1987-1989 Graduate Catalog

University of Alabama in Huntsville

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Graduate Catalog
1987-89
The University of Alabama in Huntsville is committed to equal opportunity in employment and education. The University does not discriminate in any program or activity on the basis of race, color, religion, sex, age, or national origin, or against qualified handicapped persons, and it maintains an affirmative action program for protected minorities and women.

Although this catalog intends to reflect currently any policies or rules of The Board of Trustees of The University of Alabama referred to or incorporated herein, users are cautioned that changes or additions to such policies, rules, tuition and fees may have become effective since the publication of this material. In the event of such a conflict the current statements of Board policy contained in the official minutes and manual of rules, by-laws, and guidelines shall prevail.

The University of Alabama in Huntsville also reserves the right to modify its institutional policies from time to time. Students enrolling in the University are subject to current policies and rules as contained herein and as subsequently stated or modified by official institutional action.
# Class Periods

**Monday, Wednesday, Friday**

<table>
<thead>
<tr>
<th>Period</th>
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<tr>
<td>A</td>
<td>8:00 a.m.-9:15 a.m.</td>
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<td>B</td>
<td>9:25 a.m.-10:40 a.m.</td>
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<td>C</td>
<td>10:50 a.m.-12:05 p.m.</td>
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<td>D</td>
<td>12:15 p.m.-1:30 p.m.</td>
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<td>F</td>
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<td>G</td>
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<td>H</td>
<td>4:35 p.m.-5:50 p.m.</td>
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<td>R</td>
<td>3:50 p.m.-5:50 p.m. (MW only)</td>
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<td>S</td>
<td>6:00 p.m.-8:00 p.m. (MW only)</td>
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<td>T</td>
<td>8:10 p.m.-10:10 p.m. (MW only)</td>
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**Tuesday, Thursday**

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<td>M</td>
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<td>P</td>
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<td>Q</td>
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<td>R</td>
<td>3:50 p.m.-5:50 p.m.</td>
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<td>S</td>
<td>6:00 p.m.-8:00 p.m.</td>
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<tr>
<td>T</td>
<td>8:10 p.m.-10:10 p.m.</td>
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</tbody>
</table>

## The UAH Term System

UAH has four identical terms, each spanning ten weeks plus an exam week. Credit for course work is granted in standard semester-hour units.

## General Information Center

The General Information Center located in the University Center Room 124 is available to all students, prospective students, and the public to obtain information about the University of Alabama in Huntsville. Tel: (205) 895-6295.
ACADEMIC CALENDAR 1987-88

Fall Term
- Early Registration: July 28-August 7
- Application Deadline: August 12
- Open Registration: September 16, 17
- Classes Begin—8:00 a.m.: September 19
- Deferred Exams (Summer term): September 19
- Thanksgiving Holidays: November 26-27
- Examinations: December 2, 3, 4
- Last Day Fall Term: December 5
- Commencement: December 13

Winter Term
- Early Registration: November 2-12
- Application Deadline: December 15
- Open Registration: December 16, 17, January 5
- Classes Begin—8:00 a.m.: January 6
- Deferred Exams (Fall Term): January 9
- Examinations: March 16, 17, 18, 19
- Last Day Winter Term: March 19

Spring Term
- Early Registration: February 18-March 1
- Application Deadline: March 4
- Registration: March 23-25
- Classes Begin—8:00 a.m.: March 26
- Deferred Exams: March 26
- Examinations: June 4, 6, 7, 8
- Last Day Spring Term: June 8
- Commencement: June 12

Summer Term
- Early Registration: May 9-19
- Application Deadline: May 24
- Open Registration: June 13 & 14
- Classes Begin—8:00 a.m.: June 15
- Deferred Exams (Spring Term): June 18
- Holiday: July 4
- Examinations (for 8 week term): August 11, 12, 13
- Examinations (for 10 week term): August 25, 26, 27, 29
- Last Day Summer Term: August 29
ACADEMIC CALENDAR 1988-89

Fall Term

Early Registration ................................................................. July 28-August 9
Application Deadline ......................................................... August 22
Open Registration ................................................................. September 16, 19, 20
Classes Begin—8:00 a.m. ...................................................... September 21
Deferred Exams (Summer term) .............................................. September 24
Thanksgiving Holidays .......................................................... November 24, 25
Examinations ................................................................. December 2, 5, 6, 7
Last Day Fall Term ............................................................... December 7
Commencement ................................................................. December 11

Winter Term

Early Registration ................................................................. November 2-14
Application Deadline ......................................................... December 13
Open Registration ................................................................. December 14, 15, January 3
Classes Begin—8:00 a.m. ...................................................... January 4
Deferred Exams (Fall Term) .................................................. January 7
Examinations ................................................................. March 15, 16, 17, 18
Last Day Winter Term .......................................................... March 18

Spring Term

Early Registration ................................................................. February 15-27
Application Deadline ......................................................... March 3
Open Registration ................................................................. March 22, 23, 24
Classes Begin—8:00 a.m. ...................................................... March 25
Deferred Exams ................................................................. March 25
Examinations ................................................................. June 3, 5, 6, 7
Last Day Spring Term .......................................................... June 7
Commencement ................................................................. June 11

Summer Term

Early Registration ................................................................. May 8-18
Application Deadline ......................................................... May 15
Open Registration ................................................................. June 12, 13, 14
Classes Begin—8:00 a.m. ...................................................... June 15
Deferred Exams (Spring Term) ............................................. June 17
Holiday ................................................................. July 4
Examinations (for 8 week term) ........................................... August 11, 12, 14
Examinations (for 10 week term) ........................................... August 25, 26, 28, 29
Last Day Summer Term .......................................................... August 29
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Legend of Abbreviations

ETS—Educational Testing Service
GPA—Grade Point Average
GMAT—Graduate Management Aptitude Test
GRE—Graduate Records Exam
NPG—Nondegree Postgraduate
MAT—Miller Analogies Test
NEAS—National Engineering Aptitude Search
NTE—National Teacher Examination
TOEFL—Test of English as a Foreign Language
Mission Statement

The University of Alabama in Huntsville is a campus of the University of Alabama System. It is a teaching and research institution dedicated to excellence in the promotion of the intellectual, technological, and economic enhancement of the state, region, and nation. The University offers a wide range of academic and professional majors at the bachelor's and master's levels and a specialized selection of doctoral level programs.

