program must obtain a restrictive form from the Student Health Service.

PE 119 Restrictive Activity II. 1(0-2) F,S. A follow-up of PE 118.

CONTROLLED ELECTIVE COURSES

AQUATICS

PE 221 Intermediate Swimming. 1(0-2) F,S,Sum. Gives the student competence in four basic strokes and two dives.

PE 222 Water Sports. 1(0-2) F. Water polo and water basketball, plus improvement in stamina and water skills.

PE 223 Advanced Lifesaving. Preq: PE 221 or equivalent. (Full semester). 1(0-2) F,S. Designed to qualify students for a Senior Red Cross Lifesaving certificate.

PE 224 Water Safety Instructors. Preq: PE 223 or equiv. (Full semester). 1(0-2) F,S. Designed to qualify students for a Red Cross Water Safety Instructor's rating.

PE 225 Scuba Diving. Preq: Demonstrate swimming proficiency. (Full semester). 1(0-2) F,S. Appropriate and safe use of scuba diving equipment and related in-water skills.

COMBATIVES

PE 232 Personal Defense. 1(0-2) F,S. To promote mastery of fear that may arise from the anticipation of violent personal contact and to equip students with the techniques for personal defense. To include falls, throws, counters, locks, escapes.

PE 233 Boxing. 1(0-2) F,S. Acquaints the student with the fundamentals, skills, history and rules. Emphasis on defensive techniques.

PE 238 Wrestling. 1(0-2) F,S. Wrestling skills at the beginning level; teaching developing strength and endurance; and fostering good sportsmanship in a combative sport.

DEVELOPMENTAL ACTIVITIES

PE 117 Gymnastics. 1(0-2) F,S. Fundamentals on the parallel bars, side horse, trampoline and mats.

PE 231 Body Mechanics. 1(0-2) F,S. A program of physical development and coordinated movement.

PE 236 Track and Field. 1(0-2) F,S. Develops knowledge, skill and interest in track and field events.

PE 237 Weight Training. 1(0-2) F,S. Provides essential knowledge of the principles of muscular strength development; and, an opportunity to acquire skill in a variety of progressive resistance exercises.

PE 239 Modern Dance. 1(0-2) F,S. Knowledge, skill and application of modern dance. It emphasizes the basic fundamentals of body movement executed to music.

INDIVIDUAL SPORTS

PE 234 Square Dance. 1(0-2) F,S. Coeducational course in square dance covering mixers, clogging, Schottische, two-step, Polka, Waltz, and Mazurka. Western square dancing also included.

PE 240 Social Dance. 1(0-2) F,S. Fundamentals of leading and following including fox-trot, swing, waltz, cha-cha-cha and rumba.

PE 241 Angling. 1(0-2) F,S. Spin, fly and bait casting and an understanding of game fishing.

PE 242 Badminton. 1(0-2) F,S,Sum. Skill development in the fundamental skills and strategy of the sport are emphasized. Includes history and rules of competition.

PE 243 Bowling. 1(0-2) F,S. Ball selection, grips, stance and delivery along with rules, history, scoring and the general theory of spare coverage.

PE 244 Fencing. 1(0-2) F,S. Fundamentals, skills, techniques and rules.

PE 245 Golf. 1(0-2) F,S,Sum. Teaches beginners the grip, stance, swing and use of the various clubs, along with the history of sport and etiquette of play.

PE 246 Handball. 1(0-2) F,S. Fundamental skills, history and rules.

PE 247 Roller Skating. 1(0-2) F. The fundamental skills of skating, emphasizing balance and speed.

PE 248 Squash. 1(0-2) F,S. Fundamental skills, history and rules.

PE 249 Tennis I. 1(0-2) F,S,Sum. Gives beginners a knowledge of history, rules and strategy as well as fundamental skills of tennis.

PE 250 Tennis II. Preq: PE 249 or equivalent. 1(0-2) F,S. A follow-up of PE 249 with emphasis on game strategy and doubles play.

PE 251 Target Archery 1(0-2) F,S, Sum. Emphasizes development of fundamental skills; including safety, competition, and selection and care of equipment.

PE 252 Downhill Skiing. 1(0-2) F,S. Fundamentals including safety, care of equipment, control, straight run, turns, and slalom. Offered in December during holidays and spring semester break dependent upon weather conditions. Minimum of 3 days on slopes required for credit.

PE 253 Orienteering. 1(0-2) F,S. To teach the skills used in the sport of orienteering. Orienteering is the ability to navigate on foot from defined point to defined point, with use of map and compass, in the shortest possible time.

PE 254 Beginning Equitation. (Full Semester) 1(0-2) F,S. Beginning course emphasizing hunt seat equitation, care of horse and tack and control skills at the walk, trot and canter. (Offered in conjunction with MacNair's Stables under supervision of Department of Physical Education).

PE 255 Sailing. Preq: Pass department swimming test. (Five days for 5 hours per day; CPE 255 Sailing. Preq: Pass department swimming test. (Five days for 5 hours per day; Camp Morehead). 1(0-2) Spec. Fundamentals of sailing including safety, care of boats, winds, rigging, knots and basic sailing language. To be taught after commencement in a five-day period. (At least three days on boats required for credit).

PE 257 Backpacking Skills 1(0-2) eff 1/77 2/10/77

TEAM SPORTS

PE 116 Soccer. 1(0-2) F,S. Emphasizes the basic skills of soccer. Team offense and defense are taught. Includes competitive experience in class.

PE 260 Lacrosse. 1(0-2) F,S. Designed to teach the history, rules, strategy and fundamental skills of Lacrosse.

PE 261 Basketball (Men). 1(0-2) F,S. Emphasizes offensive and defensive skills development and systems of team work. Includes coverage of history and rules of the sport.

PE 262 Basketball (Women). 1(0-2) F,S. Emphasizes offensive and defensive skills development and systems of team work. Includes coverage of history and rules of sport.

~~**PE 263 Field Hockey.** 1(0-2) S. History, rules and strategy. Fundamental skills.~~ eff 1/77 2/10/77

PE 256 Racquetball 1(0-2) 2/22/78 eff 8/78

eff 1/77 2/101

PE 264 Soccer (Women). 1(0-2) F. Fundamental skills of the game. Vigorous outdoor team sport.

PE 265 Softball. 1(0-2) F,S,Sum. Fundamental skills, history and rules.

PE 267 Touch Football. 1(0-2) F. Skills, history, rules and strategy of touch football.

PE 268 Touch Football (Women). 1(0-2) F. Skills, history, rules and strategy of touch football.

PE 269 Volleyball. 1(0-2) F,S,Sum. Skills, history, rules and strategy.

VARSITY SPORTS

PE 271 Varsity Sports I. 1(0-2) F,S. For students transferring to a varsity sport for a term (eight weeks) for the first time.

PE 272 Varsity Sports II. 1(0-2) F,S. For students making their second transfer to a varsity sport.

PE 273 Varsity Sports III. 1(0-2) F,S. For students making their third transfer to a varsity sport.

PE 274 Varsity Sports IV. 1(0-2) F,S. For students making their fourth transfer to a varsity sport.

HEALTH EDUCATION

content revised 11/15/78 eff 1/79

PE 280 Emergency Medical Care and First Aid. (Full semester). 2(2-0) F,S. Knowledge and techniques for rendering prompt and appropriate first aid and/or emergency medical care in situations when the services of qualified medical personnel are unavailable or delayed. (This course does not constitute credit toward meeting physical education requirements.)

PE 285 Personal Health. (Full semester). 2(2-0) F,S. This course does not constitute credit toward meeting physical education requirements. A lecture-discussion course with emphasis on personal health including mental health, alcoholism, drugs, sexuality, nutrition, family health, diseases, health quackery and health practitioners.

Physical Oceanography

OY (MAS) 200 Introduction to the Marine Environment. Preq: High school physics, chemistry, algebra, trigonometry, and biology, or equivalent. 3(3-0) F,S. The ocean as a part of our environment; subjects include interactions between atmosphere and ocean, ocean circulation, physical and chemical properties of sea water, marine geology, and marine biology.

OY (CE, MAS) 487 Physical Oceanography. Preq: MA 202, PY 212. 3(3-0) F. History of physical oceanography; the geological and astronomical background for the field; tides and waves; fluid mechanics; characteristics of sea water; advective and convective processes; current measurements; laboratory models; and specific problems in physical oceanography.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

OY (CE, MAS) 541 Gravity Wave Theory I. Preq: EMS 303 or PY 411. 3(3-0) S. Classical gravity wave theory with emphasis on the basic mechanics of wave motions, mass transport induced by waves and various conservation laws with their applications in wave study. Graduate Staff

OY (MAS) 551 Ocean Circulation. Preq: ESM 303 or PY 411. 3(3-0) S. Basic study of the mechanics of the ocean circulation with emphasis on various simple models of circulation systems. Pietrafesa

Physics

PY 201, 202, 203 General Physics. Preq: MA 102. 4(3-3) F,S. Intended primarily for majors in physical and mathematical sciences and nuclear engineering. Staff

PY 205, 208 General Physics. Preq: MA 102. 4(3-3) F,S. Required in most engineering curricula. A study of classical and modern physics in which the analytical approach is em-

PY 101 Perspectives on Physics 1(1-0) eff 8/77 5/13/77

ployed. Demonstration lectures, recitations, problem drill and laboratory work give a working knowledge of basic principles. PY 205, mechanics, sound and heat; PY 208, electricity, light and modern physics. Staff

PY 211, 212 General Physics. Preq: (211) MA 111 or 116; (212) PY 211. 4(3-2) F,S,Sum. Designed to provide a basic though not specialized knowledge of physics. Lecture-demonstration, recitation and laboratory give a working familiarity with basic principles of mechanics, heat, sound, electricity, light and modern physics. Staff

PY 221 College Physics. Preq: MA 111 or 115. 5(5-0) F,S. Fundamental principles applied to modern science and technology. Important concepts in the classical areas of physics, along with a brief survey of modern atomic physics. Lectures and demonstrations with class participation. Staff

PY 223 Astronomy. 3(2-2) F,S. An introductory, descriptive survey designed primarily for the non-science major, but open to all. Discussion of such recent spectacular advances in astronomy as space probes, pulsars, quasars, black holes, etc. Laboratory opportunities for direct observation of celestical objects and for experiments demonstrating the methods and techniques of astronomical research. Patty

PY 231 Physics for Non-Scientists. For liberal arts students only. 3(3-0) F,S. An elementary course for non-science students. The history, philosophy, methods and fundamental concepts of physics with applications to everyday modern living. Topics in mechanics, heat, electricity, light, relativity, quantum concepts, and atomic and nuclear phenomena. Seagondollar

PY 232 Physics in Contemporary Society. Preq: PY 231 or 221 or 201-202 or 205-208 or 211-212. 3(3-0) F,S. A look at how our surroundings can be influenced and understood in terms of basic physical principles. Topics include energy sources (e.g., nuclear, solar, etc.), purposes of orbiting satellites, space travel and relativitiy, as well as applications of physics to medical, biological and environmental problems. Emphasis on "Trans-Science", where science and society interact. Topics depend on student interest. Seagondollar

PY 240 Exophysics. Preq: MA 111 or equiv. 3(3-0) F,S. A wide range of principles of physics is employed to examine problems in exophysics. Topics include conditions for life on other planets, possibility of extraterrestrial intelligence and the problems of interstellar communications. Mitchell

PY 245 Physical Principles of Photography. Preq: PY 203 or 208 or 212 or 221 or 231; CH 101 or 111. 3(2-3) F,S. The physics and chemistry of the photographic process. Students must furnish their own cameras. Cobb

FOR ADVANCED UNDERGRADUATES

PY 401, 402 Modern and Quantum Physics I, II. Preq: PY 411. 3(3-0) F,S. The basic theories of modern physics, particularly relativity and quantum mechanics. Application of these theories to atomic structure, optical spectra, x rays, nuclear physics, solid state physics and elementary particles. Park

PY 407 Introduction to Modern Physics. Preq: MA 202, PY 208. 3(3-0) F,S. The important developments in atomic and nuclear physics this century. Topics include: an introduction to special relativity, atomic and molecular structure, determination of properties of ions and fundamental particles, the origin of spectra, and nuclear reactions. Staff

PY 410 Introductory Nuclear Physics. Preq: PY 203 or 407. 4(3-2) F,S. The properties of the nucleus, and the interaction of radiation with matter. A quantitative description of natural and artificial radioactivity, nuclear reactions, fission, fusion and the structure of simple nuclei. Waltner

PY 411, 412 Mechanics I, II. Preq: PY 203 or 208, MA 301. 3(3-0) F,S. Intermediate theoretical mechanics of particles, systems of particles, fluids, and moving reference systems. The first course emphasizes the Newtonian formulation; the second introduces the Lagrangian and Hamiltonian viewpoints. Jenkins

PY 413 Thermal Physics. Preq: PY 202 or 208; Coreq: MA 301. 3(3-0) S. An introduction to the statistical study of macroscopic systems. First principles of heat and thermodynamics are reviewed. Subsequent topics covered include basic concepts of probability, the macro-

scopic states of large systems, the concepts of temperature, heat, and entropy, and the relation between these quantities. Schetzina

PY 414, 415 Electricity and Magnetism I, II. Preq: PY 203 or 208, MA 301. 3(3-0) F,S. An intermediate course in the fundamentals of static and dynamic electricity and electromagnetic theory, developed from basic experimental laws. Vector methods are introduced and employed throughout the course. Manring

PY 441 Spacetime Physics. Preq: PY 203 or 407. 3(3-0) F. An elementary introduction to the concepts and problems of spacetime physics in accord with Einstein's special theory of relativity. Historically interesting problems, e.g., the so-called clock or twin paradox, and modern problems treated by the application of the conservation laws of momentum and energy in the natural geometry of spacetime. Davis

PY 451, 452 Intermediate Experiments in Physics I, II. Coreq: PY 411, 414. 2(1-3) F,S. Experiments in mechanics, electricity and magnetism, and modern physics. Haase

PY 499 Special Problems in Physics. Preq: Consent of department. 1-3 F,S. Study and research in classical and modern physics. Topics for experimental or theoretical investigation, or a literature survey. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PY 506 Nuclear Physics I. Preq: PY 203 or 407; PY 412. 4(3-2) F. Nuclear properties and phenomena such as alpha, beta and gamma decay, accelerator-induced nuclear reactions and fission. Emphasis on experimental techniques for probing nuclear structure and interpretation of results in terms of current theories. Tilley

PY 508 Ion and Electron Physics. Preq: PY 414. 3(2-2) S. Topics include collision processes, electron emission, charged particle dynamics, gaseous discharges, and the physics of ion and electron beams. Doggett

PY 509 Plasma Physics. Preq: PY 414. 3(3-0) F. The individual and collective motion of charged particles in electric and magnetic fields and through ionized gases. Doggett

PY 510 Nuclear Physics II. Preq: PY 410. 4(3-2) S. The properties of the atomic nucleus as revealed by radioactivity, nuclear reactions and scattering experiments, with emphasis on the experimental approach. The laboratory stresses independent research and offers project work in nuclear spectroscopy and in neutron physics. Waltner

PY (NE) 511 Nuclear Physics for Engineers. Preq: PY 410. 3(3-0) F. The properties of atomic nuclei, of nuclear radiations and of the interaction of nuclear radiation with matter. Emphasis on the principles of modern equipment and techniques of nuclear measurement and their application to practical problems. Waltner

PY 516 Physical Optics. Preq: PY 415. 3(2-2) F. Emphasis on the wave properties of light. Subjects include boundary conditions, optics of thin films, interference and diffraction, applications to absorption, scattering, and laser operation. A background in Maxwell's equations and vector analysis is required. Schetzina

PY 517 Atomic and Molecular Physics. Preqs: PY 401, 412. 3(3-0) F. The quantum mechanical treatment of structure and spectra for atoms and molecules. Topics include the hydrogen atom, helium atom, multielectron atoms, selection rules, diatomic and simple polyatomic molecules, and nuclear magnetic resonance spectroscopy. Johnson

PY 520 Measurements in Nuclear Physics. Preq: PY 410. 3(2-2) S. The fundamentals of statistics (including the binominal, normal, Poisson and interval distributions) as applied to the analysis of measurements on nuclear reactions and radioactivity. Waltner

Statistical Physics Fall 78

PY 521 ~~Kinetic Theory of Gases.~~ Preq: PY 413. 3(3-0) F. A phenomenological and theoretical study of systems of dilute gases. After treatment of the continuum mechanics of fluids, the postulates of kinetic theory are presented and the derivation from them of macroscopic conservation equations, transport laws and thermodynamic properties is discussed. Parker

PY 543 Astrophysics. Preq: PY 203 or 407; PY 411. 3(3-0) S. The basic physics necessary to investigate, from observational data, the internal conditions and evolution of stars. Topics include the formation and structure of spectral lines, methods of energy generation and transport, stellar structure, degeneracy, white dwarfs and neutron stars. Danby

PY (EE) 552 Introduction to the Structure of Solids. Preq: PY 401. 3(3-0) S. Basic considerations of crystalline solids, metals, conductors and semiconductors. Lado

PY (MA) 555 Mathematical Introduction to Celestial Mechanics. 3(3-0) F. (See mathematics, page 270.)

PY (MA) 556 Orbital Mechanics. 3(3-0) S. (See mathematics, page 270.)

PY 581, 582 Quantum Mechanics I, II. Preq: MA 512; PY 411 or 414; grad. standing or permission of graduate administrator. 3(3-0) F,S. Fundamental concepts and formulations, including interpretation and techniques, and the application of theory to simple physical systems, such as the free particle, the harmonic oscillator, the particle in a potential well and central force problems. Other topics include approximation methods, identical particles and spin, transformation theory, symmetries and invariance, and an introduction to quantum theory of scattering and angular momentum. Lado

PY 583, 584 Advanced Classical Mechanics I, II. Preq: MA 512, PY 412, PY 414; grad. standing or permission of the graduate administrator. 3(3-0) F,S. An introduction to theoretical physics in preparation for advanced study. Emphasis is on classical mechanics, special relativity and the motion of charged particles. Topics include variational principles, Hamiltonian dynamics and the canonical transformation theory, structure of the Lorentz group and elementary dynamics of unquantized fields. Hall

PY 585, 586 Advanced Electricity and Magnetism I, II. Preq: PY 415; grad. standing or permission of the graduate administrator. 3(3-0) F,S. Topics include: techniques for the solution of potential problems, development of Maxwell's equations; wave equations, energy, force and momentum relations of an electromagnetic field; covariant formulation of electrodynamics; radiation from accelerated charges. Chung

PY 599 Senior Research. Preq: Sr. honors program standing, except with special permission. 3 F,S. Investigations in physics under staff guidance. May consist of literature reviews, experimental measurements or theoretical studies. Staff

PY 610 Theoretical Nuclear Physics 3(3-0) 3/17/77 off 1/77
PY 622 Statistical Physics II 3(3-0) 6/15/77 off 8/78

Physiology

PHY (ANS) 502 Reproductive Physiology of Vertebrates. 3(3-0) S. (See animal science, page 189.)

PHY 503 General Physiology I. Preq: Sr. or grad. standing. 3(3-0) F. The general principles of homeostasis emphasizing the importance of integrative action. Study of following systems: respiratory, cardiovascular, renal, reproductive, and myological. Longmuir, Staff

PHY 504 General Physiology II. Preq: Sr. or grad. standing. 3(3-0) S. The general principles of homeostasis emphasizing integrative action. Study of: alimentary, reticuloendothelial, central nervous, autonomic nervous, and endocrine systems; detoxification mechanisms; special senses, and the response of man to the environment. Longmuir, Staff

PHY (ZO) 513 Comparative Physiology. 4(3-3) S. (See zoology, page 329.)

PHY (BCH) 533 Physiological Biochemistry. 3(3-0) S. (See biochemistry, page 192.)

PHY (BCH) 553 Physiological Biochemistry. 3(3-0) (See biochemistry, page 192.)

PHY (ZO, ENT) 575 Physiology of Invertebrates. Preq: CI. 3(3-0) S. The course deals with the physiology of the invertebrates, including the Insecta but excluding the Protozoa. The unity of the physiology of the various groups is stressed, and the relationship of physiology to contemporary biology and to other related biological fields will be illustrated. Graduate Staff

PHY (ANS) 580 Mammalian Endocrine Physiology. 3(3-0) F. (See animal science, page 189.)

FOR GRADUATES ONLY

PHY 590 Special Problems in Physiology. Preq: CI. Credits Arranged.