The University is committed to developing a faculty of the highest quality, and to providing an environment which facilitates its continued intellectual and professional growth. The University Faculty is, in turn, committed to stimulating the intellectual development of its students.

The institution recognizes its responsibility to prepare its students to take leadership roles, think creatively and critically, and communicate clearly; to respect knowledge and the pursuit of truth; and to engage in the challenge and pleasure of a lifetime of learning. Because of its location in a technologically oriented major population center, UAH offers educational opportunities for traditional students and those individuals who are beyond the traditional college age.

UAH recognizes its responsibilities to the Huntsville community and the surrounding region, one of the nation's key centers for governmental and industrial advanced technological research. In meeting those responsibilities the institution provides unusual opportunities for new and creative programs, especially in science, engineering, primary care medicine, and related areas. One of the distinguishing characteristics of UAH is its sustained core of basic and interdisciplinary research, augmented by its research centers which focus on areas of national high priority. Both the research activities and classroom experiences at UAH are supported by contemporary computer technology.

Through the excellence of its academic programs, faculty research and student support activities, UAH provides unique opportunities for the personal and professional development of each student. UAH, through its graduates and its programs, aspires to contribute to economic advancement, cultural enrichment, and quality of life.
The Setting

Surrounded by the hills, mountains, and rivers of the lower Tennessee Valley, Huntsville offers a cultural and intellectual diversity rare in any section of the country. To the outside world, Huntsville (pop. 150,000) is perhaps best known for its cluster of high technology industries and agencies — NASA's George C. Marshall Space Flight Center, the U.S. Army Redstone Arsenal, the Alabama Space and Rocket Center, and the 2000-acre Milton K. Cummings Research Park, home of some of America's most sophisticated and fastest-growing technical firms. However, Huntsville's image as a national research center built on advanced technology often obscures its uncommon blend of the traditional and the contemporary. First-time visitors are often equally struck by Twickenham, a showplace historical district in the center of town. Twickenham, a square-mile neighborhood of painstakingly restored nineteenth-century homes and gardens, captures better than most southern cities the opulence and charm of cotton-era architecture. Other visitors admire one of the best restored and revitalized downtown areas in the nation, dominated by the Von Braun Civic Center with its art museum, concert hall, sports arena, exhibition halls and playhouse. Still others appreciate the opportunities for boating, camping, hiking, and other Southern Appalachian recreational activities in the nearby lakes, mountains, and state parks. Huntsville is one of the few cities of its size offering such a variety of clubs, professional organizations, community service groups, sports activities, and cultural groups, including a symphony orchestra and an opera company. It is certainly the only city in the South or West in which the leading local sport is ice hockey.

The University

With a quarter of a century of full-time operations, programs at the University of Alabama in Huntsville are still developing and diversifying. Since UAH is new, it is unfettered by rigid patterns of established practice. It is our intention to be innovative, even experimental, to explore what is new, to evaluate existing programs continually, to develop and establish curricula and pedagogical techniques calculated to help students live and perform well in a complicated environment.

Efforts to start an undergraduate program in Huntsville began as early as 1947. Following negotiations between local officials and those at the University of Alabama in Tuscaloosa, the University Center opened as a branch of the Tuscaloosa campus on January 6, 1950, with 137 students in ten sections of basic freshman subjects. The University Center grew steadily during the 1950's, but like many things in Huntsville, it was given added impetus by the development of the space program in 1957. The first 83 acres of the present site were purchased and Morton Hall was constructed in 1960. Degree-awarding programs at the Masters level were first offered in 1963 and at the baccalaureate level in the following year. The first Master's degree based on work begun and completed in Huntsville was awarded in 1965 and the first undergraduate degrees in 1968. In 1969 UAH was made a part of the newly-established University of Alabama System, three independent, autonomous campuses in Huntsville, Tuscaloosa, and Birmingham.

The University is accredited by the Southern Association of Colleges and Schools.
The School of Graduate Studies

The School of Graduate Studies provides a challenging and intellectually invigorating environment for advanced learning, discovery, and the pursuit of knowledge. The School seeks to assemble scholars among both students and faculty whose aims are to pursue advanced research both for the sake of pure knowledge and for serving mankind. Students seeking graduate studies are those who have already demonstrated strong intellectual abilities during their undergraduate years. The faculty which supervises graduate education formulates academic policies and maintains the quality of education. It is the main element in establishing the School's level of excellence.

Faculty members of the School of Graduate Studies are selected from the University's most active and productive scholars. Instruction within the School is therefore provided by those who have achieved national or international stature in their fields. A list of graduate faculty for each department appears at the head of each departmental entry. A complete list of graduate faculty appears at the end of this catalog.
Resources

School of Primary Medical Care

The school offers postbaccalaureate professional medical training on three levels. For junior and senior medical students in the University of Alabama School of Medicine, the school offers a complete clinical education program. Through the School of Primary Medical Care, UAH jointly offers with Huntsville Hospital a three-year residency in family practice for medical school graduates who want specialized training to qualify for certification by the American Board of Family Practice. The school also sponsors or cosponsors a variety of continuing medical education conferences and workshops to aid practicing physicians in maintaining licensure and certification requirements. All three programs are accredited through the University of Alabama School of Medicine (UASOM).