Phy 552 (MB, PO, Vet) Immunobiology 3(2-3) off 6/77

PP 313 Diseases of Herbaceous Ornamentals 1(0-3) eff 8/77
311 Diseases of Vegetables Crops 1(0-3) eff 1/78 11/24/76

Plant Pathology

PP 310 Diseases of Fruit Crops 1(0-3) eff 8/77

PP 315 Plant Diseases. Preq: BS 100. ~~3(2-3)~~ F,S. The nature and symptoms of plant disease and characteristics of plant pathogenic nematodes, viruses, bacteria and fungi. Concepts and methods of disease control developed, based on knowledge of major types of diseases. 3(2-3) eff 8/78 revised 8/77 Grider, Beute

PP (FOR) 318 Forest Pathology. Preq: BS 100 or equivalent. 4(3-2) S. Major types of diseases of forest trees and deterioration of wood products are studied emphasizing: 1) principles of plant pathology; 2) symptomatology and diagnosis; 3) nature of disease-causing agents; 4) physiology, ecology and dissemination of disease-causing agents; 5) mechanisms of pathogenesis; 6) epidemiology and environmental influences; 7) principles of control. Grand

PP 450 Nematode Diseases of Plants and Their Control. Preq: PP 315 or 318. 2(1-3) F. This course will consider important plant diseases caused by pathogenic nematodes. Laboratory methodology, as well as diagnostic techniques will be studied, including assay of soil and plant tissues for nematodes. Morphology and anatomy of important pathogenic genera will be compared with non-pathogenic soil forms. Kinds and population densities will be considered in relation to symptoms and plant damage. General biology, including life cycles, host-parasite relationships, environmental influences, and principles and practices of control will be considered. Sasser, A. Triantaphyllou

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PP 500 Plant Disease Control. Preq: PP 315. 3(2-3) S. Disease control strategies and tactics. Consideration of control economics and practices in relation to principles and current research, disease resistance and regulatory methods. Jenkins, Spurr

PP 501 Phytopathology I. Preq: PP 315 or equivalent. ~~5(3-6)~~ 4(2-6) 4/6/78 eff 8/78 F. Classification, terminology, etiology and basic concepts of plant diseases caused by fungal, bacterial and abiotic agents. In-depth studies of carefully selected examples illustrate and integrate general principles. Laboratory devoted to research and diagnostic techniques including media preparation, isolation and study of pathogens in pure culture, inoculation, symptom development and disease measurement. L. Lucas, Echandi

PP 502 Phytopathology II. Preq: PP 315 or equivalent. 5(3-6) S. Viruses and nematodes as plant pathogens. Major topics such as physiology of the diseased plant, variation of plant pathogens, epidemiology, and control of plant disease. Lab. — useful research and diagnostic techniques used in the study of viruses, nematodes, epidemiology and control. Powell, Main, Barker, Moyer

PP 503 Identification of Plant Pathogenic Fungi. Preq: Mycology or one advanced PP course. 3(4-12) Sum. Recognition and identification of fungi which cause plant diseases and differentiation of fungal diseases from those caused by other agents. Use of keys in identifying fungi and major sources of descriptive information on plant pathogens. (Offered Sum. 1978 and alt. years) Grand

PP 505 Virology 2(1-3) eff 1/77

PP (BO, MB) 575 The Fungi 4(3-0) F. (See botany, page 196.)

PP (BO, MB) 576 The Fungi Lab. 1(0-3) F. (See botany, page 196.)

PP 595 Special Problems in Plant Pathology. Preq: CI. Credits Arranged. Maximum 6. Investigation of special PP problems (original research or literature survey) not related to a thesis problem. Staff

PP 615 Botanical Epidemiology 4(2-6) 11/10/77 eff 1/79

Political Science

PS 201 The American Governmental System. 3(3-0) F,S. A study of the American federal system, integrating national and state government, with emphasis on constitutional principles, major governmental organs, governmental functions, and the politics and machinery of elections. Some attention to other types of political systems, and comparisons made where relevant. Staff

PS 202 American Government Laboratory. ~~Preq. or Coreq: PS 201. 1(0-3) S.~~ Various exercises will be undertaken through which several facets of American government and politics can be explored. These exercises will include trips to local federal agencies, the

eff 1/78

PS 210 Introduction to Public Policy 3(3-0) 8/15/78 eff 8/78

Federal District Court, meetings with federal officials, political simulations, political surveys, and library exercises. Kebschull

PS 206 Local Governmental Systems. 3(3-0) F,S. In addition to examination of traditional local forms — city, county, township, and district — attention to the national, state, and regional contexts for local government. Topics include federalism and intergovernmental relations, governmental structures, political processes and political power, urbanization and problems of social and technological change, and approaches to reform. McClain, Rassel, Clary, Block

PS 231 International Relations. 3(3-0) F. The patterns of international life, the controls upon international behavior, including the development of the United Nations and the major problems in international relations since World War II. Attention to the national interests and foreign policies of the states belonging to the Western and Soviet blocs, with emphasis on the positions of the United States and the Soviet Union, and to the development and impact of newly emerging nations. Petersen

PS 236 Introduction to Global Politics. 3(3-0) F,S. Man's political activities viewed from a dynamic and future-oriented, global (planetary) perspective. The structure of the global political system in terms of the principal actors, including nation-states, international organizations, multi-national corporations, and subnational actors. Attention to problems having planetary dimensions, such as wars and arms races; poverty, inequality, and injustice; and the ecological concerns of population growth, resource depletion, and pollution. Soroos

PS 271 Introduction to Political Science. 3(3-0) F,S. A survey of existing knowledge about politics and political systems, including the theories and characteristics of political behavior and political institutions within and among nation-states. Peterson, Kebschull

298 Special Topics in Political Science 3(3-0) 2/23/78 eff 8/78

PS 303 Black Americans in American Politics. Preq: Six hours of social science. 3(3-0) F,S. The political activity of the Afro-American; the sources of and the kinds of attitudes he brings into the American political system; the contrast in political activity engaged in by different black groups and reasons for the differences; the impact of the blacks' efforts on policy-making institutions such as city councils, legislatures and executive branches of government at the state and national level. Staff

PS 306 The Legal Subsystem: Law and Courts in the American Political System. 3(3-0) F,S. The role of courts, state and federal, in the political system, including: 1) structure, court organization and legal personnel, 2) law and the need for social order, including the role of protest and civil disobedience, and 3) functions performed by courts in the political system, from dispute settling to the initiation of social change. Rubin

PS 311 Criminal Justice Policy Process. 3(3-0) F,S. The processes of formulating and implementing policies in various criminal justice institutions. Police agencies, solicitors' offices, courts, prisons, and probation and parole departments are analyzed as public bureaucracies. Emphasis on how key executives — police chiefs, judges, and prison wardens — interact with subordinates and with the larger political environment outside their organization. Students consider policy alternatives and obstacles administrators encounter in trying to get compliance with policy directives. Fairchild

PS 313 Women and Public Policy. 3(3-0) F,S. The course examines the role of women as participants in a policy-making system, the processing of feminist demands within that system, the impact of public policy from a feminist perspective, and emerging issues in the women's rights movement. Stewart

PS 331 U.S. Foreign Policy. 3(3-0) F. The determinants of American foreign policy and the economic, military, strategic, and psychological factors conditioning that policy. Emphasis on policy formulation, including the roles of the Executive, Congress, and public opinion, and on problems of content and execution. Gilbert

PS 332 Soviet and Soviet Bloc Foreign Policy. Preq: Jr. standing. 3(3-0) F,S. The elements of continuity and change in Soviet foreign policy from 1917 to the present and the post World War II policies of the Eastern European states. Foreign policy decisions are examined in light of the national interests of the Soviet Union and the Eastern European states. Attention to the emergence of polycentrism, the Sino-Soviet split, and Soviet bloc relations with the West. Mastro

PS 307 Introduction to Criminal Law in the United States 3(3-2) 11/9/77 eff 1/78
298

PS 308 Supreme Court and Public Policy 3(3-0) 8/15/78 eff 8/78

PS 312 Introduction to Public Administration 3(3-0) 11/2/78 eff 8/78

PS 336 Global Environmental Politics. 3(3-0) F,S. A global perspective of the political dimensions of man's relationship to the natural environment. Attention will be given to emerging international political problems related to population growth, food supply, energy and mineral resources, and environmental pollution. Proposals for coping with these problems on an internatioal or global basis will be investigated. Soroos

PS 341 Contemporary Western European Political Systems. 3(3-0) F. Focuses upon the contemporary political systems of Great Britain, France, and the Federal Republic of Germany. The political cultures, institutions, and processes of each will be analyzed to distinguish the similarities and differences of these three democracies. Brief attention will be given to some of their major social and economic policies and to the movements to integrate these states as part of the effort to integrate the states of Western Europe. Kebschull

PS 342 Political Systems of China and Japan. 3(3-0) S. A comparative analysis of the structure and processes of politics in China and Japan. Petersen

PS 343 Southeast Asia: Politics and Political Change. 3(3-0) S. The political systems and the processes of political change in 10 states of Southeast Asia from Burma on the west to the Phillipines on the east. Some attention to individual case studies of political systems, but primarily presented in a comparative manner dealing with particular challenges and responses common to several systems. Tilman

PS 344 Soviet Politics. 3(3-0) F,S. The contemporary Soviet political system, its structure, functions and processes, with brief consideration of the historical and ideological base of Soviet politics. Analysis designed to elucidate the similarities and differences of the Soviet system with other political systems. The Soviet system will be tested against a theoretical model of totalitarian dictatorships. Mastro

PS 345 Governments and Politics in the Middle East. 3(3-0) S. An overview of the historical, socio-cultural, economic and ideological characteristics of the Middle East, and of various countries within the region, for the purpose of considering in detail the processes and problems of political modernization and the nature of conflicts, particularly the Arab-Israeli conflict. Hurwitz

PS 346 Political Systems of New States. 3(3-0) F. General characteristics of the political systems of the new states in Asia and Africa. Survey of the pattern and nature of colonialism, the independence movements, and the contemporary social and economic conditions of the new states. Focus on political ideologies, elites, and organizations and processes. Attention to the role of intellectuals and the military. An examination of major political, social, and economic problems. Kebschull

PS 361 Introduction to Political Theory. 3(3-0) F,S. The course will examine the basic questions of the nature and purpose of politics and the principles of political right as treated by such writers as Plato, Aristotle, Machiavelli, Locke, Mill, Rousseau, Marx, and Nietzsche. Attention will be given to their treatments of the criteria of civil justice, the relationship between human nature and politics, and the character of political wisdom. Emphasis will be placed on careful reading of primary texts. Marshall, Kessler

PS 371 Methodology of Political Science. Preq: PS 201 or 271 or CI. 3(3-0) F,S. An analysis of the principles and procedures of political science research including: 1) the philosophy of science; 2) theory construction; 3) sampling, measurement of political variables and research designs; and 4) other methods of political research, such as content analysis, use of aggregate data and simulation research. Soroos

PS 401 American Parties and Pressure Groups. 3(3-0) F. Political parties and interest groups as instruments for shaping public policy and implementing democratic values. They are considered as variables in the larger American system within which they exist. Attention on the nature of organization, membership and leadership recruitment process, and problems in aggregating votes. Topics such as political style — the relationship between major and minor parties and the differences between the major parties. Holtzman

PS 402 Campaigns and Elections in the American Political System. Preq: PS 201. 3(3-0) F,S. Deals with the nature and functions of campaigns and elections in the American political system. Among the topics to be explored are American electoral behavior, techniques of political campaigning, recent reforms in campaign financing, the role of political parties in campaigns and elections, the classification of elections, with particular concern directed to the concepts of "issue voting" and "realignment." Hurwitz

PS 406 Politics and Policies of American State Governments. 3(3-0) F,S. A comparative study of the politics and policies of the 50 states. Cultural, socio-economics and political variations and state response to intergovernmental domestic programs. The analysis of state efforts in taxation, education, health, welfare, transportation and regulatory policies, the implementation and administration of national programs in the state and the state's role in urban affairs. Williams

PS 408 Urban Politics in a Changing South. Preq: Jr. standing. 3(3-0) F,S. A study of urban and urban-related problems through theories from politics, sociology, and economics, and their application to an existing environment. Formal study and research in various local communities. Students will be involved with public and private agencies and with local leaders in ongoing programs in Raleigh and adjacent communities. Clary

PS 411 Public Opinion ~~in Democracies~~ and the Media Revised 7/20/78 eff 1/79 **Preq: ~~Three~~ hours PS. 3(3-0) F,S. The nature of public opinion and its functions in a ~~democratic~~ system of government. Focus is primarily on public opinion in the United ~~States~~ but also comparisons with other nations. Areas emphasized are: theories concerning opinion formation and functions, public opinion research methodology, public opinion and policy development, and empirical studies on public opinion. Clary

PS (SOC) 413 Criminal Justice Field Work. Preq: Acceptance in criminal justice option; senior standing; SOC 306 and PS 311. 4(2-8) F,S. (See page 311.)

PS 413 Administration of Criminal Justice 3(3-0) 3/2/78 eff 8/78

PS 431 International Organization. 3(3-0) S. The evolving machinery and techniques of international organization emphasizing the establishment, operation and development of the United Nations. Petersen

PS 436 Politics of War and Peace. 3(3-0) F. Alternative conceptions of conflict, violence, and peace; the problems of wars and of arms races; approaches to arms control and disarmament; strategies of conflict management and reduction; theories of development; and designs of alternative future world orders. Soroos

PS 437 National Security Policy. Preq: PS 331. 3(3-0) S. An investigation into 1) the making of security policy, including the role of the Executive, Congress, and nongovernmental actors; 2) the evolution of changing assumptions, strategies, and goals; and 3) the nature of U.S. security requirements, U.S. military commitments abroad, and the "costs" of strategies based on arms superiority, arms control and disarmament. Gilbert

PS 445 Contemporary Issues in Law Enforcement 3-0 4/6/78 eff 1/79

PS 446 Comparative Communist Systems. Preq: PS 344 or 332. 3(3-0) S. A study of the international Communist movement and the evolution of the international sub-system of Communist states. Focuses on the Soviet and Chinese systems as alternative models for development in Communist and non-Communist states. Additional emphasis is placed on the institutional, political and ideological similarities and differences within the Communist world and major Communist parties outside the Communist state system. Mastro

PS 447 Political Development. Preq: Six hours of political science. 3(3-0) F,S. Alt. yrs. Examines the concept, theories, characteristics and problems of political development. Information derived from comparative cultural and political studies is employed in an attempt to discover patterns of change related to political development. Individual states and areas of the world are examined to evaluate the successes and failures in achieving political development. Kebschull, Hurwitz

PS 448 Politics of European Integration. Preq: Six hours comparative politics. 3(3-0) S. Focuses on the political forces, institutions, and processes affecting the movement toward European integration. Primary consideration is given to the politics of the European community, composed of the European Economic Community (the Common Market), the European Coal and Steel Community, and the European Atomic Energy Community. The supranational characteristics of the Community's institutions and laws are compared with those of the member states. Individual research papers are required. Kebschull

PS 461 Jurisprudence. Preq: ~~Junior~~ standing. ~~3(3-0)~~ S. An exploration of the major schools of juristic thought, the purposes of law and its sources, public and private law, and selected legal concepts. revised 3/78 Cahill

PS 496 Governmental Internship and Seminar. Preq: Jr. standing and approval of committee of selection. 3-6 S,Sum. Formal seminars; lecture-discussions by political scientists, legislators, executives, judges, representatives of special interests and news media; four to six

PS 490 Readings and Research in Political Science (1-6) 2/23/78 eff 8/78
300
PS 491 Internship in Political Science 1-6 2/23/78 eff 6/78
PS 492 Honors Readings and Thesis in Political Science 3-6 eff 8/78

PS 471 Survey Research 3(3-0) 4/24/78 eff 1/79

hours a day working on assignment to and under supervision of legislators or executives; formal report at completion of an internship. Staff

PS 498 Special Topics in Political Science. Preq: Six hours PS. 3-6 F,S. Detailed investigation of a topic. Topic and mode of study determined by the student and a faculty member. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PS 502 The Legislative Process. Preq: PS 206 or CI. 3(3-0) S. A study of the formulation of public policy from the institutional and behavioral viewpoints. Important current legislative problems at the congressional and state legislative levels will be selected and will serve as a basis for analyzing the legislative process. Holtzman

PS 506 American Constitutional Theory. Preq: PS 271 or CI. 3(3-0) F. Basic constitutional doctrines, including fundamental law, judicial review, individual rights and political privileges, and national and state power. Special attention is given to the application of these doctrines to the regulation of business, agriculture and labor and to the rights safeguarded by the First, Fifth and Fourteenth Amendments to the Constitution. Cahill

PS 507 Constitutional Theory II. Preq: Advanced undergrad. or grad. standing. 3(3-0) S. A continuation of PS 506, but may be elected separately. An examination of leading constitutional cases, especially in the fields of civil liberties and individual rights, and the writings of leading commentators. Cahill

PS 508 Urban Politics. Preq: PS 206. 3(3-0) F. A comparative study of political conditions in cities and localities. Topics will include the formal structures and rules of city and metropolitan governments, and the relationships to the informal norms and distribution of power; patterns of local decision-making; elite recruitment and citizen participation; variations of local autonomy and the scope of local politics; and approaches to urban policy issues. Clary

PS 509 Problems in Urban and Metropolitan Area Government. Preq: PS 206 or CI. 3(3-0) S. This course examines theory and research on problems affecting governments in metropolitan areas. Principal attention is given to those problems which affect (or result from) governmental structure, institutions, and politics and to the alternative approaches to their solution. Clary

PS 511 Public Administration. Preq: PS 271 or CI. 3(3-0) F,S,Sum. A study of the factors which contribute to goal displacement in public agencies and the institutions, concepts and techniques which may be used in such agencies to reduce the effects of these factors. Block, McClain, Rassel, Stewart, Swiss

PS 512 Comparative Administration. Preq: PS 511 or 346 or CI. 3(3-0) F,S. Concentration will be on administrative systems of developing nations with limited attention to developed systems. The major emphasis will be on administrative aspects of governmental change and modernization in developing nations; colonial influence on administration; problems of establishing new nations and adapting to change in established states; bureaucratic development and behavior; theories of development administration. Staff

PS 514 Public Finance. Preq: EB 205. 3(3-0) F. A survey of the theories and practices of governmental taxing, spending, and borrowing, including intergovernmental relationships and administrative practices and problems. McClain

PS 516 Public Policy Analysis. Preq: Graduate standing; advanced undergrad. standing and CI. 3(3-0) F,S,Sum. Course will focus on the theories and methodology of analyzing and explaining public policy and the substance of recent domestic policies in the human and physical resources area, including welfare, poverty, education, housing, urban renewal, transportation, recreation-conservation, and agriculture. Williams

PS (SOC) 517 The Police Bureaucracy in a Democratic Society. Preq: Sr. or grad. standing. 3(3-0) F,S. This is a political science seminar which focuses on the proposition that police departments are bureaucratic organizations which can be studied as such. Emphasis is placed on understanding the process by which police policy is made. Internal and external, psychological and structural variables are identified in tracing decisions on specific issues. Thus, attitudes of policemen, the nature of their work, and the resources and power of various constituencies are factors seen as determining police behavior. Staff

PS 561 Political Thought: Plato to the Reformation. Preq: CI. 3(3-0) F. The emergence

PS 536 Global Food and Resource Policy 3(3-0) 9/7/78 eff 1/79

and development of the theories underlying or explaining the political aspects of behavior, approached through the study of the writings of the principal political philosophers from the days of the Greek city-state to the Reformation. Marshall, Kessler

PS 562 Modern Political Theory. Preq: CI. 3(3-0) S. 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 16th century to the present. Marshall, Kessler

PS 563 Power and Ideology. Preq: Advanced undergrad. or grad. standing. 3(3-0) F. This course will explore competing theories of power and its distribution in the United States, and of the nature of ideology. It will analyze various forms of elite theory, particularly pluralist theory and its critics and of empirical democratic theory, with specific reference to the concepts of power and ideology. Primary attention will be given to the case of the United States, with projections made regarding the nature of power and ideology, and the prospects for democracy in post-industrial societies. Hurwitz

PS 565 American Political Thought. Preq: Sr. or grad. standing. 3(3-0) F,S,Sum. The course will examine and evaluate major American writings on the nature and purpose of politics. Readings will be grouped under the following topics: (1) various interpretations of the American Constitution and the principles embodied therein; (2) writings on civil and natural rights; (3) the character of American liberalism; (4) Black American political thought and (5) the contemporary crisis in liberal thought. The purpose is to develop the independent capacity to read and reflect with care on the grounds of different views about American politics. Marshall, Kessler

PS 569 Topics in Political Theory. Preq: Sr. or grad. standing. (Maximum of 6 hours may be taken). 3(3-0) F,S. A close examination of particular topics or theorists that are not included in the basic courses in political theory. Course content changes in different years, and, with permission of instructor, the course may be repeated for credit. Examples of course topics are: "Foundations of Modern Radicalism," "Twentieth Century Political Philosophy and Political Science," "Political Philosophy and the Problem of Law," and "Origins of Political Science." Marshall, Kessler

PS 571 Scope and Method of Political Science. Preq: PS 201 or CI. 3(3-0) F,S,Sum. This course reviews contemporary theories, concepts and methods fundamental to the study of politics. It emphasizes current empirical research and the collateral involvement in research activities aimed at the development of basic skills in this area. Williams, Rassel, Clary

PS 572 Applied Research Revised 3/16/78 eff 1/78
Research Analysis 3(3-0) a/1/78 eff 1/79

Product Design
(See Design)

Poultry Science

PO 201 Poultry Science and Production. Preq: BS 100. 4(3-3) F,S. Fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing. Parkhurst

PO 301 Evaluation of Live Poultry. Preq: PO 201. 2(1-3) S. Experience in evaluating live poultry for production and breeder stock potential. Emphasis on techniques and critera used in selecting poultry for use in commercial production units. Parkhurst

PO 351 Grading and Evaluation of Poultry Products. Preq: PO 301. 2(1-3) F. Experience in grading and evaluating poultry products, such as dressed broilers, fowl, turkeys, shell eggs and broken out eggs. Parkhurst

PO (VET) 401 Poultry Diseases. 4(3-3) S. (See veterinary science, page 326.)