All UASOM freshman students are admitted to the parent school in Birmingham, where they complete their basic medical science training, which comprises the first two years of the undergraduate medical curriculum. Students then take their clinical clerkships and electives at the Birmingham, Huntsville, or Tuscaloosa campuses. Students who satisfactorily complete the medical curriculum at any of the three campuses are awarded diplomas from the University of Alabama School of Medicine.

Address correspondence about admissions to the tri-campus UASOM medical student program to: Director of Admissions, University of Alabama School of Medicine, University Station, Birmingham, Alabama 35294. Faculty and students of the School of Primary Medical Care are available for consultation with students interested in the UASOM/Huntsville medical student program. Interested students are referred to the Office of Medical Student Affairs, UAH Clinical Science Center.

Information on the UAH-Huntsville Hospital Family Practice Residency Program is available from: Director of the Family Practice Residency, UAH Medical Clinics, 201 Governors Drive, S.W., Huntsville, Alabama 35801. Telephone (205) 536-5511.

Computer Center

The primary source of mainframe computing at The University of Alabama in Huntsville is the Computer Center’s Sperry 1100/73/H2 Processors, with sufficient peripheral equipment to meet its instructional, research, and administrative needs. Two Distributed Communications Processors (DCP/40) give terminal access to the host computer. A combination of dial-up and hard-wired ports provide for a wide variety of terminal supports. General purpose graphics terminals are distributed throughout the campus for support of instructional and research efforts. A research-quality general purpose graphics laboratory is accessible to faculty and its graduate students for their special graphics applications. The Computer Center’s extensive software library may be used by the university community. In addition to the many language processors provided, numerous applications packages are available in such areas as Mathematics, Statistics, Graphics, and Simulation. A Computer Center User’s Guide, in machine-readable format, provides extensive documentation of the library. In an effort to “help users help themselves,” a Users Services staff is on hand for consultation with University personnel on questions
about the use of the Center. Quarterly seminars are offered on Executive Control Language (ECL), 1100 Editor and graphics. These are open to all interested faculty, staff, and students.

Continuing Education

The Division of Continuing Education responds to life-long educational needs for professional development, self-enrichment and personal growth. In cooperation with the University, community groups, professional associations, business and industry, and other agencies, the Division designs and sponsors credit, noncredit, professional development and certificate programs. In Continuing Education, the worlds of academia and business and industry intersect to support the educational needs of the community. Programs in professional fields are administered through three departments within the division: Technical Studies, Management Studies and Special Studies. Credit and noncredit programs in fields not allied with professional schools are administered through a fourth department, Health, Physical Education and Community Services. The Division will occupy facilities in a new 93,000 sq. foot hotel and conference training center currently under construction on the UAH Campus.

Library

The Library supports the academic and research programs of the University. It has a collection of 300,000 volumes along with collections of U.S. Government Documents, sound recordings, materials in microform and microfiche, and manuscript collections designed to support the efforts of students and faculty. In addition, the library currently receives almost 3,000 periodicals. For students in the social sciences and humanities, microfiche collections such as the Evans Imprint series and the Library of American Civilization and slide collections on Afro-American art are of particular value. For students in the sciences, work at UAH is supported by the Redstone Scientific Information Center which is located five miles from campus. This library was developed to support the wide-ranging research interests of NASA and the United States Army Missile Command, and its collections of 300,000 volumes and 3,300 journal subscriptions along with more than 1.3 million research reports make it one of the finest scientific libraries in the southeast. It is available without charge to faculty members and graduate students of the University. Reciprocal borrowing agreements are also in force with Alabama A & M University and the University of North Alabama to allow UAH students free access to those libraries.

The library is also a member of several consortia that are designed to bring research materials not otherwise available to campus. Its membership in OCLC, the Network of Alabama Academic Libraries, and Alabama Library Exchange all are designed to facilitate rapid Interlibrary Loan Service to students without charge.

Library services, including study rooms, orientations for classes, and online bibliographic database searching, are designed to assist in the research effort. The library catalog is available online from any terminal attached to the University computer or through dial access.

A library handbook detailing individual services of the library is available without charge at the library’s reference desk.
Research Institute

The UAH Research Institute was established in 1962 and has since exercised various coordination, leadership, and initiation functions for the evolving research activities. It has initiated efforts that later grew into several separate research centers, such as the Johnson Research Center, Microgravity Center, Robotics Center and the Applied Optics Center, and more recently the Space Plasma and Aeronomic Research Center. The Research Institute provided matching funds for major equipment and research grants from NSF and DOD. This equipment and research are now a vital foundation for the various centers. Throughout its lifetime, the Research Institute has had a continuing concern with missile and space technology and aerospace sciences. Currently, these dynamic areas provide development opportunities for faculty and students. Possibilities for research support exists for most UAH graduate programs. These include the fields of electrical and computer engineering, industrial and systems engineering, mechanical engineering, chemical engineering, applied mathematics, statistics, physics, material and applied science, operations research, atmospheric science and engineering.

Kenneth E. Johnson Research Center and Alabama Solar Research Center

The Kenneth E. Johnson Research Center was established by the Alabama State Legislature in 1971. The Center was designated in 1977 by the Governor to operate the State of Alabama Solar Energy Center, to which the State Climatologist Office was assigned. Major laboratories within the center are Atmospheric Sciences, Biotechnology, Energy Propulsion and Storage, Photovoltaics, Cognitive Systems, and Alternative Energies. Other major programs in the center are the operation of the NASA'S Marshall Space Flight Center's low gravity facilities, the Alabama Educational Computing Research and Development Network with the University of North Alabama, and the TVA Energy/Environmental Education Program. The center staff includes a core of full-time professionals supported by the University faculty and graduate research assistants.

Center for Microgravity Research

The Center for Microgravity Research was established in 1986 in accordance with an annual Alabama State appropriation. Research laboratories and offices of the center are located in the Research Institute Building. The largely interdisciplinary research topics pursued in the center consolidate those of the UAH Consortium for Materials Development in Space, in which faculty and students work with industrial researchers to explore the advantages of weightlessness for materials preparation and purification. The Center has also close ties to materials research efforts in NASA’s Marshall Space Flight Center.

Specifically, research in the Center for Microgravity Research is concerned with the trace analytical and structural characterization of semiconducting and optical crystals, mass spectroscopy of high temperature vapors used in crystal growth, experimental and theoretical modeling of heat and mass transfer in materials processing, interface kinetics of vapor crystal growth processes, and with nucleation and growth phenomena in protein crystallization. The center has a principle goal of developing faculty and students in the area of materials science in low gravity environment.
Center for Space Plasma and Aeronomic Research

The Center for Space Plasma and Aeronomic Research (C-SPAR) is dedicated to fostering excellence in research and education in plasma and aeronomy relative to the solar system and astrophysical environment. C-SPAR aspires to high national standing in specific areas of expertise including: low-energy plasma in the magnetosphere and ionsphere, and physics of solar flares, solar-interplanetary dynamics, critical ionization phenomena, direct measurements of electric currents in space, electrostatic charging of spacecraft, and optical measurements of the neutral thermosphere. A wide range of experimental, theoretical and computer simulation techniques arising from several disciplines in science and engineering will characterize the approach of C-SPAR in addressing the complex questions inherent in these physical systems. In carrying out its mission, C-SPAR in cooperation with local and national industrial and government organizations is committed to research and training that will strengthen the national posture in space and defense. Research opportunities for faculty and student development are the keystone for the center.

Center for Applied Optics

For almost a quarter of a century, research and education at The University of Alabama in Huntsville have responded to the interests and needs of its community, the latest of which is a world-class Center for Applied Optics (CAO) established in May of 1985. Since the primary goal of any university is education, CAO is committed to supporting the academic disciplines in science and engineering, and in the professional development of faculty and students in applied optics. In addition to performing sponsored research for industry and government organizations, CAO serves as a central resource of research laboratories for the various academic and research units within the University. The interdisciplinary program in optics is strengthened by CAO research staff participation in course instruction and thesis/dissertation supervision.

Center for Robotics

The Center for Robotics was established by the State Legislature in 1985. The mission of the center is to conduct research in the systems aspects of Automation and Robotics (A&R) and to transfer this research to space, military, and industrial application. The principle thrusts are in software technologies, system tools and techniques, and A&R hardware/software integration and interfacing.

Specific objectives of the center are to provide a focal point for better understanding the application of advanced software technologies to scientific and engineering problems, to assist Huntsville industry in expanding A&R capabilities, and to enhance communications among scientists and engineers in universities, industry, and government agencies through sponsorship of seminars and publications. By focusing the Center’s research in the systems of software aspects of A&R, faculty, students and staff develop expertise in artificial intelligence, expert systems, image processing system modeling, simulation, manufacturing/production system, and technology transfer/industrial interface. A number of graduate research assistantships are supported by the Center.
Admission and General Academic Information

Application Procedure

An applicant should submit a completed graduate application form (available in the Office of Admissions) and a nonrefundable application fee of $15. In addition, the student must request the following items be sent to the Office of Admissions:

1. Two official copies of the academic record from each collegiate institution attended;
2. Scores of the Graduate Record Examination (GRE) from Educational Testing Service (ETS), scores of the Graduate Management Admissions Test (GMAT) for Administrative Science applicants, or score of the Miller Analogies Test for Nursing.

All application materials should be submitted to the Office of Admissions no later than dates specified in the UAH calendar.

Applicants should initiate admission procedures at least six weeks before the registration date of the term for which admission is sought.

An applicant for a Ph.D. program who has been previously admitted to the School of Graduate Studies must submit a completed re-evaluation form to the Office of Admissions. A student who has been admitted to a Master's degree program and who wishes to be considered for a Ph.D. program or an additional Master's program must submit a re-evaluation form to the Office of Admissions.

Admission Requirements

For admission to the School of Graduate Studies, applicants must hold a Bachelor's degree from an approved institution. The following minimum requirements are acceptable to the graduate faculty; individual departments may require higher averages or additional requirements.

Unconditional Admission

Applicants may be admitted unconditionally if they have criteria A or B:

A. 1. A minimum average of B (GPA of 3.0) on the undergraduate record or on the last 60 semester hours, and
   2. a. A score of 1000 on the aptitude test (verbal and quantitative) portion of the GRE; or
      b. A score of 50 on Miller Analogies Test for Nursing.

B. For the College of Administrative Science, a minimum composite score of 950 based on the formula of 200 multiplied by the undergraduate GPA plus the GMAT score, i.e. \((200 \times \text{undergraduate GPA}) + \text{GMAT score}\).
Conditional Admission

An applicant whose scholastic record does not fully meet the requirements for unconditional admission may, upon recommendation of the department chairman and with approval of the graduate dean, be admitted on a conditional basis provided the applicant has taken the Graduate Record Examination, the Miller Analogies Test, or GMAT (for Administrative Science). The applicant must have a minimum of:

1. GPA of 2.5 overall, or QPA of 3.0 on the last 60 semester hours; or
2. Composite GRE score of 1000 on the verbal and quantitative portions; or
3. MAT score of 50.