PO 402 Commercial Poultry Enterprises. 4(3-3) S. Principles of production and incubation of hatching eggs; hatchery operation; organization and development of plants for the operation and maintenance of commercial facilities for poultry meat and egg production; building construction, insulation and equipment and management methods. Staff

PO (FS) 404 Poultry Products. 3(2-3) F. (See food science, page 240.)

PO 405 Avian Physiology. Preq: CH 220. 4(3-3) F. The principles of avian physiology integrating the physiological processes and the associated anatomical structures that insure the homeostatic state in birds.

PS 590 Readings and Research 1-3 10/27/77 eff 1/78
PS 691 Internship in Public Affairs 1-6 10/27/77 eff 1/78
PS 598 Special Topics in Political Science 1-6 9/1/78 eff 9/78

PO 420 Turkey Production 2(1-2) 11/23/77 eff 1/78
PO 421 Commercial Egg Production 2(1-2) 11/23/77 eff 1/78
PO 422 Incubation and Hatchery Management 2(1-2) 11/23/77 eff 8/
PO 423 Broiler Production 2(1-2) 11/23/77 eff 8/78

PO 410 Production and Management of Game Birds in Confinement. Preq: PO 201. 3(2-3) S. Principles of management associated with the successful propagation and rearing of game birbs, ornamental birds and waterfowl in confinement. Included will be information related to permit requirements at the state and federal level as well as shooting preserve regulations. Housing and pen requirements, nutrition and disease control will also be stressed.

Parkhurst

PO (ANS, NTR) 415 Comparative Nutrition. Preq: CH 220 or 221. 3(3-0) F. Fundamentals of animal nutrition, including the classification of nutrients, their requirement and general metabolism by different species for health, maintenance, growth and other productive functions. Donaldson or Ramsey

PO 490 Poultry Seminar. Preq: Required of PO srs. 1(1-0) S. Current topics and problems are assigned for oral report and discussion. Cook

PO 495 Special Problems in Poultry Science. Preq: Jr. standing and CI. 1-6 F,S. Individualized study of problems in student's interest area and not covered in scheduled courses. Emphasis on research problems developed with faculty approval. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PO (GN) 520 Poultry Breeding. Preq: GN 411. 3(2-2) S. Application of genetic principles to poultry breeding considering physical traits and physiological characteristics — feather patterns, egg production, hatchability, growth, body conformation and utility. Krueger

PO (ZO) 524 Comparative Endocrinology. Preq: ZO 421 or equivalent. 4(3-3) S. The endocrine system with respect to its physiological importance to metabolism, growth and reproduction. Prince

PO 552 Immunobiology 3(2-3) eff 6/77 (MB; Ph 4; Vet)

Psychology

PSY 200 Introduction to Psychology. 3(3-0) F,S,Sum. General characteristics of human behavior, including motivation, learning, development, thinking, perception, 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 and a capacity to use scientific ideas and processes as they apply to behavior; an understanding of the behavior of organisms. Staff

PSY 210 Psychological Analysis Applied to Current Problems. Preq: PSY 200. 3(3-0). F,S,Sum. Explores the psychological bases of certain current social problems. Emphasis is on review of pertinent literature and planning simple research projects. Problems studied from a set of relevant problems: violence and aggression, equal rights for women, attitude change, rehabilitation, population growth, service delivery systems, etc. The interests and abilities of students and teacher and availability of literature will be the principal criteria for problem selection. Juniors and seniors are advised to take PSY 412 rather than PSY 210. Smith

PSY 300 Perception. Preq: PSY 200, introductory BS, CH or PY recommended. 3(3-0) F,S. An introduction to anatomy and physiology of major sensory systems, their relation to central structures, and basic problems dealt with by psycho-physics. Examination of the chief determiners of perception, including both stimulus variables and such organismic variables as learning, motivation, and attention. The discussion of perceptual theory and processes emphasizes topics in two- and three-dimensional spatial perception. Mershon

PSY 304 Educational Psychology. 3(3-0) F,S,Sum. Introduction to a model of instruction through readings, group activities, and class discussions. Engages student in activities which employ some concepts of educational psychology. Staff

PSY 310 Learning and Motivation. Preq: PSY 200. 3(3-0) F. Acquaints students with the structure of the areas of learning and motivation and with the major theories and empirical findings in these areas. Develops skill in deriving and testing implications of theories and in manipulating theoretical concepts. Cole

PSY 320 Cognitive Processes. Preq: PSY 200. 3(3-0) F,S. Complex cognitive processes such as: thinking, reasoning, problem solving, creativity and originality, intelligence, social interaction, verbal behavior and decision processes. Emphasis on theoretical approaches,

research findings. Aims at developing skills in deriving and testing hypotheses in these areas. Newman

PSY 337 Psychology, Industrial Society and Social Policy. Preq: PSY 200. 3(3-0) F,S. Current problem areas in human resource development for modern technological societies are considered, emphasizing systems approaches as a unifying concept. General systems concepts, methods of industrial psychology, human resource development and social psychology are jointly introduced and their implications considered. Policy formulation, analysis, implementation, evaluation, feedback, and citizen participation are stressed. An exemplary human resource development system is defined; procedures for analysis, evaluation and for possible design alternatives are explored in the context of modern urban-industrial societies. Cunningham

PSY (IE) 338 Human Factors in Equipment Design. Preq: PSY 337 or IE 332. 3(2-2) F. An introduction to methodology in human factors research, equipment design, biomechanics, and accident study. Man's sensory, motor, and decision-making abilities are related to problems of systems design, operator efficiency, and safety as these involve displays, controls, workplace layout, and environmental stressors. Pearson

PSY 350 Interviewing and Behavior Observation Skills. Coreq: PSY 351, 352, SP 231. 4(2-6) F,S. Instruction and practice in interviewing. Developing skill in behavior observation with children of all age levels and with adults, particularly those from disadvantaged and varied cultural backgrounds. Use of communications and instructional media such as video tape, audio tape, and varied observational techniques and instruments. Cowgell

PSY 351 Instructional Skills. Coreq: PSY 350, 352, SP 231. 4(2-6) F,S. Development of skills in the psychology of instructing, tutoring, instructional programming, and instructional communication. Emphasis on disadvantaged learners, problems of measurement, evaluation, and test construction. Cowgell

PSY 352 Organizational Skills. Coreq: PSY 350, 351, SP 231. 4(2-6) F,S. Topics are: 1) Current theories of organizational structure and process applicable to human serving organizations, 2) problems associated with change and intervention in human serving organizations, 3) recognition and determination of organizational goals, and 4) organizational gaming. Cowgell

PSY 370 Psychology of Personality and Adjustment. Preq: PSY 200. 3(3-0) F,Sum. Mechanisms influencing human behavior related to crisis resolution, effective adjustment and personal fulfillment. Includes a supervised group interaction laboratory and a major semester problem as well as lectures and examinations. Staff

PSY 376 Human Growth and Development. Preq: PSY 200 or 304. 3(3-0) F,S. Study of behavioral development during the human life span through 1) studying current theories and 2) working with persons at various stages of the life cycle. Student problems require applications of concepts drawn from developmental psychology. Staff

PSY 400 Perception: Research Methods. Preq: PSY 300; Coreq: ST 311. 3(1-4) F. The various methodologies and research strategies currently employed in the area of perception. Includes extensive individual experience in the perception research laboratory, readings of both methodology and experimental research, and the conduct of an independent project of original design within the area of perception. Mershon

PSY 410 Learning and Motivation: Research Methods. Preq: PSY 310; Coreq: ST 311. 3(1-4) S. The various methodologies and research strategies currently employed in learning and motivation. Includes extensive individual experience in the activities of the Operant laboratory, readings on both methodology and experimental research, and the conduct of an independent project of original design within the area of learning and motivation. Cole

PSY 411 Social Psychology. Preq: PSY 200. 3(3-0) S,Sum. A study of the importance of social factors for the behavior of individuals. Topics include affiliation, interpersonal attraction, person perception, attitude formation and change, conformity, and altruistic behavior. Luginbuhl

PSY 412 Psychological Research Applied to Current Problems. Preq: PSY 200 and ST 311. 3(3-0) S. Emphasis from a psychological perspective is given to application of conceptual and technical skills relevant to understanding and acting on social problems. Basic material will include: governmental agencies and social action, models of behavior systems,

research techniques and computer-based data processing. Specific social problems will be selected for class demonstration projects. The interests and abilities of students and teacher will be the principal criteria for project selection. Smith

PSY 420 Cognitive Processes: Research Methods. Preq: PSY 320; Coreq: ST 311. 3(1-4) F. The various methodologies and research strategies currently employed in cognitive processes. Extensive individual experience in the activities of the Cognition Research Laboratory, readings on both methodology and experimental research, and the conduct of an independent project of original design with the area of cognitive processes. Newman

PSY 430 Neuropsychology: Research Methods. Preq: PSY 400, 410, 420; or CI 3(1-4). The various methodologies and research strategies currently employed in neuropsychology. Includes extensive individual experience in the activities of the Neuropsychology laboratory, and readings on both methodology and experimental research. LeVere

PSY 475 Child Psychology. Preq: PSY 200 or 304. 3(3-0) F,S. Emphasis upon the intellectual, social, emotional and personality development of the child. Physical growth emphasized as necessary to an understanding of the psychological development of the pupil. Staff

PSY 476 Psychology of Adolescent Development. Preq: Junior standing. 3(3-0) F,S. Considers adolescent behavior as part of the development sequence of human behavior with emphasis on the adolescent experience in Western culture and implications for the instruction of adolescents. Taylor, Chmielewski

PSY 491, 492 ~~Seminar in Psychology.~~ Preq: ~~Sr. standing, consent of department~~ 3(3-0) F,S. Provides the undergraduate psychology major with skill in designing and conducting independent research studies; sources and skill in locating information pertaining to behavior; major trends in selected areas of study, research techniques available to the psychologist, organization of psychology as a profession; the code of ethics for psychologists. Staff

PSY 493 Special Topics in Psychology. Preq: CI. 1-6 F,S. An individual study course. Any undergraduate student may suggest an activity (review of literature on a topic, designing and conducting an experiment, or survey, etc.). After discussion if both student and supervising professor agree the topic is worthwhile, that the student is competent to undertake it, the student will enroll the following semester. Staff

PSY 495 Human Resource Development Practicum. Preq: Jr. standing. PSY HRD option, PSY 350, 351, 352, SP 231. 8(0-8) F,S. Field experience in the use of skills acquired during the skill semester. The student will spend at least a full semester working in a selected off-campus center. The student experiences real-world problems in context, and can arrange his later course work around subjects applicable to the solution of such problems. Cowgell

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PSY 502 Physiological Psychology. Preq: 12 hours PSY, including PSY 200, 300, 310. 3(3-0) F,S. A survey of the neuroanatomical and neurophysiological mechanisms of behavior with emphasis upon mammalian neuroanatomy, neural conduction, synaptic transmission and reflex mechanisms. Designed to form a basis for advanced study of the neurophysiological requisites of more complex behavioral processes. LeVere

PSY 504 Advanced Educational Psychology. Preq: Six hours PSY. 3(3-0) S. A critical appraisal of potential contributions of psychology to the analysis and improvement of instruction. Laboratory practice in various applications of psychology to instruction. Staff

PSY 505 History and Systems of Psychology. Preq: PY 200, 300, 310, 320 or CI. or grad. status. 3(3-0) Acquaints students with the history of psychology and psychological systems and practice in taking different approaches to a particular problem area. Cole

PSY 511 Advanced Social Psychology. Preq: Grad. standing or CI. 3(3-0) F. A survey of theory and research in social psychology through reading and discussion of primary source materials. Also, issues of methodology, ethical questions in social psychological research, and application of research findings to the world at large. Luginbuhl

PSY 530 Abnormal Psychology. Preq: PY 200, 302. 3(3-0) S. The causes, symptomatic behavior and treatment of the major personality disturbances. Emphasis on theory, experimental psychopathology and preventive measures. Corter

PSY (ED) 531 Mental Deficiency. 3(3-0) Sum. (See education, page 220.)

PSY 532 Psychological Aspects of Exceptionality. Preq: CI. 3(3-0) S. Considers effects of severe deviancy (sensory, physical, mental, etc.) arising from any causes at any stage of life; the personal and social ramifications; and possible courses of intervention. Utilization of psychological theory and clinical information in interpreting probable implications. Research findings related to sensory deprivation, research needs and possible research projects. R. Rawls

PSY 535 Tests and Measurements. Preq: Six hours PSY. 3(3-0) F,S,Sum. The principles of psychological testing including norms and units of measurement, elementary statistical concepts, reliability and validity. Some attention to the major types of available tests such as general intellectual development, tests of separate abilities, achievement tests, measures of personality and interest inventories. Westbrook

PSY (IE) 540 Human Factors in Systems Design. Preq: IE (PSY) 338 or IE 354; Coreq: ST 507 or 515. 3(3-0) S. Problems of the systems development cycle, including man-machine function allocation, military specification, display-control compatibility, the personnel subsystem concept, and maintainability design. Detailed treatment is given to man as an information processing mechanism. Pearson

PSY 565 Organization Psychology. Preq: Nine hours in PSY. 3(3-0) S. The application of behavioral science, particularly psychology and social psychology to organizational and management problems. Miller

PSY 571 Individual Intelligence Measurement. Preq: PSY 570. 3(3-0) A practicum in individual intelligence testing with emphasis on the Wechsler-Bellevue, Stanford-Binet, report writing and case studies. Corter

PSY 576 Developmental Psychology. Preq: Nine hours PSY, including 475 or 476. 3(3-0) F. The development of human behavior with attention to theoretical issues and research in developmental psychology. R. Rawls

PSY 578 Individual Differences. Preq: Six hours in PSY. 3(3-0) F. Nature, extent and practical implications of individual differences and individual variation. Staff

PSY 594 Area Seminar in Human Resources Development. Preq: CI. 1-3, 6 Maximum F,S. Topics are: 1) the development of human resources as an area of inquiry, 2) methods of inquiry, 3) contemporary issues, 4) ethical questions, 5) relationships to other areas within psychology. Staff

FOR GRADUATES ONLY

PSY 500 Perception. 3(2-2) S.

PSY 510 Learning and Motivation. 3(3-0) F.

PSY 514 Logical Foundations of Behavioral Analysis. 3(3-0) F.

PSY 520 Cognitive Processes. 3(2-2) F.

PSY 545 Fundamentals of Skill. 3(3-0) Alt. F.

PSY 570 Theories of Personality. 3(3-0) F.

PSY 575 Behavior Modification. Preq: PSY 510 or equiv. and/or CI. 3(2-2) S.

PSY 592 Area Seminar in Experimental Psychology. 1-3, Max. 6 F,S.

PSY (IE) 593 Area Seminar in Ergonomics. 1(0-2), Max. 3 F.

PSY 595 Area Seminar in School Psychology. 1-3, Max. 6 F,S.

PSY 596 Area Seminar in Social Psychology. 1-3, Max. 6 F,S.

PSY 599 Research Problems in Psychology. Preq: CI. Credits Arranged F,S.

PSY 591 Special Topics in Psychology 1-3 4/6/78 eff 8/78

PSY 620 Advanced Problems in Cognition 3(3-0) 12/7/78 eff 1/79

Recreation Resources Administration

RRA 152 Introduction to Recreation. 3(3-0) F,S. History and foundations of recreation including objectives, economic and social aspects, definition and importance; status or organized recreation in our modern society; certain applied principles of recreation. Wilson

RRA 215 Maintenance and Operations I. Prereq: RRA 152. 3(3-0) F,S. Methods of operation of various park and recreation facilities for public use; protection and law enforcement; job planning and scheduling; preventive maintenance; and modern maintenance techniques and maintenance materials. Warren

RRA 216 Maintenance and Operations II. Prereq: RRA 152. 3(3-0) F,S. Emphasis upon water-oriented recreation and public camping facilities; swimming pools; beaches; small lake management; marinas; day and family camping. McKnelly

RRA 241 Recreation Resource Relationships. ~~Coreq: FOR 472 or ZO 221.~~ 3(3-0) F,S. The concepts and principles involved in identifying and describing natural recreation resource components significant to management. The relationships between various governmental agencies and private enterprise in providing forest recreation. Staff

RRA 341 Principles of Recreation Planning. Prereq: RRA 241. 3(2-2) F,S. The recreation administrator's role in planning situations typical of the public and private sectors. Categories of information and their significance in the decision-making and problem-solving process. Competent information systems.

RRA 353 Public Camp Administration. Prereq: RRA 152. 3(2-2) F,S. Development of organized camping and its educational, health and recreational objectives. Program planning and leadership training in community, private, agency and school camping. Laboratory — campcraft skills. Warren

RRA 354 Health Practices in Recreation Management. 3(3-0) F,S. Emphasis upon health problems, disease prevention, communicable diseases and their control, public health administration, school and industrial hygiene, and other health problems confronting the individual and community. Staff

RRA 358 The Recreation Program. Prereq: RRA 216. 4(2-4) F,S. Types of recreation opportunities available to individuals, groups, neighborhoods or municipalities and the methods of providing these opportunities. Smith

RRA 359 Recreation and Park Supervision. Prereq: RRA 358. 3(2-2) F,S. Directing, inspecting and critical evaluation. Emphasis on the roles of the public recreation supervisor, community centers, sports, special activities, maintenance and operation. Sternloff

RRA 442 Wildland Recreation Environments. Prereq: Jr. standing. 3(2-3) F,S. Environmental modifications and resource developments required to support recreation use. Factors affecting site selection are related to resource planning functions. Site planning procedures provide a basis for managerial review. Natural history interpretation is an element of resource management. Concepts of natural beauty and approaches to preservation of amenities through modified methods of commercial product management. Erickson

RRA 451 Facility and Site Planning. Prereq: RRA 215 and 216. 3(3-0) F,S. The history of park and recreation facility development and trends in recreation facility planning. Emphasis upon the planning principles in design and layout of recreation areas and buildings. Field trips to various types of recreation facilities. McKnelly

RRA 453 Administrative Policies and Procedures. Prereq: RRA 359. 3(3-0) F,S. The internal organization of the recreation and park department; the administrative process; legislation and legal foundations; boards and commissions; personnel practices and policies; office management; public relations. Sternloff

RRA 454 Recreation and Park Finance. Prereq: Six hours RRA, sr. standing. 3(3-0) F,S. Recreation and park fiscal administration; sources of finance for current and capital expenditures; revenue activities; financial planning; budgeting; expenditure policies; accounting; auditing and planning for recreation and park services. Hines

RRA 475 Recreation and Park Internship. Prereq: Sr. standing, RRA 359. 9(0-27) (9 weeks) S,Sum. Provides prospective recreator with an opportunity for controlled experiences in skills and techniques involved in recreation and park department management. The student spends nine weeks off campus in a departmental selected location. Smith

RRA 580 Current Issues in Recreation Resources 1-3 eff. 1/79 10/5/78

RRA 491 Special Problems in Recreation. Preq: Consent of department. 1-6 F,S. 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. Seminar procedure. Smith

FOR GRADUATES AND ADVANCED UNDERGRADUATES

RRA 500 Theories of Leisure and Recreation. Preq: Nine hours RRA. 3(3-0). Leisure and recreation's origin and development as revealed by man's behavioral patterns. The influence and social significance of leisure and recreation concepts on contemporary American culture and their future implications. Warren

RRA 501 Theory Development in Recreation Research. Preq: ST 311 and SOC 416. 4(3-2). The historical emphasis of recreation research with analyses of various approaches to research design and model building. The philosophy of social scientific investigation, and possible application of existing behavioral theory to recreation research. Efforts to develop theory useful in explaining use of leisure time. Siderelis

RRA (EB) 503 Economics of Recreation. Preq: EB 301 or 401. 3(3-0) F. The principal emphasis will be on identity and importance of economic information for planning. The market mechanism and government will be examined as they affect and interact to affect allocation of resources to recreation, distribution of recreation services, and behavior of recreationists. Other topics include demand analysis, economics of planning, cost/benefit analysis, secondary economic impacts, public decision-making, externalities, public finance, and supply considerations in urban and rural recreation situations. Staff

RRA 538 Recreation for Special Populations. 3(3-0). The leisure concerns of deprived groups with exposure to the status, problems, and community service needs of special populations found in most American communities. Special populations include the physically disabled, the mentally retarded, the aging, and the economically deprived. Sternloff

RRA 591 Recreation Resources Problems. Preq: Advanced undergrad. or grad. status. 1-4. Assigned or selected problems in RRA planning, supervision, maintenance, operations, financing, or program. Selected on basis of student interest and supervised by graduate faculty members. Staff

RRA 595 Special Topics in Recreation Resources 1-3 9/01/78 eff 1/79

Religion

(Also see Philosophy.)