A student admitted on a conditional basis who has an overall grade average of B or better for all graduate work attempted up to and including the term in which 12 semester hours are completed assumes the status of an unconditionally admitted student.

Failure to remove conditional status by maintaining a minimum overall grade average of B or better on all graduate work attempted as described above results in dismissal from the School of Graduate Studies. In exceptional cases, a student may be re-admitted upon justified recommendation of the faculty in the major department and approval by the graduate dean.

Residency

A determination of residency status is made at the time the student is admitted to UAH. In order for a change in residency status to be effective for any given term, such change must be accomplished no later than the first day of classes for that term. Contact the Admissions Office, Rm 124, University Center, to apply for a change in residency status.

International Student Admission

An applicant who is a graduate of a foreign institution is subject to the same criteria for admission as a graduate of a U.S. institution. The applicant whose native language is not English is required to take the Test of English as a Foreign Language (TOEFL) and score at least 500. An I-20 form (Student Visa) will not be issued by UAH until acceptable results of the TOEFL are received and all admission requirements met.

In addition, all international students must request that:

1. Two official copies in English of secondary school and college or university transcripts be forwarded to UAH directly from the institution(s) attended. Do not send personal copies.
2. Graduate Record Examination (GRE) or Graduate Management Admission Test (GMAT) scores be sent directly to UAH from Educational Testing Service.
3. Scores from the Test of English as a Foreign Language Test (TOEFL) be sent directly to UAH from Educational Testing Service. A minimum score of 500 is required.
4. A certified financial statement be submitted as evidence of sufficient finances to cover university and personal expenses while attending UAH. In addition, a
A deposit of $1,500 is required before an applicant will be considered for admission. To make this deposit, have a bank cashier’s check drawn in U.S. dollars for $1,500, made payable to the University of Alabama in Huntsville. Mail this check to the Office of Admissions, the University of Alabama in Huntsville, Huntsville, AL 35899. If an applicant is unable to attend UAH after making the deposit or if admission is denied, the deposit will be returned. The deposit must be maintained at $1,500 until the student completes studies at UAH. The amount held on deposit by the university will accrue interest.

5. Evidence be presented of university-approved health insurance coverage. Proof of continued coverage must be presented by the student during each term of enrollment.

Nondegree Graduate Students

Students interested in earning graduate credit but who are not applicants for a graduate degree at UAH may be admitted as nondegree graduate students and continue on a term-by-term basis. Admission in this category may be granted to students submitting evidence of at least a Bachelor’s degree from an accredited institution. Students must maintain the same GPA grade requirements expected of the conditionally admitted graduate students. Courses taken while in this category must have prior approval by the department offering the course and the graduate dean.

Credit earned under a nondegree graduate status may be applied toward a graduate degree program following admission to the graduate degree program and approval of courses by the major department. If the student’s previous record qualifies the student for admission to the graduate program, then the student by petition may apply up to 12 semester hours toward the degree. If the student is not admissible, the nondegree graduate credit may be considered in lieu of irregular postgraduate requirements.

Seniors Taking Graduate Courses

UAH seniors may take up to 9 hours of courses (500-level or above) for graduate credit while completing requirements for the baccalaureate if they meet the following qualifications:

1. An approved degree application on file;
2. An overall GPA or GPA for the last 40 hours of at least 3.5;
3. A total course load of no more than 12 hours a term;
4. Permission of the instructor for courses at the 600 level or above.

Students initiate the process by filling out the Request for Approval of Graduate Credit by UAH Senior (available at the Office of Admissions, Rm. 124, University Center) that requires the approval of the department chairman and graduate dean.

Unclassified Admission

Persons who desire graduate credits without pursuing one of the degree programs offered at UAH may be admitted as unclassified graduate students if the qualifications for conditional admission are met.
Change in Major

A student previously admitted to the School of Graduate Studies to pursue a degree offered in one department may be admitted to a degree program in another department if the admission criteria of the latter department are met. Application re-evaluation of major (Form 1-B) is available at The Office of Admissions.

Nondegree Postgraduate Status

A person whose application to the graduate school has not been approved may be admitted to UAH as a nondegree postgraduate student. Those admitted in this category may register in courses at the 500 level or below at UAH, provided that all prerequisites for those courses have been met. In some instances students may, with the approval of the department chairman, take courses at the 600 level or above.

Upon completion of 12 or more semester hours of advanced-level courses with an average grade of B or better, a student may reapply for admission to the graduate school. An applicant may be admitted conditionally, if acceptance is recommended by the chairman of the appropriate academic department.

Once a student is admitted, graduate credit for courses taken during NPG status may be granted upon admission to the graduate school subject to the following conditions and limitations:

1. All grades received in 500 level courses or above during NPG status must have been B or higher.

2. Upon petition by the student, up to six credit hours may be granted for courses taken as an NPG and completed with grade of A, subject to approval by the major department and the Graduate Dean. These courses will not be used for calculating graduate quality point average.

General Academic Information

A student must be admitted to the School of Graduate Studies to receive graduate credit for courses taken. The maximum course load for a graduate student is 10 semester hours a term. A student employed full-time (40 or more clock hours a week) may schedule no more than 3 semester hours of graduate work a term without permission of the faculty advisor or the department chairman if the student does not have an advisor. A full-time teacher working toward certification is limited to one course a term and a maximum of three three-hour courses an academic year (nine months).

Students should schedule required undergraduate prerequisites or deficiencies early in the graduate program.

Students working on a thesis must register for thesis supervision. Thesis and dissertation supervision courses are graded on a pass/fail basis.
General Information Center

The General Information Center in room 124, University Center maintains current information on academic programs, procedures, and activities of interest to the public and the university community. Interested persons should call 895-6295. Information on admissions, application forms, brochures, testing, and other materials relating to the university are available at the Center.

Testing Services

The tests used for admissions, credit by examination, and placement administered through this office include: the Miller Analogies Test (MAT), the Graduate Record Examination (GRE), and the Medical College Admissions Test (MCAT).

Applications and information pertaining to the following testing programs are also available: the Graduate Management Admissions Test (GMAT), the National Teachers Examination (NTE), the Law School Admission Test (LSAT), and the Test of English as a Foreign Language (TOEFL), and the Alabama Initial Teacher Certification Test.

Testing Services is located in Room 203 University Center; phone 895-6725.

Student Course Load

A full-time graduate student is one enrolled in courses totaling six to ten semester hours a term.

Registration

Dates of early and open registration are listed in the UAH calendar and the timetable of classes. Any continuing or returning student eligible to register may take part in early registration. All past financial obligations to the university must be clear before a student may register for courses.

All students in the Colleges of Administrative Science, Engineering, and Nursing, are required to have an advisor's approval of registration requests.

A student who schedules courses during any registration period (early or open) will have made a financial commitment to the university. If courses are dropped or changed, these changes must be submitted in writing to the Office of Student Records. Adjustments in fees, if any, will be made by the Bursar's Office.

Schedule Changes

After a student has completed registration, all schedule changes must be made on a change-of-course form and recorded in the Office of Student Records. (See section on registration for approval required.)

Credit to Audit

A student is permitted to change a course from credit to audit only during the first two weeks of classes.

Removal of Course from Schedule

1. In the case of a cancelled class, submission of a change-of-course form by the student helps to correct the record.
2. In the case of a drop before class begins, a change-of-course form must be submitted before the first day of the term.
3. Except in the case of (1) or (2), removal of a course after the first scheduled meeting of a class is considered a withdrawal (see below).

Other Kinds of Changes
The following kinds of changes may be accomplished only during the designated hours of regular and final registration (see UAH calendar).
1. Change from one course to another.
2. Change from one section to another section of the same course.
3. Addition of course to schedule.
4. Change from audit to credit. Only students who are otherwise eligible to take the work for credit will be permitted to make this kind of change.

Withdrawal Policy
To withdraw from one or more classes, a student must initiate a formal request for withdrawal through the Office of Student Records. Class non-attendance does not constitute withdrawal nor does notification to the instructor. Unless the withdrawal procedure is followed, a student continues to be enrolled in class and a failing grade may be assigned.
Regardless of the reasons for withdrawing, students must carry out withdrawal procedures as follows:
1. Obtain a Request for Withdrawal Form from the Office of Student Records, 116 University Center.
2. If withdrawing during the first two weeks of the term, submit the completed withdrawal form to the Office of Student Records. A grade of W will be recorded.
3. If withdrawing during the third through sixth week of the term, the withdrawal form must be signed by the student’s academic advisor. (Depending on the student’s class rank and program of study, the appropriate advisor is located in the Academic Advisement Center, the advising offices of the Colleges of Administrative Science, Engineering, or Nursing, or within the major department.) A grade of W or WF will be assigned by each instructor based on the student’s performance up to the date of withdrawal. A grade of WF is calculated in the grade point average in the same manner as an F.
4. Beginning with the seventh week of the term, a student may withdraw ONLY in exceptional circumstances and with the approval of the dean of the college in which the student is enrolled. If the dean signs the withdrawal form, a grade of W or WF will be assigned by the instructor based on the student’s performance to the date of withdrawal.
5. THE EFFECTIVE DATE OF WITHDRAWAL is the date the Request for Withdrawal Form with appropriate signatures is received in the Office of Student Records, which will then notify instructors that the student has withdrawn.
6. Students in the Cooperative Education (Coop) program must secure the approval of the Director of Cooperative Education prior to withdrawal.

Repeating a Course
There is no limit on the number of times a student may repeat a course. However, some colleges may have restrictions overriding this policy. Each time a course is taken, the hours attempted and the quality points earned will be counted in calculating the student’s grade point average. The credit for any course repeated may be counted only once toward graduation.
Class Attendance
Education at UAH depends upon the cooperation of students and faculty. Students are held responsible for the full work of the course in which they are registered, including participation in the discussion and work of the class at each class meeting.

A student's final grade in each course is determined on the basis of identified course requirements; therefore, regular class attendance is important.

Examinations
During each term, one or more announced examinations of class period length may be held.

At the end of each term, an examination period is scheduled for each course. Absences from a scheduled final examination without previous arrangement with the course instructor (except in extenuating circumstances) will be classified unexcused and a failing grade in the course will be assigned.

Any student whose final examination schedule is such that three examinations are scheduled during a single day shall have the right to have the middle examination rescheduled. The date and time of the rescheduled examination shall be by mutual agreement between the student and the affected faculty member and must be agreed upon by the end of the ninth week of classes. It is the student’s responsibility to notify the instructor of this type of conflict, and it is the instructor’s responsibility to verify that the conflict actually exists. If a student is scheduled to take four examinations during a single day, then the same procedure shall apply, except that the student shall now have the right to have both the second and third examinations rescheduled.

GRADES
Grades | Quality Points per Semester Hour Credit
--- | ---
A-Superior | 4
B-Above average | 3
C-Average | 2
D-Passing | 1
F-Failure | 0

I-Incomplete.
Assigned by the instructor when a student, due to circumstances beyond control, has not satisfied some requirement of the course. The deadline for a student to remedy a grade of I is the last day of class of the next term enrolled, or one calendar year from the date of the grade, whichever occurs first. If the grade of I is on a student’s record at the time of graduation, it is treated as an F.