Rel 298 Special Topics in Religion 3(3-0) eff 8/77 2/23/77

REL 300 Introduction to Religion. 3(3-0) F,S,Sum. Various aspects of religion are analyzed, such as the development of the great traditions, as well as the relation of religion to personal maturity, cultural change, and the social good. Staff

Introduction to the O.T. Testament 10/25/78 eff 8/78

REL 311 ~~The Hebrew Bible.~~ 3(3-0) F. Man's religious quest is explored in the varied Biblical literature of the Hebrews. The course stresses the development of their religious faith and tradition, but such background matters as geography, archeology, history, and literary problems are also considered. VanderKam

Introduction to the New Testament 11/1/78 eff 8/78

REL 312 ~~Christian Origins.~~ 3(3-0) S. The Biblical writings of the early Christian community are examined in their historical context. The results of recent studies of the Dead Sea Scrolls as well as of Hellenistic and Hebrew thought and religion are brought to bear on early Christian life and thought. VanderKam

REL 315 Western Religions to the Reformation. 3(3-0) F. This course traces the major steps in the development of Christianity and Judaism during the period 100-1500 A.D., noting the events, persons, and ideas which were most significant in this development. Fitzgerald

REL 316 Western Religions Since the Reformation. 3(3-0) S. This course traces the major developments within Christianity and Judaism from 1500 to the present. Fitzgerald

REL 321 Religion in American Life. 3(3-0) F,S. This is a study of representative men, movements, and thought in the major religions within the context of American society and culture. Moorhead

REL (ENG) 325 Religion and the Modern Literary Imagination. 3(3-0) This course examines the relationship between religion and imaginative literature by exploring in concrete

Rel 101, 102 Elementary Biblical Hebrew I, II 3(3-0) 3/9/77 eff 8/77

Rel 201(FLH) Intermediate Biblical Hebrew I 3(3-0) 2/22/78 eff 8/78

and dramatic form a variety of options on such themes as the problem of evil and suffering and the quest for meaning in human existence. Staff

REL 327 Contemporary Religious Thought. 3(3-0) F,S. Investigates the development of recent religious and theological thought in America and Europe, as it has responded to the rapidly changing intellectual, scientific, and social dimensions of Western culture. Fitzgerald, Stalnaker

REL 331 Hinduism and Islam. 3(3-0) F. The religious traditions of India, including early Vedic religion, Brahamanism, the various Yogas, the devotion cults, the religio-philosophical traditions, and modern religious movements. Islam is examined in its Arabian origin and as it has developed in other parts of the world. Highfill

REL 332 Buddhism. 3(3-0) S. Buddhism is followed from its beginnings in India through the expansion into the whole of Asia. Creativity in art, political involvements, and meditative disciplines, as in Zen, are some of the facets. Highfill

REL 498 Special Topics in Religion. Preq: Six hours REL. 1-6 F,S. This course is used to offer areas of study which appear only rarely in the curriculum. It will also function as a readings course for honors students in religion. Staff

Social Work

SW 203 Social Welfare in the United States. 3(3-0) F,S,Sum. Introduction to current social welfare programs in the United States. Examines historical development of these programs including the motivations of individuals and groups which initiated them. Students visit selected programs and explore their philosophies, structures and effectiveness.

SW 205 Social Welfare Policies and Issues. Preq: SW 203. 3(3-0) F,S,Sum. Examines policies and issues associated with existing social welfare delivery systems and emphasizes policy formulation and assessment of alternative strategies for establishing and meeting social goals. Influence of social work principles, values and practice on social welfare policies and issues.

SW 307 Social Welfare Programs and Delivery Systems. Preq: SW 205. 3(3-0) F,S,Sum. An indepth study of major social welfare programs. Focus is on income maintenance programs and social services provided to the aged, families and children, handicapped adults and minority groups. Program content and methods of service delivery explored in class and by small student teams to determine effectiveness of financial and non-financial programs.

SW 308 Social Work Practice and Methods I. Preq: SW 307. 3(3-0) F,S. Fundamental elements of an integrated approach to social work practice. Focuses on professional values, social work roles and the social work-client relationships. Skills in interviewing, data collection and case recording are explored and practiced.

SW 310 Personality Development and Human Behavior. Preq: Sophomore standing. 3(3-0) F,S,Sum. Knowledge of man as an individual, interacting with an ever-changing social environment, continually evolving as a unique personality with individualistic combination of capacities and mechanisms for coping.

FOR ADVANCED UNDERGRADUATES

SW 405 Social Work Practice and Methods II. Preq: SW 308. 3(3-0) F,S. Examines the strategies of study, evaluation and intervention utilized in social work practice in the beginning, core and ending phases of the social worker-client, problem solving relationship.

SW 406 Field Work I. Preq: or Coreq: SW 405. 6(2-16) F,S,Sum. Supervised field experience in a social welfare agency or program for two full days each week. Assigned participation in an agency or program operation includes interaction with individuals, small groups, and agency staff. Provision for application of social work values, skills, objectives and methods gained in class. A two hour seminar on campus each week will link social work theory with field experience.

SW 407 Field Work II. Preq: SW 406. 6(2-16) F,S,Sum. Supervised field experience in a social welfare agency or program for two days each week and a two hour weekly seminar enables the student to increase and refine professional social work skills and knowledge. Seminars focus on integration of content areas of the curriculum with field practice. Faculty liaison with field instructors and students on a regular basis.

SW 312 Social Work Practice in Health Care 3(3-0) 3/15/78 ok

Sociology

(Also see Anthropology.)

SOC 202 Principles of Sociology. 3(3-0) F,S,Sum. Introduces basic ideas in the field of sociology. Exposure to a variety of concepts, theories and research findings develops student's abilities to conceptualize, analyze and interpret patterns of human interaction from a sociological perspective.

SOC 203 Current Social Problems. 3(3-0) F,S,Sum. Examines the concept of social problems with emphasis on the problem orientation of contemporary United States society. Investigates the social and cultural aspects of problems to demonstrate the basic integration of society and community life. Problems for intensive study vary to reflect current interests and may include crime, divorce, race conflict, illness, poverty, housing, recreation, personality adjustment, population and social aspects of environmental crisis.

SOC 204 Contemporary Family Life. 3(3-0) F,S,Sum. The American family as a social institution as an interaction process with emphasis on mate selection, marital adjustment, socialization and marital dissolution.

SOC 205 Work: Occupations and Professions. 3(3-0) F,S,Sum. The sociology of occupations, professions and work, especially human relations in industrial plants and other work situations.

SOC 241 Rural Society — U.S.A. 3(3-0) F. Major rural social institutions, ecological patterns and land tenure systems are examined emphasizing the American setting. Influence of rural patterns and values in contemporary urbanized society. Stresses the role of the rural community as an area of institutional functioning and social integration within the framework of a complex, industrial society.

SOC 301 Human Behavior. Preq: SOC 202 or PSY 200. 3(3-0) F,S,Sum. Examines effects of social interaction upon individual behavior and personality and collective attitudes and behavior as products of group experience. Analyzes fashions and fads, crowds, mobs, publics, social movements.

SOC 302 Mass Communications and Modern Society. Preq: Three cr. in SOC. 3(3-0) F,S. Introduction to the sociology of mass communications including its process, content, audiences, communicators, and social effects in modern society. The preparation of a news media comparison report enables critical examination of local and national media content. Provides insight from classic works by sociologists and other social scientists.

SOC 305 Race Relations. Preq: Three cr. in SOC. 3(3-0) F,S,Sum. Analyzes race relationships both in the United States and throughout the world with emphasis on factors producing current changes.

SOC 306 Criminology. Preq: Three cr. in SOC. 3(3-0). F,S,Sum. The study of the processes whereby behavior is defined as crime and persons are identified as criminals including a sociological investigation of agencies of law enforcement, adjudication, corrections, and prevention; patterns of criminal behavior; explanations of variations in criminality with emphasis on sociocultural and sociopsychological theories.

SOC 311 Community Relationships. Preq: Three cr. in SOC. 3(3-0) F,S. 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 (ED) 318 Introduction to the Sociology of Education. Preq: Three hours of basic sociology or CI. 3(3-0) F,S. An investigation of the United States educational institution in a sociological framework. Analyzes the objectives of education, the school as a social system, the roles and role relationships of various position occupants, and the effects of social factors — including social class and organizational expectations — upon the educational experience within a framework of the characteristics and influences of a bureaucratic organization.

SOC 342 Rural Societies Around the World. Preq: SOC 202 or SOC 241. 3(3-0) S. Sociological description, analysis and understanding of traditional rural societies of Asia, Africa and Latin America. Basic social institutions, groupings and processes provide bases for understanding these societies in the context of an increasingly urbanized and industrial world. Stresses examination of these societies on a Gemeinschaft-Gesellschaft continuum.

SOC 309 Sociology of Religion 3(3-0) 5/4/77 eff 1/78

SOC 313 Sociology of Health 3(3-0) 4/13/78 eff 1/79

SOC 351 Population and Public Affairs. Preq: Three cr. in SOC. 3(3-0) F,S. Growth rates, changing composition and residential redistribution in relation to public issues and planning. Studies the ways in which population data are utilized by public agencies in program and policy formulation. Analysis encompasses new problems and socioeconomic situations resulting from the dynamic nature of population changes in contemporary society.

FOR ADVANCED UNDERGRADUATES

SOC 402 Urban Sociology. Preq: SOC 202. 3(3-0) F,S. Analyzes urban social structures emphasizing determinants and consequences of changes in urban places and life styles. Understanding current urban problems as reflecting existing situations and changes occurring in the larger society. Examines various approaches to urban social planning.

SOC 410 Formal Organizations. Preq: SOC 202. 3(3-0) S. This course examines why and how formal organizations — for example, businesses, industrial firms, civic clubs, professional and religious associations — are created, developed, maintained, changed, and destroyed. Topics include alternative theoretical perspectives, methodological considerations, organizational structure, groups within organizations, organizational environments, and future prospects.

SOC (PS) 413 Criminal Justice Field Work. Preq: Acceptance in criminal justice option; senior standing, SOC 306 and PS 307. 4(2-8) F,S. Supervised observation and experience in a criminal justice agency; study of relationships between ongoing programs and relevant political and sociological theory and research through participation in weekly seminars as well as preparation and presentation of integrative report.

SOC 414 Social Class. Preq: SOC 202. 3(3-0) F. Examines the universality of structured inequality, the criteria for assignment and the causes and consequences of vertical differentiation. Relates social class to life chances, life styles and mobility and to other forms of social stratification. Investigates theories and research methods pertinent to the study of social class.

SOC 415 Social Thought. Preq: SOC 202. 3(3-0) F,S. A course dealing with the growth of social thought from a philosophical to a scientific perspective, from social philosophy to scientific sociological theory. Emphasis is on the understanding of major sociological theories and their intellectual and philosophical antecedents; philosophical and methodological issues relevant to the development of sociological theories; and the relationship between theory and research.

SOC 416 Research Methods. Preq: Sr. standing, ST 311, or CI. 3(3-0) F,S. The basic methods of social research, research design sampling, data collection, measurement, and analysis; the relation of theory and research.

SOC 418 Analysis of School-Community Relations. Preq: SOC 202, or 318, or 411, or ED 344. 3(2-2) S. Analyzes the reciprocal relations of school and community, the variant effect of influence sources, and consequences for both school and community. Systematic characteristics and relationships, social change, values, social processes and the American community constitute key analytical variables, implemented by student laboratory experience in school and community.

SOC 420 Sociology of Corrections. Preq: SOC 306 and PS 311. 3(1-2) S. A variety of correctional settings are studied in sociological perspective. Major topics include: formal and informal organization; inmate social systems; correctional programs and their consequences; alternatives to confinement; and special purpose facilities. The focus is on contemporary American prison sytems with historical and cross-cultural material included for comparative purposes.

SOC 425 Juvenile Delinquency. Preq: SOC 202, SOC 301 desirable. 3(3-0) F,S. Explores epidemiology of juvenile delinquency. Compares descriptive typologies. Develops theories of causation with emphasis on social institutions, peer groups and socialization processes. Investigates procedures for enforcement, adjudication and correction of young offenders. Examines strategies for prevention of delinquency. Opportunities for observation and participation in agency operations.

SOC 441 Social Change in Asia. Preq: SOC 202. 3(1½-1½) F. The main problems of rapid social change in Asia are examined with regard to the sources, mechanisms, patterns,

and consequences of change, utilizing major theoretical perspectives and methodological approaches available in sociology.

SOC 490, 491 Senior Seminar in Sociology. Preq: Consent of department. 3(3-0) F,S. Affords an opportunity to synthesize knowledge, theory and methods learned in earlier courses and to conduct original explorations in special interest areas.

SOC 498 Special Topics in Sociology. Preq: Six hours SOC above the freshman level. (1-6) F,S. A detailed investigation of a topic in sociology or anthropology. Topic and mode of study determined by the faculty member(s) in consultation with the departmental head.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

SOC (ED) 501 Leadership. Preq: SOC 202 or equivalent. 3(3-0) F,S,Sum. Leadership in various fields of American life; analysis of factors associated with it; techniques of leadership. Stresses recreational, scientific and executive leadership procedures.

SOC 502 Society, Culture and Personality. Preq: SOC 202 or equivalent. 3(3-0) S. Studies human personality from its origins in primary groups through its development in secondary contacts and its ultimate integration with social norms. Explores comparative anthropological materials but places emphasis on the normal personality and individual adjustment to our society and culture. Dynamics of personality and character structure analyzed in terms of society's general culture patterns and social institutions.

SOC 504 Education in Modern Society. Preq: SOC 202, 301 or equivalent. 3(3-0) Places varying emphasis on the historical development of education in the United States, cross-cultural comparisons of educational structure and function, professionalization of educators, investigation of the ecological factors affecting education, effects of group processes upon learning, and the effects of social processes and changes upon the educational institution.

SOC 505 ~~The Sociology of Rehabilitation I.~~ Preq: Grad. standing and/or CI. 3(3-0) F. The area of disability and handicap is introduced from a conceptual and theoretical standpoint. Sociological and social-psychological aspects of handicaps, the rehabilitation processes and rehabilitative organizations are stressed. Emphasizes rehabilitation of the sociology of work in the rehabilitation processes. Socio-cultural factors in disability and handicap (residence, social class, family relationships, etc.) are analyzed.

SOC 506 The Sociology of Rehabilitation II. Preq: Grad. standing and/or CI. 3(3-0) S. Students engage in individual research projects on a specific handicap, a rehabilitation process or a rehabilitative agency or subagency. Lectures and discussions furnish perspective concerning rehabilitation work in process while student pursues a specialized interest. Emphasizes sociological methods and techniques applicable to above aspects of social behavior.

SOC 507 Social Movements. Preq: SOC 503 or six hrs. SOC or Soc. Psy. 3(3-0) S. Nature and variety of social movements; conditions affecting the emergency of social movements; the structure of social movements; and the relationship between social movements, social conflict and social change. While the primary emphasis will be conceptual and theoretical, a number of social movements both past and contemporary will be examined within this framework. Similarly research issues relative to social movements will be examined.

SOC 509 Population Problems. Preq: SOC 202 or equivalent. 3(3-0) F. Examines population growth, rates of change and distribution. Emphasizes functional roles of population, i.e., age, sex, race, residence, occupation, marital status, and education. Population dynamics are stressed: fertility, mortality and migration. Population policy is analyzed in relation to national and international goals stressing a world view.

SOC 510 Industrial Sociology. Preq: SOC 202 or equivalent. 3(3-0). Industrial relations are analyzed as group behavior with a complex and dynamic network of rights, obligations, sentiments and rules. This social system is viewed as an independent part of total community life. The background and functioning of industrialism are studied as social and cultural phenomena and its social problems are analyzed.

SOC 511 Sociological Theory. Preq: Six hours SOC and grad. standing or CI. 3(3-0) F,S. The interdependence of theory and method; the major theoretical and methodological systems. Examines selected cases of research in which theory and method are classically combined.

SOC 512 Family Analysis. Preq: SOC 202 or equivalent. 3(3-0) F,Sum. Examines the basic theoretical and methodological framework in sociology within which contemporary family research is conducted.

SOC (ED) 513 Community Organization and Development. Preq: SOC 202 or equivalent. 3(3-0) F,Sum. Community organization is viewed as a process of bringing about desirable changes in community life. Community needs and resources are studied. Democratic processes in community action and principles of organization are stressed, along with techniques and procedures. Roles of lay and professional are analyzed.

SOC 514 Developing Societies. Preq: Six hours SOC or ANT or grad. standing. 3(3-0) S. Defines major problems posed for development sociology and explores the social barriers and theoretical solutions for development set forth with regard to the newly-developing countries. Significant past strategies reviewed and main themes in current development schemes presented. Untested strategies for the future proposed and discussed. These problems are examined in their national and international contexts.

SOC 515 Deviant Behavior. Preq: Six hours SOC or ANT or grad. standing. 3(3-0) F. Topics include: the inevitability of deviance and its social utility; cross-cultural variations in appearance and behavioral cues for labeling the deviate; descriptive and explanatory approaches to kinds and amounts of deviance in contemporary American society; social change, anomie and social disorganization theories; the process of stigmatization; formal and informal societal responses to deviance and the deviate; social action implications.

SOC (PS) 517 The Police Bureaucracy in a Democratic Society. 3(3-0) F,S. (See politics, page .)

SOC 523 Sociological Analysis of Agricultural Land Tenure Systems. Preq: Three hours SOC. 3(3-0). A systematic sociological analysis of the major agricultural and land-tenure systems of the world with emphasis on problems of U.S. family farm ownership and tenancy.

SOC 534 Agricultural Organizations and Movements. Preq: Three hours SOC, American history, American government or a related social science or consent of department. 3(3-0). 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 Nonpartisan League, cooperative marketing, government programs and present problems.

SOC 541 Social Systems and Planned Change. Preq: Three hours SOC. 3(3-0) F,S,Sum. An examination of social systems within the framework of both functional theory and conflict theory, with particular emphasis upon system change and the planning of social change.

SOC 555 Social Stratification. Preq: Six hours SOC. 3(3-0) The theoretical background, methodological approaches, and analysis of the consequences of systems of stratification. Emphasizes the static and dynamic qualities of stratification systems on relations within and between societies. Attention to the integrative and divisive quality of stratification as it is expressed in life styles, world views, etc.

SOC 560 Racial and Cultural Contacts. Preq: Six hours SOC or CI. 3(3-0) Examines intergroup relations as a legitimate concern of the social sciences. Appraises cross-cultural data drawn from a variety of situations wherein race and ethnicity figure in a significant manner. Attempts to interpret data by delineating observable patterns, trends and relationships.

SOC 565 Sociology and General Systems Theory. Preq: Six hours SOC, one ST course. 3(3-0) Examines the basis of general systems theory and its application in the sociological fields. Emphasizes the philosophical nature of systems theory and its potential as an alternative conceptualization to mechanistic and organismic models. Scrutinizes the underlying basis of systems theory; cybernetics as models of change and control; learning and equilibrium; information theory as models of choice and selection; decision theory, and game theory.

SOC 570 Commitment. Preq: Six hours SOC. 3(3-0) The process of commitment and its strength are covered from several theoretical views as applicable to collective behavior, social movements, the sociology of religion, political sociology, deviance, attitudes, decision making, dissonance, structural effects and other topics. An aim is to construct propositions and testable models of the commitment process.

SOC (EB) 574 The Economics of Population. 3(3-0) S. (See economics and business, page 216.)

SOC 590 Applied Research. Preq: SOC 202 or equivalent. 3(3-0) F,S. Studies research process with emphasis upon its application to action problems. The development of research design to meet action research needs is stressed.

SOC 591 Special Topics in Sociology. Preq: CI. 1-6 F,S. An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

SOC 592 Demographic Structure and Processes. Preq: SOC 509 or equivalent. 3(3-0) Explores in depth, the major demographic variables (size, composition and distribution) and basic demographic processes (fertility, mortality and migration). Attention to theoretical and methodological considerations as well as to current substantive knowledge. Specific course content varies depending upon student needs and interests.

SOC 595 Practicum in Sociology 3-6 9/21/78 eff 1/79

FOR GRADUATES ONLY

SOC 503 Contemporary Sociology. 3(3-0) F,S.

SOC 533 Theory of Human Communication Behavior. Preq: Six hrs. SOC or Soc. Psy. 3(3-0) F,S.

Soil Science

SSC 200 Soil Science. Preq: CH 103 or 107; GY 120 recommended. 4(2-4) S. Fundamentals including origin, composition and classification of soils; their physical, chemical, and biological properties; significance of these properties to soil-plant relationships and soil management. For SSC students and those in allied fields. Cook

SSC 205 Soils as a Natural Resource. Preq: CH 101 or 111. 3(2-3) F. Emphasis on soil as an important component in natural resource use and planning; characteristics and properties of soils as related to natural resources; impact of technological advances and soil use on environmental quality. Primarily for majors in fields not closely allied with SSC.

SSC (BAE) 321 Water Management 4(3-3) F. (See biological and agricultural engineering, page 193.)

SSC 341 Soil Fertility and Fertilizers. Preq: SSC 200, BS 100. 3(3-0) F. Plant nutrition and growth as related to crop fertilization; fertilization materials, their manufacture, properties and usage; fertilizer practices for a sound management program. Kamprath

SSC 342 Soil Fertility Laboratory. Coreq: SSC 341. 1(0-3) F. Applications of soil fertility principles in plant growth; laboratory and greenhouse exercises in soil and plant tissue testing; written reports of observations and their interpretation. Nicholaides

SSC 352 Soil Classification. Preq: SSC 200. 4(2-5) S. Morphology and diagnostic properties of soils; characterization of selected North Carolina soils and their placement in the modern soil classification system; practical field problem in soil identification and mapping. Field trips. Cook, Phillips

SSC 361 Soil Resources and Land Use. Preq: SSC 200 or 205. 3(2-3) F. Factors important to the interpretation of soils information for land use with emphasis upon soil profile properties. Planning of land areas using soil maps; practical field problems in soils interpretation for various uses. Staff

SSC 461 Soil Physical Properties and Plant Growth. Preq: SSC 200 or equivalent. 3(3-0) F. Study of soil physical properties and their influence upon plant growth; emphasis placed on soil solid-porosity relationships, soil water, soil temperature, soil aeration and mechanical impedance. Principles associated with management and alteration of physical properties are also discussed. Cassel

SSC (CS) 462 Soil-Crop Management Systems. Preq: CS 211, 414, SSC 341, 352. 3(2-3) S. Unites principles of soil science and crop science with those of allied areas into realistic agronomic applications; practical field studies in planning and evaluation of soil and crop management systems. Phillips, Fike

SSC (BAE) 471 Agricultural Water Management. 4(3-2) F. (See biological and agricultural engineering, page 193.)

SSC 472 Forest Soils. Preq: SSC 341, or FOR 452. 3(2-3) S. Soil as a medium for tree growth; the relation of soil physical, chemical, and biological factors to the practice of silviculture; extensive soil management in the forest and intensive soil management in forest nurseries and in seed-tree orchards; the relation of soil and site to forest genetics, ecology, pathology, and entomology. Wollum

SSC 492 Senior Seminar in Soil Science. Preq: Sr. standing in Agriculture and Life Sciences. 1(1-0) S. Students prepare and present thorough and documented discussions of important soil topics. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

SSC 501 Tropical Soils: Characteristics and Management. Preq: Six credits SSC. 3(3-0) F. Characteristic of the tropical environment: distribution and classification of tropical soils; soil-plant relationships in the tropics; soil management systems emphasizing shifting cultivation, flooded rice production, subsistence farming and tropical pasture management. Sanchez

SSC 511 Soil Physics. Preq: PY 212, SSC 200. 4(3-3) F. Physical properties of soils and their measurement; theory and mechanics of transport of water, air, heat and solutes. Cassel

SSC 520 Soil and Plant Analysis. Preq: PY 212, CH 315, at least three SSC courses including SSC 341, or CI. 3(1-6) S. Theory and advanced principles of the utilization of chemical instruments to aid research on the heterogenous systems of soils and plants. Gilliam

SSC 522 Soil Chemistry. Preq: SSC 200, one year of general inorganic chemistry. 3(3-0) S. The chemical and colloidal properties of clay and soil systems, including ion exchange and retention, soil solution reactions, solvation of clays and electro-kinetic properties of clay-water systems. Weed

SSC (MB) 532 Soil Microbiology. Preq: MB 401, CH 220 or CI. 4(3-3) S. Soil as a medium for microbial growth, the relationships and significance of microbes to mineral transformations in soil, biological equilibrium, and environmental quality. Wollum

SSC 541 Soil Fertility. Preq: SSC 341. 3(3-0) F. Soil conditions affecting plant growth and the chemistry of soil and fertilizer interrelationships. Factors affecting the availability of nutrients. Methods of measuring nutrient availability. Kamprath

SSC 551 Soil Morphology, Genesis and Classification. Preq: GY 120, SSC 200, 341. 3(3-0) F. Concepts of soil horizons and soil profiles and chemical, physical and mineralogical parameters useful in characterizing them. Soil-forming factors and processes. Evaluation of historical development and present concepts of soil taxonomy with particular reference to great soil groups and discussion of logical basis of soil classification. Buol

SSC 553 Soil Mineralogy. Preq: SSC 200, 341, and GY 330. 3(2-3) F. Composition, structure, classification, identification, origin occurrence and significance of soil minerals with emphasis on primary weatherable silicates, layer silicate clays and sesquioxides. Cook

SSC 560 Advanced Soil Management. Preq: SSC 200, 341. 3(3-0) Sum. Characteristics related to management of soil in the coastal plain, Piedmont and mountain areas of North Carolina. Field trips. Management practices that should be associated with various soils for different types of enterprises. (Offered Sum. 1977, and alt. years.)
Cook, Kamprath, Phillips

SSC 590 Special Problems. Preq: SSC 200. Credits Arranged. F,S. Problems in various phases of soils with emphasis on recent and current research. Staff

Speech-Communication

SP 100 Foundations of Communication Theory 3(3-0) 2/28/77 eff 8/77

SP 210 Voice and Articulation. 3(3-0) F,S,Sum. Basic processes of speech production. Attention to student's voice quality, articulation, pronunciation and general vocal expression. Speech improvement; help in recognition and reduction of excessive regional substandard dialect. Staff, Franklin, Parker, Schumacher 2/28/77 eff 8/77

SP 103 Introduction to the Theatre 3(3-0) 1/17/77 eff 8/77
SP 110 Public Speaking 3(3-0) 2/28/77 eff 8/77
SP 112 Basic Principles of Interpersonal Communication 3(3-0) 3/15 2/28/77 eff 8/77
SP 201 Theories of Persuasive Communication 3(3-0) 2/28/77 eff 8/77
SP 202 Problem Solving: Group Interaction 3(3-0) 2/28/77 eff 8/77
SP 203 Theory and Practice of Acting 3(3-0) 2/28/77 eff 8/77

SP 205 Speech Improvement 3(3-0) 2/28/77 eff 1/77
SP 213 Oral Interpretation of Literature 3(3-0) 2/28/77 eff 8/77
SP 214 Introduction to Radio Production 3(1-4) 2/28/77 eff 8/77

SP 231 Expository Speaking. 3(3-0) F,S,Sum. Basic theories of informative, report and instructional speaking. Delivery of short expository speeches. Emphasis on basic rhetorical, audience, and idea analyses. Staff

2/28/77 eff 8/77 **SP 232 Persuasive Speaking.** 3(3-0) F,S. Principles of influencing attitudes and actions through persuasive speaking. Emphasis upon short speeches to stimulate, convince and actuate. Francesconi, Leonard

2/28/77 eff 8/77 **SP 237 Group Discussion.** 3(3-0) F,S,Sum. Theory and practice of leading and taking part in panels, forums, symposiums, conferences and committees. Munn, Leonard

2/28/77 eff 8/77 **SP 238 Interpersonal Communication.** 3(3-0) F,S,Sum. Verbal and non-verbal communication theory resulting in practical experiences in intrapersonal, interpersonal, small group, and public communication. Strives toward improvement of personal effectiveness and fulfillment of individual potential through oral communication. Staff

SP 298 Special Projects in Speech-Communication. Preq: SP 231. 1-3 F,S. A special projects course to be utilized for guided research or experimental classes at the sophomore level, topic determined by instructor. Staff

SP 310 Phonetics. Preq: Completion of freshman English requirement. 3(3-0) F,S,Sum. A study of the anatomy and movements of vocal organs; correct pronunciation; speech sounds; standards of American pronunciation; application of the International Phonetic Alphabet, with vocal and ear training. Franklin

2/28/77 eff 8/77 **SP 311 Introduction to Speech Correction.** Preq: SP 310. 3(3-0) F,S. A study of the development of normal speech and hearing. Common speech and hearing defects; basic techniques for their prevention and treatment. Franklin, Schumacher

eff 8/77 **SP 332 Argumentation and Debate.** 3(3-0) F,S. The process of influencing opinion through use of logical arguments, with emphasis upon analysis, briefing, evidence, reasoning, and refutation. In-class debating. Attaway, Camp

2/28/77 eff 8/77 **SP 336 Parliamentary Practice.** 3(3-0) F,S. Rules and customs of assemblies, including organization, motions; participation in and conduct of meetings; parliamentary strategy. Camp

2/17/77 eff 8/77 **SP 340 Introduction to the Theatre.** Preq: Completion of freshman English requirement. 3(3-0) F,S. A survey of methods and techniques in staging dramatic art. Organizing, play selection, casting, directing, acting, scene designs and construction, lighting. Russell, Martin

2/28/77 eff 8/77 **SP 350 Fundamentals of Radio Broadcasting.** 3(2-2) F. Audio production course. Laboratory work suitable for both inexperienced and advanced students. Lectures, discussions and demonstrations arranged to examine elements of advertising, business, engineering, journalism, politics and show business relevant to American radio broadcasting. Schnur

2/28/77 eff 8/77 **SP 351 Radio Production.** Preq: SP 350 or CI. 3(2-2) S. Advanced course in writing and production. Copy writing, news writing and more complex writing assignments lead to recorded individual "special" program which is evaluated by instructor and by class. Best programs may be broadcast over area radio stations. Schnur

2/28/77 eff 8/77 **SP 361 Oral Reading.** 3(3-0) F,S. Analysis and presentation of printed materials — literary, technical and semitechnical — for platform, radio and television. Franklin, Snow, Russell

eff 8/77 **SP 420 Development of Rhetorical Theory.** 3(3-0) F,S. Development through the Greek, Roman, Medieval, Renaissance and modern periods. Camp, Francesconi

SP 430 History and Criticism of American Public Address. 3(3-0) F,S. Significant political and social speakers in America from colonial times to present. Analyses of the social settings, of the speeches themselves, and of their impact upon American history. Camp, Francesconi

8/3/77 eff 8/77 **SP 450 Fundamentals of Television Production.** 3(1-4) F. Philosophy and techniques of television production, particularly instructional and informational programming. Lectures consider television as a communication medium in contemporary society. Laboratory sessions involve the student in studio production of 30-minute television programs. The term project requires each student to "structure," produce and direct a 30-minute program for taping and critque by teacher, professionals and class. Shnur

SP 215 Introduction to Speech Disorders 3(3-0) 2/28/77 eff 8/77
SP 223 Play Production 3(3-0) 2/28/77 eff 8/77
SP 224 Introduction to Television Production 3/3/77 eff 8/77
SP 301 Advanced Public Speaking 3(3-0) 2/28/77 eff 8/77
SP 302 Procedures for Meetings of Organizations 3(3-0) 2/28/77 eff 8/77
SP 312 Barriers to Organizational Communication 3(3-0) 2/28/77 eff 8/77
SP 314 Advanced Radio Production 3(1-4) 2/28/77 eff 8/77
SP 315 Phonetics 3(3-0) eff 8/77

SP 211 Argumentation and Debate 3(3-0) 4/5/77 eff 8/77
SP 212 Interracial Communication 3(3-0) 2/22/78 eff 8/78
SP 221 Traditional Theories of Rhetoric 3(3-0) 4/24/77 eff 8/77
SP 233 Introduction to Stage Lighting 3(2-2) 4/6/78 eff 8/79
SP 303 Stage Directing 3(3-0) 4/14/77 eff 8/77
SP 324 Advanced Television Production 3(1-4) 4/13/77 eff 8/77
SP 331 Traditional Rhetorical Criticism 3(3-0) 4/29/77 eff 8/77
SP 411 Contemporary Rhetorical Criticism 3(3-0) 4/29/77 eff 8/77
SP 415 American Dialects 3(3-0) eff 8/77
SP 422 Interpersonal Communication: Laboratory 3(0-6) 4/14/77 eff 8/77
SP 325 Anatomy and Physiology of Speech 3(3-0) 5/17/77 eff 8/77

SP 304 Survey of Broadcasting 3(3-0) 2/22/78 eff 8/78
322 Nonverbal Communication 3(3-0) 3/2/78 eff 8/78
323 Introduction to Scenic Design 3(2-2) 4/6/78 eff 1/78
335 Speech and Language 3(3-0) 2/22/78 eff 8/78
345 Delayed Speech and Language Development 3(2-2) 2/22/78 eff 1/79
SP 330 Communication in Interpersonal Relationships 3(3-0) 4/6/78 eff 8/78
SP 425 Fundamentals of Diagnostic Procedures 3(2-2) 3/15/78 eff 1/79

SP 401 Contemporary Rhetoric: Theory 3(3-0) 2/28/77 eff 8/77
SP 412 Advanced Interpersonal 3(3-0) 2/28/77 eff 8/77
SP 490 Senior Seminar in Speech-Communication 3(3-0) 2/28/77 eff 8/77

SP 451 Advanced Television Production. Preq: SP 450 or CI. 3(2-2) S. For speech-communication majors, teacher trainees and others of advanced standing who already have general knowledge about operation and basic function of media. Lect. — Theories of media and message. Lab. — Evaluation and analyses of student productions. Schnur

SP 496 Seminar in Speech-Communication. Preq: Consent of department. 3(3-0) F,S. 2/28/77 Research oriented study of major periods, movements and personalities in oral communication. Encourages student to synthesis aspects of preceding work in speech. Staff. eff 8/77

SP 498 Special Topics in Speech-Communication. Preq: Nine hours of speech. 1-6 F,S. Detailed investigation of topic in communication arts or sciences. Topic and mode of study determined by the faculty member in consultation with speech division head. Staff

Statistics

ST 311 Introduction to Statistics. 3(3-0) F,S,Sum. Relates general statistical concepts to everyday life and emphasizes giving perspective to those concepts: quantitative descriptions of populations, some sampling ideas, techniques of making inferences from samples,and the uncertainties involved in making statistical inferences. Hafley, McVay, Stines

ST (EB) 350 Economics and Business Statistics. Preq: MA 112, EB 201 and 202 or equivalent. 3(3-0) F,S. (See page 217.)

ST 361 Introduction to Statistics for Engineers. Preq: College algebra. 3(3-0) F,S, Sum. Statistical techniques useful to engineers and physical scientists. Includes elementary probability, frequency distributions, sampling variation, estimation of means and standard deviations, confidence intervals, significance tests, elementary least squares curve fitting. Staff

ST 371 Introduction to Probability and Distribution Theory. Preq: MA 201. 2(1-2) F,S,Sum. Basic concepts of probability and distribution theory for students in the physical sciences and engineering. Intended to provide the background necessary to begin the study of statistical inference and regression analysis. Manson, Quesenberry

ST 372 Introduction to Statistical Inference and Regression. Preq: ST 371. 2(1-2) F,S,Sum. Statistical inference and regression analysis including theory and applications. Point and interval estimation of population parameters. Hypothesis testing including use of t, x^2 and F. Simple linear regression and correlation. Introduction to multiple regression. Manson, Quesenberry

FOR ADVANCED UNDERGRADUATES

ST 421, 422 Introduction to Mathematical Statistics. (421) Preq: MA 202 or 212; (422) Preq: ST 421 3(3-0) F,S. Elementary mathematical statistics primarily for undergraduate majors and graduate minors in statistics. Includes introduction to probability, common theoretical distributions, moments, moment generating functions, sampling distributions, estimation, hypothesis testing concepts, decision theory concepts and elements of general linear model theory. Giesbrecht, Rawlings

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ST 501, 502 Basic Statistical Analysis. Preq: ST 372 or CI. 3(3-0) F,S. Basic concepts; random variables, distributions, statistical measures, estimation, tests of hypotheses, the anova, elementary design and sampling, factorial experiments, multiple regression, covariance analysis of discrete data and other topics. Primarily for statistics majors and minors. Steel

ST 507 Statistics for the Behavioral Sciences I. 3(3-0) F. A general introduction to descriptive and inferential statistics. Investigates the role of statistics in behavioral science research as well as presenting the techniques and principles for summarizing data. Basic inferential statistics with emphasis on the concepts of hypothesis testing and decision making. Principles and methods illustrated by examples and problems from behavioral science.Wasik

ST 508 Statistics for the Behavioral Sciences II. Preq: ST 507 or CI. 3(3-0) S. Further consideration of advanced statistical techniques used in decision making in behavioral

science research. Hypothesis testing and analysis of variance procedures used in the design of experiments. Part of the course devoted to topics relating to least squares and multiple regression analysis. Wasik

ST 511 Experimental Statistics for Biological Sciences I. Preq: ST 311 or grad. standing. 3(3-0) F,S,Sum. Basic concepts of statistical models and use of samples; variation, statistical measures, distributions, tests of significance, analysis of variance and elementary experimental design, regression and correlation, chi-square. Staff

ST 512 Experimental Statistics for Biological Sciences II. Preq: ST 511 or equivalent. 3(3-0) F,S,Sum. Covariance, multiple regression, concepts of experimental design, factorial experiments, individual degrees of freedom, confounded factorial and split-plot designs. Staff

ST 513 Experimental Statistics for Social Sciences I. Preq: ST 311 or grad. standing. 3(3-0) F. Basic concepts in collection and analysis of data. Variability of sample data, distributions, confidence limits, chi-square, t-test, analysis of variance, regression, correlation, analytic and descriptive surveys, experimental designs. McVay

ST 514 Experimental Statistics for Social Sciences II. Preq: ST 513 or equivalent. 3(3-0) S. Extension of basic statistical concepts to social experiments and surveys; sampling from finite populations and estimating using unrestricted, stratified, systematic and multistage selections; analysis of variance continued; multiple regression; covariance; experimental designs. Proctor

ST 515, 516 Experimental Statistics for Engineers. Preq: ST 361 or grad. standing. 3(3-0) F,S. General statistical concepts and techniques useful to research workers in engineering, textiles, wood technology, etc. Probability, distributions, measurement of precision, simple and multiple regression, tests of significance, analysis of variance, enumeration data, and experimental designs. Hader

ST 517 Applied Least Squares. Preq: ST 502 or equivalent. 3(3-0) F. Use of least squares estimation with linear models. Regression, analysis of variance and covariance considered in a unified manner that requires no extensive statistical background. Emphasis on application of these techniques to analysis of data from non-standard experimental and survey situations. Staff

ST 519 Applied Multi-variate Statistical Analysis. Preq: ST 511, ST 512 or equiv. 3(3-0) S. An introduction to the use of multi-variate statistical methods in the analysis of data collected in experiments and surveys. Topics covered will include multi-variate analysis of variance, discriminant analysis, canonical correlation analysis and principal components analysis. The use of a computer to perform the multi-variate analysis calculations will be emphasized.