X-Excused absence from examination.
Assigned by the instructor when a student completes all course requirements except the final examination. This grade becomes an F unless the examination is completed by the time of the announced deferred examination date at the beginning of the term of next regular enrollment of the student. (See Examinations and UAH calendar.) Time schedule permits students to take only one examination on this date. If students receive more than one grade of X, they should make arrangements directly with other instructors for additional make-up examinations.
W-Withdrawal.  
Recorded by the Office of Student Records when a student withdraws from a course with passing work. (See Withdrawal.)

WF-Withdrawal failing.  
Recorded by the Office of Student Records when a student withdraws from a course with failing work. (See Withdrawal.)

Indeterminate Academic Status Policy
For the purpose of determining academic status of those students on academic probation, a grade of I or X will be treated as a grade of F. Credit hours attempted will be charged to the student and zero quality points will be earned for the I and/or X. The action of Academic Suspension will be exercised when the results of calculation of grade point average (with the I or X treated as an F) indicates such action to be appropriate (See Conditional admission, p. 00 of this catalog). When the I or X is remedied and the grade change reported to the Office of Records, grade point average and subsequent standing will again be determined.

Change of Grade
Grades submitted to the Office of Student Records can be changed only by the instructor’s submission of a Change of Grade form containing a written explanation of the error. The Change of Grade form must be approved by the dean of the school concerned.

Student Grade Report
At the completion of each term, a report of final grades is mailed to the address furnished by the student.
A statement of a student’s satisfactory or unsatisfactory academic performance will be provided, upon request, to the individual or agency sponsoring the student’s tuition if the individual or agency submits a statement certifying grade release, unless written notification to the contrary is submitted by the student to the Office of Student Records before the final examination period.

Grade-Point Average
The grade-point average (GPA) is computed by dividing the total number of quality points earned by the total number of semester hours attempted. Courses in which a grade of W, P, or S is assigned are not included.

Academic Appeal Process
Academic appeals will originate with the student in written form and will be processed through the student’s major department, the dean of the college, and the Office of Academic Affairs, in that order. Students classified as “special” will be routed through the most appropriate academic dean.

Change of Major
Students pursuing a program of study in one academic unit and desire to change to a program in another unit may petition to do so by making application at the Office of Admissions, Room 124, University Center. Admission recommendation is made by the new unit. Application of previously earned credits toward the new program will be determined after the transfer has been approved.
Transcripts

Official transcripts are issued and sent by the Office of Student Records to recognized institutions and agencies which require such documents. Transcripts are issued only upon the written request of the student involved.

Official transcripts are not issued to individual students; however, they may request an unofficial transcript which does not bear the university seal. No charge is made for transcripts issued.

No transcript will be issued for a person who has a financial obligation to the university.

Nondiscrimination Policy

The University Alabama in Huntsville is committed to equal employment and educational opportunity. Its policy is one of nondiscrimination with regard to any person on the basis of race, color, national origin, religion, sex, or age, and with regard to any otherwise qualified handicapped individual solely on the basis of handicap. This equal opportunity policy extends to the recruitment and admission of students, the recruitment and employment of faculty and staff, and the operation of all programs and activities. Additionally, the university is an affirmative action employer of protected minorities and women.

The foregoing commitment is designated to meet the nondiscrimination affirmative action requirements of applicable federal laws, including the following statutes (with implementing regulations) and executive orders, as amended: Title VI and Title VII, Civil Rights Act of 1964; Executive Order 11246; the Age Discrimination in Employment Act of 1967 and the Age Discrimination Act of 1975; Title IX, Education Amendments of 1972; the Equal Pay Act of 1963; the Rehabilitation Act of 1972; and the Vietnam Era Veteran Readjustment Assistance Act of 1974.

Inquiries or complaints concerning the application to these federal requirements and this policy should be directed to one of the following persons:

Dr. Allan Spitz
Faculty EEO Officer
123 Madison Hall
The University of Alabama in Huntsville
Huntsville, AL 35899 (205-895-6337)

Mr. Kenneth W. Thompson
Staff EEO Officer
131 Madison Hall
The University of Alabama in Huntsville
Huntsville, AL 35899 (205-895-6350)

Confidentiality of Records

The Family Educational Rights and Privacy Act of 1974 is a federal law which protects the confidentiality of student educational records. To implement this law, UAH has formulated and adopted a written institutional policy governing the handling of these records. Copies of this policy document are available to students at the Office of Student Records, and it should be referred to for a more
comprehensive treatment of this subject than is given in the summary statement here.

Under this law and university policy, students have a right of access to their educational records and may inspect and review the information contained in them. The term *educational record* generally refers to any record maintained by the institution directly pertaining to an individual as a student, other than that made by institutional, supervisory, or administrative personnel remaining in the sole possession of the maker; by campus security; or by a physician, psychiatrist, or any other such professional medical personnel. This right of access does not extend to financial information submitted by students' parents or to confidential letters and recommendations collected under established policies of confidentiality and placed in their files before January 1, 1975. Furthermore, students may at their discretion waive the right to any confidential letters of recommendation.

If a student believes the records contain inaccurate, misleading, or otherwise inappropriate data, the student may bring the matter to the attention of the records official concerned. If by informal discussion with this official the student does not obtain the corrective action desired, the student is entitled to a hearing at which the item found objectionable may be challenged. If the decision is adverse to the student, an explanatory statement relating to the contested item may be inserted in the educational record.