ST 521 Statistical Theory I. Coreq: MA 425 or 511 and MA 405 or CI. 3(2-2) F. The use of statistics as illustrated by an example, pointing out the need for a probabilistic framework. The probability tools for statistics: description of discrete and absolutely continuous distributions, expected values, moments, moment generating functions, transformation of random variables, marginal and conditional distributions, independence, order statistics, multivariate distributions, concept of random sample, derivation of many sampling distributions. Bhattacharyya

ST 522 Statistical Theory II. Preq: ST 521; Coreq: MA 426 or 512. 3(2-2) S. General framework for statistical inference. Point estimators: biased and unbiased, minimum variance unbiased, least mean square error, maximum likelihood and least squares, asymptotic properties. Interval estimators and tests for hypotheses: confidence intervals, power functions, Neyman-Pearson lemma, likelihood ratio tests, unbiasedness, efficiency and sufficiency. Bhattacharyya

ST 531 Design of Experiments. Preq: ST 502 or equivalent. 3(3-0) F. Review of completely randomized, randomized complete block and Latin square designs, and the basic concepts in the techniques of experimental design. Designs and analysis methods in factorial experiments, confounded factorials, response surface methodology, change-over design, split-plot experiments and incomplete block designs. Examples illustrate application and analysis of designs. Monroe, Nelson

ST (MA) 541 Theory of Probability I. 3(3-0) F. (See mathematics, page 270.)

ST (MA) 542 Introduction to Stochastic Processes. II. 3(3-0) S. (See mathematics, page 270.)

ST 552 Basic Theory of Least Squares and Variance Components. Preq: MA 405, ST 521; Coreq: ST 522. 3(2-2) S. Theory of least squares; multiple regression; analysis of variance and covariance; experimental design models; factorial experiments; variance component models. Gallant

ST (EC) 561 Intermediate Econometrics. 3(3-0) S. (See economics, page 216.)

ST (BMA, MA) 571 Biomathematics I. 3(3-0) F. (See biomathematics, page 195.)

ST (BMA, MA) 572 Biomathematics II. 3(3-0) S. (See biomathematics, page 195.)

ST 581 Introduction to Nonparametric Statistics. Preq: ST 522. 3(3-0) F. Treats both theoretical and methodological materials relevant to inference problems arising when sampling is from a parent family that is not assumed to have a particular functional form. Concentrates on inference problems for the absolutely continuous family of distributions. (Offered F 1977 and alt. years.) Quesenberry, Gerig

ST 583 Introduction to Statistical Design Theory. Preq: ST 522. 3(3-0) F. The theory of statistical inference discussed from a unified decision theoretic point of view and its relationship with the zero-sum two person game. Develops techniques of statistical analysis using Bayesian approach. Major emphasis on solution of problems using decision theoretic concepts. (Offered F 1977 and alt. years.) Bhattacharyya

ST 591 Special Problems. 1-3 F,S. Development of techniques for specialized cases, particularly in connection with thesis and practical consulting problems. Staff

ST 683 Multivariate Analysis 3(3-0) 6/13/77 eff 1/78

Textile Chemistry

TC 303 Textile Chemistry I. Preq: Soph. standing or equivalent. 2(2-0) S. The physical and chemical phenomena which occur in the preparation and finishing of textile materials. Emphasis on general principles, rather than detailed technical procedures.

TC 304 Textile Chemistry II. Preq: T 301, TC 303. 2(1-3) F. A combination of lecture periods and laboratory exercises designed to reveal and emphasize the practical implications of the theoretical concepts introduced in TC 303.

TC 401 Textile Industry and the Environment. Preq: CI. 3(3-0) S. The concept of water quality management, criteria of pollution, sources of pollution from fabric processing, plant surveys and in-plant remedial measures, principles of biological oxidation, current waste-treatment practices, and new developments and trends in pollution control. Emphasis is on textile industry wastes, with introduction to the broader aspects of environmental pollution. Staff

TC 403, 404 Textile Chemical Technology. (403) Preq: T 301, TC 303; Coreq: CH 223; (404) Preq: TC 403. 3(3-0) F,S. The chemistry involved in the wet processing of fibrous systems, especially dyeing, printing and finishing. Emphasizes principles and includes a study of the various classes of dyes and their application to all important textile fibers and blends of fibers; preparatory and bleaching processes, roller printing and print formulations for important dye classes; nature and application of finishes for textiles. Campbell

TC 405, 406 Textile Chemical Technology Laboratory. (405) Preq: T 301, TC 303; Coreq: TC 403. 1(0-3) F. (406) Preq: CH 223, TC 303; Coreq: TC 404. 2(0-6) S. Designed to complement the subject matter of TC 403, 404 by selected laboratory and pilot plant exercises in the application of selected important dyes and finishes to the important fiber types. Campbell

TC 411 Textile Chemical Analysis I. Preq: T 301. 3(2-2) S. A survey of textile chemicals, emphasizing surfactants, warp 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. (Not available to TC majors.) Livengood

TC 412 Textile Chemical Analysis II. Preq: T 203. 3(2-3) S. Application of certain techniques of analysis to fibers, textile chemicals and textile processes; ultraviolet, visible and infrared spectrophotometry, chromatography, viscometry; interfacialtension; calorimetric, gravimetric and mechanical thermal analyses. Emphasis on solving problems of analysis involving such processes as sorption, solution, diffusion, crystallization, etc. Cates

TC 415 Textile Printing 3(2-2) 3/2/78 eff 8/78

TC (CH) 461 Chemistry of Fibers. Preq: CH 223. 3(3-0) F. Lectures emphasize: the formation and properties of fiber-forming polymers; addition and condensation polymerization; theories of fiber structure, the relationship between the chemical structure and physical properties of natural and man-made fibers; the production of man-made fibers. Gilbert

TC 490 Special Topics in Textile Chemistry. 1-6 F,S. Topics relate to current developments in textile and polymer chemistry. Staff

TC 491 Seminar in Textile Chemistry. Preq: TC ~~205~~, 403. 1(0-2) S. Familiarizes student with the principal sources of TC literature and emphasizes importance of keeping abreast of developments in the field. Emphasizes fundamentals of technical writing. Reports. Lectures arranged. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

TC 504 Fiber Formation-Theory and Practice. Preq: MA 301, PY 208 or CI. 3(3-0) F. Practical and theoretical analysis of chemical and physical principles underlying the conventional methods of converting bulk polymer to useful fiber; rheology; melt, dry and wet polymer extrusion; fiber drawing; heat setting; application of general theory to unit processes. Cuculo

TC 505 Theory of Dyeing. Preq: CH 433 or CI. 3(3-0) S. Mechanisms of dyeing. Application of thermodynamics to dyeing systems. Kinetics of diffusion in dyeing processes. McGregor

TC 561 Organic Chemistry of High Polymers. Preq: TC 461, CH 331 or 431. 3(3-0) S. Principles of step-and-chain-growth polymerizations; co-polymerization theory; homogenous free radical polymerization; emulsion polymerization; Ziegler-Natta polymerizations; ionic polymerization. Gilbert, Theil

TC (CH) 562 Physical Chemistry of High Polymers-Bulk Properties. Preq: CH 220 or 223; CH 331 or 431. 3(3-0) F. Molecular weight description; states of aggregation and their interconversion; rubbery, glassy and crystalline states; rubber elasticity; molecular friction; diffusion and viscosity; dynamics of network response; retardation- and relaxation-time spectra; thermo-dynamics of nucleation; kinetics of crystallization. Cates, Walsh

TC (CHE) 569 Polymers, Surfactants and Colloidal Materials. 3(3-0) F. (See chemical engineering, page 198.)

TC 591 Special Topics in Textile Science. Preqs: Sr. or grad. standing and CI. 1-4. Topics in textile science of interest to advanced students. Staff

Textile Technology

TX 211 Fiber Science II. Preq: MA 112 or 102. 3(2-2) F,S. The physical properties of textile raw materials as related to type of fibers and chemical structure. Typical areas are parameters used to describe textile fibers, classification in terms of quality factors, their reactions to moisture, stress-strain properties, method of measuring physical properties covered in Fiber Science I, and relationship between polymer structure, fiber properties, and their utilization as single fiber composites or blends of fibers. Staff

TX 320 Design and Control of Staple Yarn Systems. Preq: T 220. ~~Coreq: TX 211.~~ 5(4-2) F,S. The technological and economic aspects of staple yarn forming systems. Topics include fiber-machine interactions, use of automated systems and processes, blending of similar and dissimilar textile fibers, and control of the overall manufacturing operation to yield products with designed characteristics. El-Shiekh, Pardue

TX 330 Textile Measurements and Quality Control. Preq: T 250, ST 361. 4(3-2) F,S. Principles of measuring basic physical properties of textile materials, techniques of in-process control and evaluation of finished product quality, application to the manufacturing sequence of statistical control charts and capability limits, aspects of sampling theory. Hutchison, Stuckey.

TX 340 Principles of Knitted Fabric Structures. Preq: TX 211, T 250. 5(4-2) F,S. Warp and weft knit fabrics, their properties, end uses and production as related to current trends and developments in fabrics and machines. The principles of design and fabric geometry as a basis for performance, quality, and costing. Finishing and its effect on fabric properties. Staff

TX 341 Knitting Systems. Preq: T 250. 3(2-2) F,S. Technology of producing knitted fabrics. The range of fabric structures is reviewed, but the major emphasis is on yarn preparation for knitting, the basic mechanics of weft and warp knitting machines, patterning mechanisms, technologies of production, new developments and management of knitting operations. Rhodes

TX 350 Woven Fabric Structures. Preq: TX 211, T 250. 5(4-2) F,S. Performance characteristics of woven structures as related to properties of raw materials, fabric structure and methods of production. The utilization of modern control systems to optimize the systems involved in the production of woven fabrics. Klibbe, Moser, Porter

TX 351 Weaving Systems. Preq: T 250. 3(2-2) F,S. Technology of producing woven fabrics. The range of fabric structures is reviewed but the major emphasis is on yarn preparation for weaving, the basic mechanics of looms, the technologies of production, new developments and management of weaving operations. Lord

TX 370 Technical Fabric Design. Preq: T 250. 4(3-2) F,S. Technical aspects of textile fabric design. Available technologies are reviewed; properties of the various types of fabric, methods of reproducing aesthetic designs and means of designing fabrics to specifications are covered. Lab consists of formal designs, analyses, testing and design projects. Staff

TX 380 Management and Control of Textile Systems. Preq: EB 201, T 250. 3(3-0) F,S. The principles and techniques of controlling the process of converting staple fibers or filament yarns into industrial and consumer products as viewed from the standpoint of the process decision maker. Cooper, Robinson

TX 405 Non-Conventional Fabric Structures. Preq: Sr. standing and CI. 3(3-0) F,S. Advanced study of systems for direct conversion of fiber to fabrics. The total spectrum of possible fabric structure is surveyed and classified. Current marketable structures analyzed with respect to production technologic, economic, and property potential. Trends in direct conversion technology are discussed to provide a viable basis for participating in the evolution of the technology and its production. George, Mohamed

TX 420 Modern Developments in Yarn Manufacturing Systems. Preq: Sr. standing. 3(3-0) S. The newly emerging means of yarn production such as open-end, composite, self-twist and twistless forms of spinning. The preprocesses and their effects on spinning; also the after-processes and effects of the new systems. Lord

TX 425 Textured Yarn Production and Properties. Preq: TX 211, T 220. 3(2-2) F,S. The structure of thermoplastic polymers in continuous filament form and their response to elevated temperatures, high velocity air flow and other methods of modification to produce bulked, textured and torque type yarns. Related properties such as stress relaxation, generation and control of electrostatic charges and responses to lower order tensile forces. El-Shiekh, Tucker

TX 426 Long Staple and Tow Systems. Preq: TX 211, T 220. 3(2-2) F,S. Long staple yarn forming systems including the woolen, worsted, tow to top, and compact yarn systems. Emphasis on relationship of fiber structures and characteristics necessary to produce the desired properties and performance characteristics of such yarns as woolen and worsted blends with man-made fibers, bulked yarns and carpet yarns. Pardue

TX 431 Special Topics in Testing. Preq: TX 330, sr. or grad. standing. 3(2-2) S. Special advanced techniques for measuring selected physical and aesthetic properties of natural and man-made textile materials; application of the physical law to technique and instrumentation; interrelation of the material, method of test, instrumentation involved and the resulting physical measure. Stuckey

TX 441 Knitwear and Hosiery Manufacture. Preq: TX ~~340~~ 370 3(2-2) F,S. Complex weft knit mechanisms and their products. Hosiery, sweater strip, and full-fashioned equipment and products discussed with respect to quality, costing, and recent developments. Middleton

TX 442 Advanced Knitted Fabric Design. Preq: TX 340 or 370. 3(2-2) S. Complex warp- and weft-knitted structures, including flat, solid or open-work, plain or jacquard structures, raised and relief effects and other three-dimensional cloths, such as plush, fleece, and sliver fabrics. Technology of fabric processing, design potential and limitations, fabric aesthetics and markets. Practical fabric manufacture and analysis. Rhodes

TX 443 Analysis of Knitting Systems and Fabric Properties 3(3-0) 1/31/77 eff 8/77

TX 381 Supervision in the Textile Industries 3(3-0) 5/5/78 eff 8/78

370 eff 1/78

TX 449 Warp Knitting Systems. Preq: ~~TX 340~~. 3(2-2) F,S. Critical review and discussion of production of warp knitted fabric principles. Aspects of warp knitting including yarns, machinery and methods of operation analyzed and discussed both individually and as a part of the total system. Fabric design, quality and costing. Staff

TX 450 Advanced ~~Design and~~ Weaving. Preq: TX ~~350~~. 3(2-2) F,S. Special weave formations and new developments and research findings in warp preparation, design weaving and fabric formation. Mohamed

Revised 8/78

Revised Weave Fabric Design 370 eff 8/78

TX 451 ~~Complex Woven Structures~~. Preq: TX ~~450~~. 3(2-2) S. Design specifications for complex fabrics as related to fabric geometry, functional and aesthetic properties and manufacturing limitations. Mohamed

TX 460 Physical Properties of Textile Fibers. Preq: MA 212, PY 212. 3(3-0) F,S. The structural, mechanical, thermal, optical, frictional and electrical properties, and the effect of moisture on physical and mechanical properties. Influence of these properties on utility and scope of fibers as related to performance. Staff

TX 470 Fabric Styling and Design. Preq: Jr. or sr. standing and CI. 2(2-0) F,S. Basic textile styling and design as influenced by aesthetic and end-use considerations. Limitations and influence of current technology on design principles and aesthetic capabilities. Massey

TX 480 Textile Cost Control. Preq: ~~TX 320, TX 350,~~ EB 201, 3(3-0) F,S. Cost methods applicable to textile costing with emphasis on decision-making. Interpretation of cost reports and their use in pricing and cost control. Powell

TX (EB) 482 Sales Management for Textiles. Preq: TX 380. 3(3-0) S. Definition and analysis of sales management in the textile industry. Areas of control and responsibility. Analytical tools of sales management with case methods. Staff

TX 484 Management Decision Making for the Textile Firm. Preq: TX (EB) 482. 3(3-0) S. The economic and environmental setting within which the textile firm makes decisions, and an application of various analytical tools, quantitative and qualitative, in making these decisions. Strategies for implementing decisions. Cooper, Robinson

Revised eff 8/78

TX 490 Development Project in Textile Technology. Preq: ~~Sr. standing,~~ CI. 2-3 F,S. Introduction to research through experimental, theoretical and literature studies of textile and related problems. Staff

TX 491 Special Topics in Textiles. Preq: Sr. standing. 1-3 F,S. Current developments in the textile industry. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

TX 505 Textile Instrumentation and Control Systems. Preq: MA 301, PY 212 and one course in computer science. 3(3-0) F. Theory and applications of instruments and control systems used in modern textile plants. Basic instruments and computer systems are described along with their use in process control, production control, research and development. Grady

TX 520 Yarn Processing Dynamics. Preq: MA 301 and CI. or grad. standing. 3(2-2) F. Theoretical analysis of the dynamics and machine-fiber interactions of such functions as opening, cleaning, carding actions, fiber attenuation, ring spinning, open-end spinning, texturing and winding. The role of fiber placement, cohesion and lubrication on yarn processing and properties. Laboratory experiments are designed to verify the analysis. El-Shiekh

TX 530 Textile Quality Control. Preq: TX 330 or CI. 3(3-0) S. Quality control systems for textile operations. Emphasis on sampling plans for attributes and variables and on interpretation of data as related to identifying sources of product variability. Stuckey

Revised eff 8/78

TX 541 Theory and Practice of Knitted Fabric Production and Control. Preq: ~~TX 340 and CI~~. 3(3-0) F. The technology and control of systems for manufacturing simple and complex knitted fabrics; control and monitoring of yarn feeding systems; influence of yarn, machine, finishing and fabric structure on the fabric aesthetics, physical and mechanical properties; optimization of fabric properties and machine productivity, including costing; problems of jacquard fabric processing and control. Knapton

TX 549 Warp Knit Engineering and Structural Design. Preq: TX 449. 3(3-0) S. Senior status with consent of instructor. Engineering analysis of tricot and raschel machinery.

TX 487 Textile Labor Management 3(3-0) 6/22/78 eff 8/78

Design of yarn let-off and fabric take-up mechanisms. Studies of fabric production techniques and quality control systems. Theory of production optimization and the properties of fabrics. Complex geometrical loop models and their application. Knapton

TX 550 Fabric Analysis. Preq: TX 350 or grad. standing. 3(3-0) F,S. Development of a numerical system for characterizing designs. Permutations and combinations of weave elements. Correlation of fiber and yarn properties with those of the fabrics. Engineering design of fabrics. Relationships between fabrics having geometrical similarity and the prediction of their physical properties. Bogdan

TX 555 Production Mechanics and Properties of Woven Fabrics. Preq: MA 301 and CI. or grad. standing. 3(2-2) S. The interrelations between the mechanics of production and mechanical properties of woven fabrics; unit operations required to prepare yarns for weaving and the mechanisms employed in weaving; fabric structure, geometry and mechanical properties; designing for specific fabric properties. Mohamed

TX 560 Structural and Physical Properties of Fibers. Preq: MA 301. 3(3-0) F. Advanced study (including thermal, optical, frictional and electrical) of textile fibers. Theoretical relations and advanced techniques. Fornes, Gupta

TX 561 Mechanical and Rheological Properties of Fibrous Material. Preq: MA 301. 3(2-2) S. In-depth study of the stress-strain, bending torsional dynamic and rheological behavior of natural and man-made fibers. Theoretical relations and advanced techniques. Fornes, Gupta

TX (EB) 585 Market Research in Textiles. Preq: MA 405, ST 421. 3(3-0) S. The quantitative methods employed in market research in the textile industry. The function of market research and its proper orientation to management and decision-making. Cooper

TX 586 Textile Labor Management. Preq: CI. 3(3-0) F,S,Sum. Labor management problems in the textile industry, with emphasis directed toward the roll of production supervision in a non-union textile plant. A study of NLRB decision and court opinions involving textile corporations. Powell

TX 590 Special Projects in Textiles. Preq: Sr. standing or grad. standing, CI. 2-3 F,S. Special studies in the major or minor field of the advanced undergraduate or graduate student. Includes current problems of the industry, independent investigations, seminars and technical presentation, both oral and written. Staff

TX 591 Special Topics. Preq: CI. 1-4 F,S. Intensive treatment of TX topics. Staff

TX 598 Textile Technology Seminar. Preq: Sr. standing, CI. 2(2-0) S. Lecture, discussion of current textile industry topics. Staff

Textiles

GENERAL COURSES

T 101 Fundamentals of Textiles. 2(1-2) F. Introduction to textiles: the history of the industry, description of textile materials and products and their utilization. Basic manufacturing systems, materials flow, terminology and calculations. Staff

T 200 Introduction to Textiles. Not open to students required to take T 101. 3(3-0) F,S. Survey of textiles including technical and economic history of the industry; physical and chemical processes involved in producing textile products from raw materials; unique aesthetic, physical and chemical properties of textiles and how these properties are determined by raw materials and production processes; and influence of properties of textile materials on their utilization and performance. Staff

T 203 Fiber Science I. Preq: CH 101. 3(3-0) F,S. Lectures emphasize: chemical constitution and properties of fiber-forming polymers; theories of fiber structure; relationship between the molecular structure of linear polymers and physical properties of natural and man-made fibers; principles and methods for producing man-made fibers; chemical behavior of natural and man-made fibers. Theil, Whaley

T 220 Yarn Forming Systems. Preq: T 101 or equivalent. 4(3-2) F,S. The principles of staple and filament yarn systems and structures. The influence of manufacturing systems and the input materials on product characteristics. Staff

MA 111 or equivalent eff 8/77

T 250 Fabric Forming Systems. Prereq: ~~T 101 or equivalent.~~ 4(3-2) F,S. The basic systems, including nonconventional, weaving and knitting. Emphasis on fabric construction and geometry. Structures of fabric and resulting properties are related to raw materials and product performance. Staff

eff 8/78

T 300 General Microscopy. ~~Prereq~~: PY 212. 3(1-4) F. The art and science of light microscopy and introduction to electron microscopy and microradiography; theoretical and practical aspects of visibility, resolution, and contrast. Laboratory practice in assembly, testing, and using various microscopes and accessories in describing, identifying, and photomicrographing crystalline, oriented, or amorphous materials used in the textile, fabric, plastic, and agricultural industries and in the life sciences. Staff

T 301 Technology of Dyeing and Finishing. Prereq: T 203. 4(3-2) F,S. A comprehensive course designed to familiarize the textile student with the basic principles involved and the procedures used for the preparation, dyeing, printing, and finishing of natural and man-made fibers. Some emphasis is placed upon the chemical nature of dyes and fastness properties, and the chemical nature of finishes used to impart specific end-use properties. Livengood, Walsh

T 305 Introduction to Color Science. Prereq: Soph. standing in textiles or equivalent. 1(1-0) S. Discussion of color vision, defective color vision as it contributes to the understanding of color vision. Definition of color space and detailed discussion of the measurements and transformation of coordinates leading to the "CIE" color space. Color calculations, differences and matching. Goldfinger

T 402 Introduction to the Theory and Practice of Fiber Formation. Prereq: CH 103, T 203, MA 212, PY 212. 3(3-0) S. Fundamental theory of flow behavior of polymeric materials as related to the formation of fibers by melt, dry and wet extrusion is discussed. Elementary theories of drawing and heat setting are also analyzed. This background is then applied to interpret the entire fiber forming processes of representative all-synthetic and cellulosic fibers. Cuculo

~~T 492 Problems in Science and Technology.~~ Prereq: Jr. standing. 1(0-2) S. Lectures given by scientists and technologists from outside the University consisting of the description of a scientific or technological problem, its analysis and its solution. The latter is arrived at with class cooperation. Students write brief critical reviews of lectures; class discussions. Course may be taken twice for maximum of two credits. Staff

T 493 Industrial Internship in Textiles. Prereq: Jr. or sr. in good standing. 3-6 Sum. A professional level work experience in any area of textiles designed to relate academic training in science and technology to industrial practice. Work experience under professional guidance. Written reports required and used as basis for grading. Registration must be approved in advance by the appropriate department head. Graded *S* or *U*. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

T 500 Advanced Microscopy. Prereq: T 300 or CI. 3(1-4) S. The art and science of light and electron microscopy and introduction to microradiography; theoretical and practical aspects of visibility resolution and contrast. Laboratory practice in assembly, testing and using various microscopes and accessories in describing, identifying and micrographing crystalline, oriented or amorphous materials, especially those of student interest. Lab. may include special projects for independent investigations. Tucker

T 501 Resinography. Prereq: T 300 or 500 and TX 460 or 560 or TC 461. 3(1-4) F,S. Lectures, laboratory and discussion regarding structure and morphology of resins, fibers, elastomers and composites which are studies by reflected light or electrons and by transmitted light or electrons. Other methods of diffraction and spectrometry. Crystallographic and optical properties. Staff

T 506 Color Science. Prereq: TC sr. or grad. student. 3(2-2) F. Discussion of color theory with emphasis on color measurement. Color and color difference calculations. From data of the basic color matching experiments the description of a color-space and its transformation into the CIE color space will be followed. The basis of color difference calculations. Color matches and color differences calculated based on experimental data obtained in course. Goldfinger

T(AD) 471 Introduction to Textile Design I 3(2-2) eff 8/77

T(AD) 472 Textile Design II/Internship 3 eff 8/77

T(AD) 473 Textile Design III 3(2-2) eff 8/77

T 491 Honors Seminar in Textiles 1(1-0) 2/23/78 eff 8/78

Toxicology

TOX 510 Biochemical Toxicology. Preq: Biochemistry, sr. status. 3(3-0) F.

TOX 515 Environmental Toxicology. Preq: Two years of biology. 3(3-0) S.

FOR GRADUATES ONLY

TOX 590 Special Problems in Toxicology. 1-3.

TOX 699 Research. Credits arranged 9/7/78 eff 8/77

University Studies

UNI 295 Special Topics in University Studies

~~**UNI (CHE) 300 Chemical Technology and the Environment.** 3(3-0) F. (See chemical engineering, page 198.)~~ eff 8/78

UNI 301 Science and Civilization. Preq: Soph. standing. 3(3-0) F,S. An inquiry into the scientific achievement and cultural impact of three different, but interrelated, models (or paradigms) of understanding the world and man's place in it; the Ancient-Medieval model of Aristotle, Ptolemy and Aquinas; the 17th century model of Newtonian physics; and the emerging, but fragmentary, 20th century model based upon the "new physics" of Einstein, Planck and Heisenberg.

UNI 302 Contemporary Science and Human Values. Preq: Soph. standing. 3(3-0) F,S. Surveys of some of the revolutionary developments in 20th century science and scientific method, particularly in the bio-sciences and psycho-social sciences, and explores their major intellectual consequences.

UNI 303 Man and His Environment. Preq: Soph. standing. 3(3-0) F,S. Attention is directed to the fundamental concepts of ecology, the impacts of technology upon the contemporary world environment, the broad, humanistic aspects of our present environmental problems and the need for new institutional arrangements in both government and the university as an aid to their solution.

UNI 323 World Population and Food Prospects. Preq: Soph. standing. 3(3-0) S. An interdisciplinary analysis of United States and world population growth in connection with national and world food requirements and man's place in the ecology of the earth. Controversial proposals discussed and evaluated.

UNI 324 Alternative Futures. 3(3-0) F. An examination of possible alternative future societies with stress upon the nature and likelihood of various alternatives. Special emphasis is given to the methodology and limitations of forecasting and the interaction between present and possible future technologies and human values.

delete d 9/26/78 eff 1/79

UNI 325 Bio-Medical Ethics: An Interdisciplinary Inquiry. 3(3-0) F,S. An examination of ethical issues emerging from recent advances in the bio-medical sciences. The approach will be interdisciplinary, drawing upon medicine, biology, philosophy, theology, law and other related disciplines. Topics will include death, abortion, experimentation and consent, behavior control, *in vitro* fertilization, amniocentesis, renal dialysis, mental illness, and health care delivery. Attention will focus on value questions and conceptual issues.

UNI 401 The Urban Crisis. 3(3-0) F. The change from a rural to an urban society, urban issues, the impact of technology and such resulting problems as poverty in affluence, racial tensions and changes in the environment. Controversial proposals discussed.

UNI 402 Peace and War in the Nuclear Age. 3(3-0) S. An interdisciplinary examination of the basic cluster of issues associated with the phenomena of peace and war. Areas of investigation include the nature of conflict, conflict management and resolution, aggression and violence, defense policy and nuclear strategic issues, the role of technology, arms races and arms control, and future prospects for world order.

UNI 490 Seminar in University Studies. 1-3 F,S. Investigation and discussion of selected topics of an interdisciplinary nature.

UNI 495 Special Topics in University Studies. ~~1-3~~ 1-6 3/4/77 eff 8/77, F,S. Examination of selected topics of an interdisciplinary nature.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

UNI 595 Special Topics in University Studies. Preq: Grad. standing or CI. 1-3 F,S. Examination of selected topics of an interdisciplinary nature.

401 326 Technology Assessment 3(3-0) 3/17/78 eff 1/79

Veterinary Science

VET 300 Laboratory Animal Management. Preq: Junior standing. 4(3-3) S. Designed to familiarize the student with the proper methods of handling, feeding, breeding, housing and disease control of the commonly used laboratory animals (mouse, rat, guinea pig, rabbit, hamster and nonhuman primates). Humane care is stressed throughout this study. Laboratory sessions will provide the student with an opportunity to handle, care for and rear a generation of one or more species during which time principles learned in lecture will be applied. Moncol

VET 333 Medical Vocabulary. Preq: Jr. or sr. enrolled in the pre-veterinary program. 2(2-0) S. Designed to familizarize students with a number of common medical terms through the use of Latin and Greek word parts and to teach pre-veterinary medical students the uses of a medical dictionary. Simmons

FOR ADVANCED UNDERGRADUATES

VET (PO) 401 Poultry Diseases. 4(3-3) S. The major infectious, noninfectious and parasitic diseases of poultry are studied with respect to economic importance, etiology, susceptibility, dissemination, symptoms and lesions. Emphasis upon practices for prevention, control and treatment of each disease. Colwell

VET 490 Special Topics in Veterinary Science. Preq: Junior standing. 1-6 F,S. Offered as needed to cover new or special subject matter within the scope of veterinary science at the undergraduate level. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

VET (ANS) 505 Diseases of Farm Animals. Preq: CH 101, 103. 3(3-0) F. The pathology of bacterial, viral, parasitic, nutritional thermal and mechanical disease processes. Batte

Vet 552 (MB, PO, PHY) Immunobiology 3(2-3) eff 6/77

Visual Design

(See Design.)

Wood and Paper Science

WPS 101 Introduction to Wood and Paper Science. 1(1-0) F. Staff

WPS 201 Elements of Wood. 3(2-3) S. For students not in Forest Resources. Identification, structure, properties properties and uses of common softwoods and hardwoods. Wood characteristics, moisture relationships and special features. Carter

WPS 202 Wood Structure and Properties I. Preq: BS 100 or BO 200. 3(2-3) F. The macrostructure and microstructure of wood. Wood structure, the physical properties and uses of several commercially important coniferous and deciduous woods. Techniques of hand lens and microscope identification of wood. Thomas

4(3-2) eff 1/78

WPS 203 Wood Structure and Properties II. Preq: WPS 202, PY 221. ~~3(3-0)~~ S. Physical properties of wood, specific gravity relationships, wood in relation to moisture, heat, sound, light, electricity, combustion, introduction to strength properties. Hart

WPS 205 Wood Products Practicum. Preq: WPS 201 or 202. 5 Sum. Shop drawings and a bill of materials are prepared for a furniture item which is then constructed and finished. Processes include grading, drying, machining, gluing, assembly and coating. All wood and wood-based materials used are prepared. Plant trips supplement the simulated factory order. Staff

WPS 210 Forest Products Internship. Preq: Completion of summer practicum. 1 Sum. Experience in the forest products or related industries. The student is assigned problem solving in an industrial situation to gain insight of forest products technology. Students write a paper on their experience. Carter

WPS 211 Pulp and Paper Internship. Preq: Completion of soph. year 1(1-0) S. Experience in the pulp and paper industry. The student is assigned problem solving in an industrial setting to gain insight of pulp and paper technology. Students write a paper on their experience. Staff

WPS (FOR) 219 Forest Economy and Its Operation. ~~3(2-2) F. (See forestry, page 247.)~~

eff 8/78

WPS 220 Wood Protection. Preq: WPS 202, CH 103. 3(2-3) S. Description of the deterioration of wood by various agents such as fungi, insects, fire, weather, and chemicals, and the methods of protecting wood against their action. Staff

WPS 242 Wood Fiber Analysis 3(2-3) S. Anatomy of wood and the relationship of anatomical structures to physical properties. Detailed microscopic studies of wood anatomy are conducted in the laboratory. Also, intensive laboratory work in the area of fiber microscopy with special emphasis on identification of pulped fibers from woody plants is included. Thomas

WPS (FOR) 273 Quantitative Methods in Forest Resources. 3(2-2) F,S. (See forestry, page 248.)

WPS 301 Wood Processing I. Preq: WPS 201 or 202 and summer practicum. 3(2-2) F. The processes of drying, gluing and finishing wood. Processes of reconstituting wood as fiberboard, hardboard and particleboard. Basic requirements of various procedures and materials. Factors in selecting production methods. Carter

WPS 302 Wood Processing II. Preq: WPS 201 or 203 and summer practicum. 3(2-3) S. The theories and techniques of converting raw wood into usable products by milling, veneering and chipping round wood. The processing of finished lumber, dimension stock, plywood and other wood products. Carter

WPS 315 Introduction to Wood-Polymer Principles. Preq: WPS 203, CH 103. 2(2-0) F. Emphasis on basic organic and polymeric terminology necessary for understanding chemical components and macrostructure of wood. Introduction to the organic functional groups used in adhesives and finishes in wood products manufacturing. Kelly

WPS 316 Wood-Polymer Principles. Preq: WPS 315. 3(3-0) S. Emphasis on the chemical and physico-chemical properties of wood based on its polymeric chemical structure. Finishing and adhesive systems widely used in wood products manufacturing are described and characteristics detailed. Kelly

WPS 321, 322 Pulp and Paper Technology I, II. Preq: CH 101, 107. 3(3-0) S. The physical and chemical characteristics of wood and cellulose. Chemistry and technology of the major mechanical, chemical and semichemical processes employed in the manufacture of pulp and paper. Content revised 1/2478 eff 8/78 Hitchings

WPS 331 Introduction to Wood and Pulping Chemistry. Preq: CH 220. 1(1-0) F. Topics in organic chemistry required for a basic understanding of wood and pulping chemistry. Emphasis on carbonyl groups and aliphatic and phenolic hydroxyl groups as well as stereochemistry. Gratzl

WPS 332 Wood and Pulping Chemistry. Preq: CH 220, WPS 331 or CH 221-223. 4(3-3) S. Wood as a basic source for fibers and chemicals. Major wood components including cellulose, hemicelluloses, lignin and extractives. Emphasis on the reactions of wood components in the major pulping and bleaching processes. Gratzl

WPS 344 Introduction to Quality Control. Preq: ST 361. 3(2-1) S. Methods used to control quality of manufactured wood products. Control charts of variables and attributes. Acceptance sampling techniques. Hart

WPS 403 Paper Process Analysis. Preq: WPS 321, 322. 3(0-6) S. Manufacture of several types of papers with attention to stock preparation, sizing, filling and coloring. The finished products are tested physically and chemically and evaluated. Hitchings

WPS 411, 412 Pulp and Paper Unit Processes I and II. Preq: CHE 301 and 302. 3(3-0) F,S. The principles of the design, construction and operation of process and auxiliary equipment employed in the pulp and paper industry. Processes include pulping, recovery, pollution reduction, recycling, fiber sources other than wood, papermaking, power (steam and electric) generation and utilization. Rogers

WPS 413 Paper Properties and Additives. Preq: Sr. standing. 3(1-6) F. Physical, chemical, and microscopical testing of commerical papers; identification and evaluation of dyestuffs and color matching; nature and use of chemical additives in papermaking. Reeves

Engineering Applications in Forest Resources eff 8/78 revised 6/22/78

WPS (FOR) 423 ~~Logging and Milling~~. Preq: Jr. standing. 3(2-3) F. ~~Analysis of timber~~ harvesting and transportation systems, equipment selection and costs; safety and supervi-

WPS 350 Wood Technology Literature 1(1-0) eff 1/78

sion; manufacturing methods; log and lumber grades; analysis of investment alternatives. Hassan

WPS 434 Wood Operation. Preq: WPS 301, 302. 3(2-3) F. Organization of manufacturing plants producing wood products, including company organization, plant layout, production planning and control. Analysis of typical manufacturing operations processes, equipment, size and product specification. The organization and operation of wood products markets. Carter

WPS (FOR) 435 Systems Analysis in Forest Products. Preq: Sr. standing. 3(3-0) S. Operations analysis techniques applied to management decision-making in wood products. Allocation of production resources, inventory of raw materials, scheduling of production activities and general problems of quantitative decision-making. Staff

WPS 441 Introduction to Wood Mechanics. Preq: MA 212, PY 221 or 211. 2(2-0) F. Strength and related properties of commercial woods; standard ASTM strength tests; toughness; timber fastening; design of columns; simple, laminated and box beams; trusses and arches. Pearson

WPS 442 Wood Mechanics and Design. Preq: ESM 211 or WPS 441. 3(2-3) S. Wood as an engineering material. Topics include — generalized Hooke's law for orthotropic bodies and the effect of orientation of applied forces relative to the axes of symmetry; mechanical properties of wood as affected by its cellular structure; influence of defects, moisture, temperature and duration of load; visual and mechanical grading; derivation of working stresses; glued laminated construction; structural plywood; design of wooden members. Pearson

WPS 461 Paper Converting. Preq: Jr. standing. 1(1-0) S. The principal processes by which paper and paperboard are fabricated into products. Reeves

WPS 463 Plant Inspection. Preq: Sr. standing in Pulp and Paper. 1(0-3) S. One-week inspection trips of representative manufacturers of pulp and paper and papermaking equipment. Hitchings

WPS 471 Pulping Process Analysis. Preq: WPS 321. 3(1-6) F. Predominately a laboratory course concerned with preparation and evaluation of different types of wood pulp. The wood raw material is varied each year to study the principal pulp and bleaching variables and evaluate these critically. Students are organized in groups and encouraged to allocate time as necessary for experimental work. Hitchings

WPS 481 Pulping Processes and Products. Preq: WPS 202, CH 103. 2(2-0) S. Technology and economics of pulp products and by-products, including: paper and paperboard, containers and boxes, structural boards, molded and laminated products, cellulose fibers and films, cellulose derivatives and silvichemicals. Reeves

WPS 491 Senior Problems in Wood and Paper Science. Credits Arranged. Management or technology problems selected with faculty approval. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

WPS 513 Tropical Woods. Preq: WPS 203, 301. 2(1-3) F. Structure, identification, properties, characteristics and use of tropical woods, especially those used in plywood and furniture. Staff

WPS 521, 522 Chemistry of Wood and Wood Products. Preqs: CH 315, CH 331, WPS 202, PY 21those used in plywood and furniture. Staff

WPS 521, 522 Chemistry of Wood and Wood Products. Preqs: CH 315, CH 331, WPS 202, PY 212. 3(2-3) F,S. Fundamental chemistry and physics of wood and wood components; pulping principles; electrical and thermal properties. Staff

WPS 525 Pollution Abatement in Forest Products Industries. Preq: Grad. or advanced undergrad. standing in science or engineering curricula. 3(3-0) S. Pollution sources, inplant control and treatment of water and air pollution in forest products. Concentration on inplant pollution control in the pulp and paper industry. Staff

WPS 533 Advanced Wood Anatomy. Preq: WPS 202 or CI. 3(1-6) S. Alt. yrs. Fundamental wood anatomy and cell wall ultrastructure. Laboratory techniques for light and electron microscope studies of wood. Thomas

WPS 450 Wood Industry Case Studies 2(1-3) 3/3/77 eff 1/78
WPS 485 Management Development Seminar 3(3-0) 4/19/77 eff 1/79

WPS 560 Advanced Pulp and Paper Process Analysis 3(3-0) 4/20/78

WPS 540 Wood Composites. Preq: WPS 441; grad. or adv. undergrad. standing. 3(3-0) S. Alt. yrs. Designed to acquaint adv. undergrad. and grad. students with the rapidly expanding field of wood composites. Production processes for particle board, plywood, hardboard, fiberboard and other composites are presented. Elastic theory for the stiffness, strength and buckling resistance of composites will be developed. Test procedures for determining mechanical properties and design procedures for glued laminated members, panel products, and built-up members, including I- and box-beams, stressed-skin panels and sandwich panels, will be outlined. Staff

WPS 591 Wood and Paper Science Problems. Preq: Sr. or grad. standing. Credits Arranged. Assigned or selected problems in silviculture, logging, lumber manufacturing, pulp technology, or forest management. Staff

WPS 599 Methods of Research in Wood and Paper Science. Preq: Advanced undergrad. or grad. standing. Credits Arranged. Research procedures, problem outlines, presentation of results; consideration of selected studies by forest research organizations; sample plot techniques. Staff

Zoology

ZO 201 General Zoology. Preq: BS 100 or 105. 4(3-3) F,S,Sum. The biology of the major groups of animals, with emphasis on general structural plans and diversity, reproduction development, ecology, behavior and evolution. Doerr, G. Miller

ZO 202 Invertebrate Zoology. Preq: BS 100. 4(3-3) F. The biology and classification of invertebrate animals, especially types commonly encountered and those that illustrate zoological principles. Primarily for zoology and wildlife biology majors. Bradbury

ZO 203 Vertebrate Zoology. Preq: BS 100 or BO 200. 4(3-3) F. The biology of the vertebrates; their adaptations and evolutionary history. Comparative physiological, developmental, behavioral and anatomical studies. Primarily for zoology and wildlife biology majors. Martof

ZO 212 Basic Anatomy and Physiology. Preq: BS 100 (only free elective credit allowed for students majoring in biological sciences, zoology, conservation and wildlife biology). 4(3-3) F. Major emphasis on the structure and function of the muscular, skeletal, circulatory and nervous systems. Grant

ZO 221 Conservation of Natural Resources. 3(3-0) F,S,Sum. The importance of natural resources to man and the part they play in his environment. The physical, biological and ecological principles underlying natural resource conservation with attention to the biological consequences of overexploitation and environmental pollution. Barkalow

ZO 315 General Parasitology. Preq: ZO 201 or 202. 3(2-3) S. To gain a knowledge and appreciation of the life history, pathology and control of some common parasites. Miller

ZO 323 Comparative Anatomy. Preq: ZO 201, Jr. standing. 4(2-4) F,S. A comparative morphology of vertebrates demonstrating the interrelationships of the organ systems of the various groups. Harkema

ZO 345 Histology. Preq: ZO 323 or 203. 4(2-4) F. The microscopic anatomy of animal tissues. Harkema, Muse

ZO 353 Wildlife Management. Preq: BS 100. 3(3-0) F,S. Describes historical development from empirical practices to the scientific American system. The principles of management, protection, and conservation of those warm-blooded vertebrates of aesthetic, sport or food values in urban, rural and wilderness areas. Barkalow

ZO (BO) 360 Introduction to Ecology. 4(3-3) F,S. (See botany, page 196.)

ZO 361 Vertebrate Embryology. Preq: ZO 323 or 203. 4(3-3) S. Fundamental principles that apply to the embryonic development of vertebrates. Roberts

ZO 400 Biological Basis of Man's Environment. Preq: Jr. standing. 3(3-0) F,S. Man's impact on the environment and the biological laws that govern the consequences in terms of population growth, pollution, and ecology. Quay

ZO (ENT) 401 Bibliographic Research in Biology. 1(1-0) F. (See entomology, page 239.)

ZO (BO) 414 Cell Biology. Preq: CH 223, PY 212, ZO 201 or 203. 3(3-0) F. The chemical and physical bases of cellular structure and function with emphasis on methods and interpretations. Roberts

ZO 415 Cellular and Animal Physiology Laboratory. Coreq: ZO 414 or ZO 421. 2(0-5) F,S. An introduction to physiological techniques and experimentation. Laboratory experiments include studies of cells and examination of the functions of vertebrate organ systems. Smith

ZO 420 Fishery Science. Preq: ZO 201 or 203, ZO 360. 3(2-2) F. The science of fishery biology: life history and biology of important game and commercial fishes, fishing methods, age and growth analysis, survey of fishery resources, tagging studies, population estimations and pollution studies. Hassler, Huish

ZO 421 Vertebrate Physiology. Preq: CH 223, PY 212, ZO 201 or 203. 3(3-0) F,S. A comprehensive study of the processes involved in the function of specialized cells, tissues and organ systems of vertebrates. Emphasis is on the study of mammalian systems. Smith, Underwood

ZO 441 Ichthyology. Preq: ZO 201 or 203; jr. standing. 3(3-0) S. A study of the origin, evolution, and classification of fishes. Detailed information is presented on the biology, life history, ecology, and economics of selected species. Hassler

ZO 442 Ichthyology Laboratory. Preq: ZO 201 or 203; Coreq: ZO 441; jr. standing. 1(0-3) S. Concerned with methods of collecting and preserving fish for scientific use. Provides the student with the basic background to identify and classify fish. The student also becomes familiar with fish distribution and ecology. Hassler

ZO 490 Special Topics in Zoology. Preq: Jr. standing. 3(2-1).

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ZO 501 Ornithology. Preqs: ZO 203 or 323, ZO 421. 3(2-3) F,S. The biology of birds: systematics, physiology, life histories, ecology and behavior. Quay

ZO 510 Adaptive Behavior of Animals. Preq: ZO 421 or CI. 4(3-3) F. The comparative study of animal behavior including a treatment of physiological mechanisms and adaptive significance. Both invertebrates and vertebrates are studied. Whitsett

ZO (PHY) 513 Comparative Physiology. Preq: ZO 421 or CI. 4(3-3) S. Comparison of the organ systems of vertebrates and the physiological process involved in maintaining the hemostatic state. The various compensatory mechanisms employed during environmental stress. Underwood

ZO 515 Growth and Reproduction of Fishes. Preq. or Coreq: GN 411, ZO 420, 421, 441. 3(2-3) S. The biology of fishes: physiology, anatomy, pathology, behavior and genetics. Primarily for graduate students in fisheries. Includes trips to research laboratories. (Offered in S 1977 and alt. years.) Kerby

ZO 517 Population Ecology. Preq: ZO 360, ST 511 or equivalent. 3(3-0) S. The dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, the ecological niche, food chains and energy flow. Emphasis on methods of study. Hayne

ZO 519 Limnology. Preq: ZO 360 or equivalent. 4(3-3) F. A study of inland waters. Lectures deal with physical, chemical and biological factors that affect freshwater organisms. General principles illustrated in laboratory and on field trips. Staff

ZO (PO) 524 Comparative Endocrinology. 4(3-3) S. (See poultry science, page 302.)

ZO (MAS) 529 Biological Oceanography. Preq: ZO 360 or CI. 3(3-0) S. Stresses the dynamic interrelationships between organisms of the sea and their physical and chemical environment. Examines fundamental concepts in biological oceanography stressing experimental methods. Staff

ZO (GN) 532 Biological Effects of Radiations. 3(3-0) S. (See genetics, page 250.)

ZO (GN) 540 Evolution. 3(3-0) F. (See genetics, page 250.)

ZO 542 Herpetology. Preq: ZO 203 or ZO 323, ZO 421. 3(2-3) S. The biology of the amphibians and reptiles: systematics, life history, anatomy, behavior, physiology and ecology.

Martof

ZO 544 Mammalogy. Preq: ZO 203 or 323, CI. 3(2-3) S. The classification, identification and ecology of the major groups of mammals. Barkalow

ZO (GN) 550 Experimental Evolution. 3(3-0) F. (See genetics, page 250.)

ZO 553 Principles of Wildlife Sciences. Preq: ZO 360. 3(2-3) F. The principles of wildlife management and their application are studied in the laboratory and in the field. Davis

ZO 554 Wildlife Field Studies. Preq: ZO 553, ST 311; CI. 3(2-3) S. Field applications of methods for studying vertebrate wildlife populations; sampling methods, data gathering, analysis, and interpretation of results are practiced. Participation in field laboratories and one or two weekend field trips is required. Doerr

ZO (MB) 555 Protozoology. Preq: CI. 4(2-6) F. The biology of the Protozoa: lectures include morphology, physiology, ecology, genetics, reproduction, evolution, systematics and life-cycles of both free-living and parasitic taxa; laboratory stresses recognition of selected forms and demonstrates techniques to prepare specimens for microscopic examination. Bradbury

ZO (BO) 560 Principles of Ecology. Preq: Three semesters of college-level biology courses. 4(3-3) F. Each of the major subject areas of ecology is developed in sufficient depth to provide a factual and philosophical framework for understanding ecology. Staff

ZO (PHY, ENT) 575 Physiology of Invertebrates. Preq: ZO 202 or CI. 3(3-0) F. Physiology of invertebrates including the insects but excluding the Protozoa. The unity of the physiology of the various groups stressed. Wolcott

ZO 581 Helminthology. Preq: ZO 323 or 203, ZO 315 or equivalent. 4(2-4) F. The study of the morphology, biology and control of the parasitic helminths. G. Miller

ZO (ENT) 582 Medical and Veterinary Entomology. 3(2-3) S. (See entomology, page 239.)

ZO 590 Special Studies. Preq: Twelve hours zoology, CI. Credits Arranged. A directed individual investigation of a particular problem in zoology, accompanied by a review of the pertinent literature. Staff

ZO 592 Topical Problems. Preq: CI. 1-3. Organized, formal lectures and discussions of a special topic. Staff

ZO 691 Topics in Animal Behavior 3(3-0) 5/12/77 gfl 1/78

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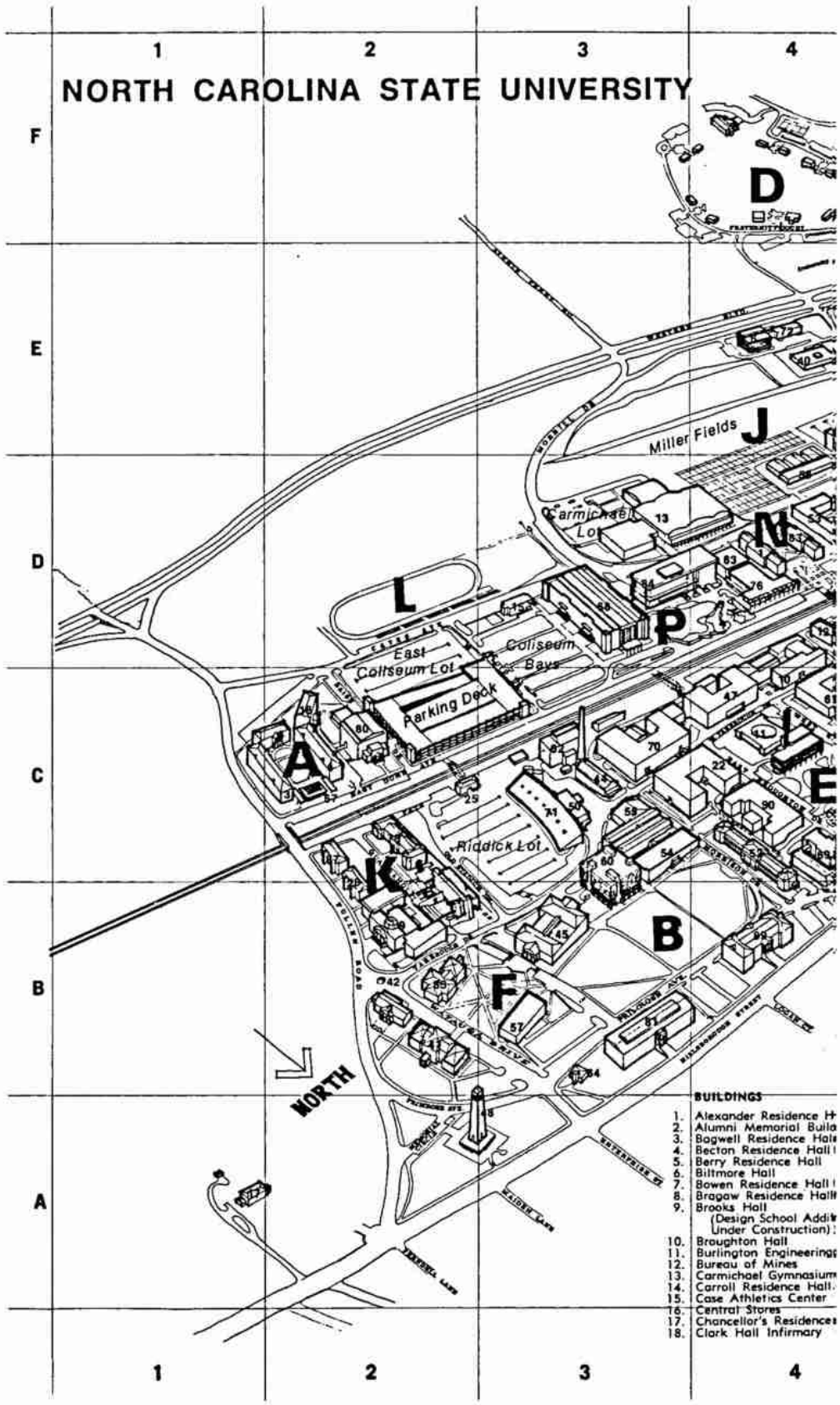
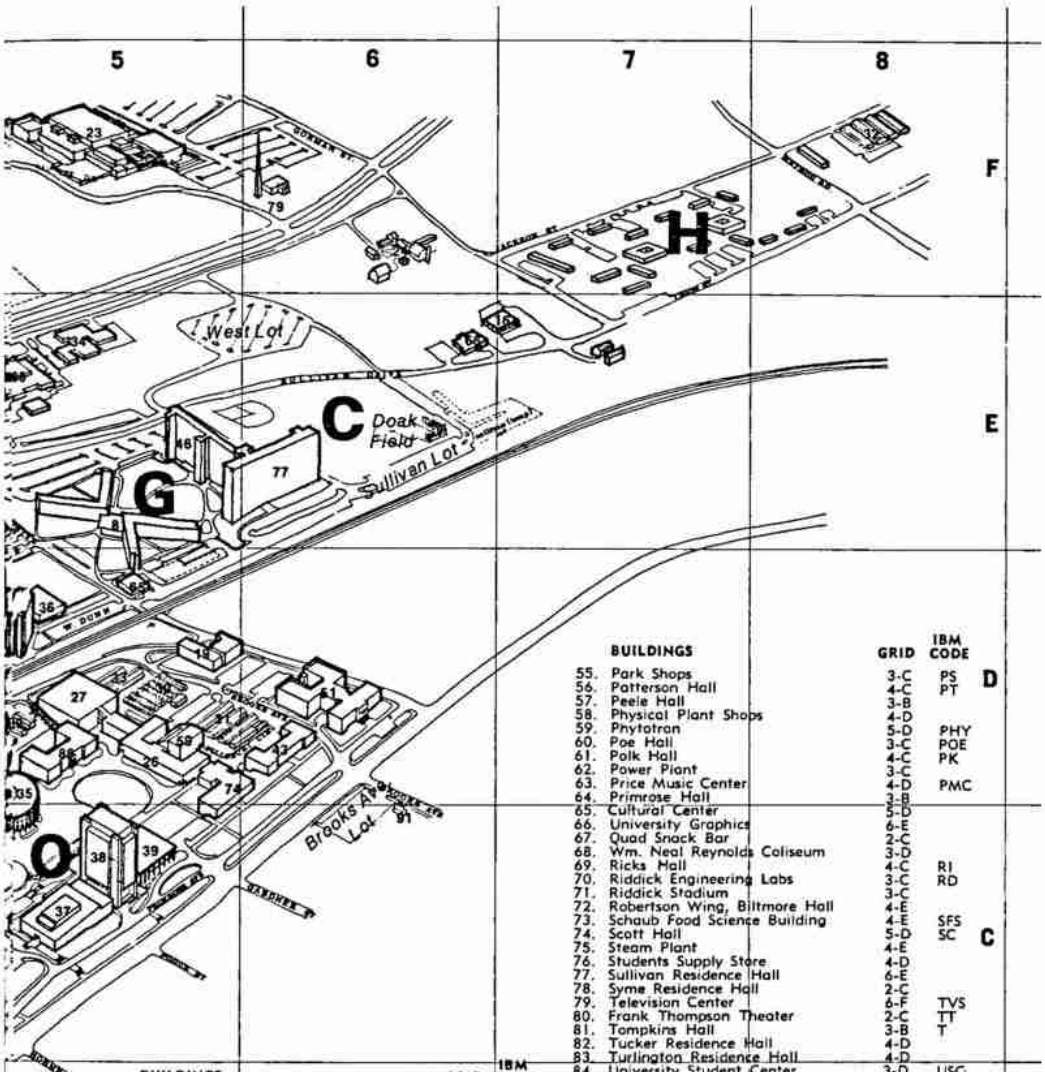

NORTH CAROLINA STATE UNIVERSITY
1
2
3
4
A
B
C
D
E
F
Miller Fields
Carmichael Lot
East Coliseum Lot
Coliseum Bays
Parking Deck
Riddick Lot
NORTH
BUILDINGS
1. Alexander Residence H
2. Alumni Memorial Build
3. Bagwell Residence Hall
4. Becton Residence Hall
5. Berry Residence Hall
6. Biltmore Hall
7. Bowen Residence Hall
8. Bragaw Residence Hall
9. Brooks Hall
(Design School Addi
(Under Construction)
10. Broughton Hall
11. Burlington Engineering
12. Bureau of Mines
13. Carmichael Gymnasium
14. Carroll Residence Hall
15. Case Athletics Center
16. Central Stores
17. Chancellor's Residence
18. Clark Hall Infirmary



	BUILDINGS	GRID	IBM CODE
19.	Clark Laboratories	5-D	CL
20.	Cox Hall	4-D	COX
21.	Dabney Hall	4-D	DAB
22.	Daniels Hall	4-C	DAN
23.	McKimmon Extension Education Center	5-F	
24.	Farm Unit 5	6-F	FH
25.	Field House	2-C	
D.	Fraternity Court	4-F	GA
26.	Gardner Hall	5-D	
27.	Gardner Hall Addition	5-D	
28.	Gold Residence Hall	2-C	AGH
29.	Greenhouse—Agronomy	5-D	BSG
30.	Greenhouse—Biological Sciences	5-D	HGH
31.	Greenhouse—Horticulture	5-D	
32.	Greenhouse—840 Method Rd.	8-F	PPG
33.	Greenhouse—Plant Pathology	5-D	GHL
34.	Grinnells Animal Health Lab	5-E	HA
35.	Harrelson Hall	5-D	
36.	Harris Hall	5-D	DHL
37.	D. H. Hill Library-original wing	5-C	
38.	D. H. Hill Library-book stack tower	5-C	
39.	D. H. Hill Library-Erdahl-Cloyd wing	5-C	HWP
40.	Hodges Wood Products Lab	4-E	
41.	Holladay Hall	2-B	BI
42.	Information Center	2-B	
43.	Kilgore Hall	6-D	KI
44.	Laundry	3-C	KRC
45.	Leazar Hall	3-B	BS
46.	Lee Residence Hall	5-E	LEZ
47.	Mann Hall	4-C	BR
H.	E. S. King Village (17 apt. bldgs. A-Q)	7-F	MN
48.	Memorial Tower	3-A	BU
49.	Metcalf Residence Hall	4-D	
50.	Morris Building	3-C	CG
51.	Nelson Textile Building	6-D	
52.	1911 Building	4-C	N
53.	Owen Residence Hall	4-D	
54.	Page Hall	3-C	PA

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55.	Park Shops	3-C	PS
56.	Patterson Hall	4-C	PT
57.	Peele Hall	3-B	
58.	Physical Plant Shops	4-D	
59.	Phytotron	5-D	PHY
60.	Poe Hall	3-C	POE
61.	Polk Hall	4-C	PK
62.	Power Plant	3-C	
63.	Price Music Center	4-D	PMC
64.	Primrose Hall	3-B	
65.	Cultural Center	5-D	
66.	University Graphics	6-E	
67.	Quad Snack Bar	2-C	
68.	Wm. Neal Reynolds Coliseum	3-D	
69.	Ricks Hall	4-C	RI
70.	Riddick Engineering Labs	3-C	RD
71.	Riddick Stadium	3-C	
72.	Robertson Wing, Biltmore Hall	4-E	
73.	Schaub Food Science Building	4-E	SFS
74.	Scott Hall	5-D	SC
75.	Steam Plant	4-E	
76.	Students Supply Store	4-D	
77.	Sullivan Residence Hall	6-E	
78.	Syme Residence Hall	2-C	
79.	Television Center	6-F	TVS
80.	Frank Thompson Theater	2-C	TT
81.	Tompkins Hall	3-B	T
82.	Tucker Residence Hall	4-D	
83.	Turlington Residence Hall	4-D	
84.	University Student Center	3-D	USC
85.	Watauga Hall	2-B	
86.	Weaver Laboratories	5-E	DSW
87.	Welch Residence Hall	2-C	
88.	Williams Hall	5-D	WMS
89.	Winston Hall	4-B	WN
90.	Withers Hall	4-C	WI
91.	Turner House	6-C	

	COURTS AND FIELDS	GRID
A.	Becton-Berry Quad	2-C
B.	Court of North Carolina	3-B
C.	Doak Field	6-E
D.	Fraternity Court	4-F
E.	Gardner Arboretum	4-C
F.	Holladay Hall Court	3-B
G.	Lee-Bragaw Court	5-E
H.	E. S. King Village	7-F
J.	Miller Fields	4-E
K.	Syme-Brooks Court	2-C
L.	Track	2-D
M.	Tucker-Owen Court	4-D
N.	Turlington-Alexander Court	4-D
O.	University Plaza	5-C
P.	University Student Center Plaza	3-D

	PARKING LOTS	
	Brooks Avenue Lot	6-C
	Carmichael Lot	3-D
	Coliseum Bays	3-D
	East Coliseum Lot	2-C
	Harris Lot	4-E
	Parking Deck	2-C
	Riddick Lot	3-C
	West Lot	6-E
	Sullivan Lot	6-E
	Sullivan Temporary Lot	7-E

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