A student's privacy interest in personal records is further protected by the rule against unauthorized disclosure. The university may not without the student's consent release the student's educational records or any personally identifiable information contained in them to other individuals or agencies. Disclosure to the following parties, however, is specifically excepted by the Privacy Act from this rule: (a) administrative and academic personnel within the institution who have legitimate educational interest; (b) officials of institutions in which the student seeks to enroll; (c) persons or organizations to whom the student is applying for financial aid; (d) accrediting agencies; (e) organizations conducting studies relating to tests, student aid programs, instruction; (f) certain federal and state government officials; (g) any person where the disclosure is required for compliance with a judicial order to proper subpoena; (h) appropriate persons where a health or safety emergency affecting the student exists; and (i) parents of a dependent student. As to some of these parties, additional conditions must be met for the disclosure to be allowable in the absence of a written consent from the student. Personally identifiable information will be transmitted by the university to a third party only on the condition that the recipient not permit any other party to have access to it without the student's consent.

The university may release directory information to others without the necessity of obtaining permission from the student. Directory information is limited to the student's name, address (local and permanent), telephone number, date and place of birth, major field of study, participation in officially recognized activities and sports, weight and height statistics if an athletic team member, date of attendance, degrees and awards received, and the previous educational institution most recently attended. If students do not wish this information to be released, they may so indicate on the form provided at the time of registration, and the university will withhold it during that particular term. This request for nondisclosure of directory information must be renewed each term.

The following officials have been designated as records officials for student records within their respective area:
A student should make a request concerning educational records to the appropriate official listed above.

Any student who believes that rights under the Privacy Act have been violated by the university may notify and request assistance from the Vice-President for Academic Affairs and may file a complaint with the Family Educational Rights and Privacy Act Office, Department of Health, Education, and Welfare, Washington, D.C. 20201.

Marital, Parental, or Temporary Disability Status

The university does not discriminate against any student or exclude any student from its educational program or extracurricular activity on the basis of a student’s sex, marital, or parental status. Pregnancy or related conditions are treated the same as other temporary disabilities. The university may require written approval of a student’s physician regarding participation in an activity or educational program which might adversely affect the safety or health of a temporary disability.

Conduct

Students enrolling in the university assume an obligation to conduct themselves in a manner compatible with the university’s role as an educational institution. The administration reserves the right to establish rules for expulsion and penalties for failure to meet standards of scholarship, character, and health.

All members of the UAH community are subject to the provisions of federal and state statutes and local city ordinances with regard to alcoholic beverages, drugs and narcotics, weapons, gambling, fireworks, and the use of state property. Such laws are fully in force on the university campus and may be enforced by public authorities as well as by campus police. Each person associated with the university is responsible for being aware of and abiding by these laws.

The university has incorporated as its own regulations all existing federal, state, and local laws defining and proscribing criminal acts. In addition, the following policy applies to the UAH campus community:
1. University policy forbids the possession or consumption of alcoholic beverages by a student anywhere on University property, except in the student's residence in University Housing. In addition, any possession or consumption of alcoholic beverages by a student under 19 years of age, the legal age for drinking established by state law, or any other violation of state or local law with respect to drinking is contrary to established University policy.

A student organization should be aware that it may be held responsible for actions of individuals, including non-members, connected with their consumption of alcoholic beverages made available by the organization at its functions. Careful consideration of this potential liability under the law and under University policy should therefore enter into plans to offer such beverages at an activity.

2. Narcotics and other controlled substances will not be permitted anywhere on university property except upon prescription by a practitioner (as that term is defined in the Alabama Uniform Control Substances Act) or except by practitioners or authorized agent under their supervision, incident to research, teaching, chemical analysis, or professional practice.

3. Firearms or other weapons (including explosives) are not to be brought onto or kept on UAH property by anyone, whether holding a firearm's license or not, except police officers and other law enforcement officials in the exercise of their lawful duties.

Students who violate any of the foregoing laws, regulations, or policies are subject to university disciplinary action as provided in the UAH Student Judicial Code and/or arrest and prosecution by civil authorities, as appropriate. Similarly, faculty or staff personnel who violate these laws, regulations, or policies are subject to adverse employment action, including dismissal, and/or arrest and prosecution, as appropriate. Suspected violations of the Student Judicial Code should be reported to the Office of the Vice President for Student Affairs.

Officers in the Office of Campus Security are by statute charged with all the duties and vested with all the power, such as that of arrest, of police officer. Violations of federal, state, or local laws should be promptly reported to the security office and full cooperation given in the discharge of its responsibilities.

Plagiarism

Plagiarism is the use of another's work as if it were one's own. A graduate student found guilty through university processes of plagiarism or falsification of data or results in any program is subject to dismissal from the university.

Graduate Cooperative Education (Co-op) Program

The UAH Graduate Cooperative Education (Co-op) Program offers qualified candidates the opportunity to combine classroom experience with closely-related practical work experience with a major employer. Students accepted for Graduate Co-op normally work six months, return to UAH as a full-time student for the following six months, and then return to work for the next six months. In addition, students are encouraged to take one degree-related course during each work term. Frequently, students can fulfill some University research requirements in conjunction with work they are completing with their employer. Salary during work terms is based on the student's qualifications and is comparable to the pay of a typical employee who has similar education and experience.
Students will be considered as candidates for Graduate Co-op positions when the following requirements are met:

1. Admission to the School of Graduate Studies as a degree candidate.
2. A minimum of 3.0 cumulative quality point average (on a 4.0 scale) on all graduate work. If the graduate program of study differs from the undergraduate, a student may need to complete nine hours of graduate work at UAH.
3. Formal application to the UAH Co-op Program.

The UAH Co-op Program is open to UAH students, regardless of race, color, religion, sex, age, national origin, handicap or veteran status.

For more information, contact the UAH Co-op Office. The mailing address is Cooperative Education Office, The University of Alabama in Huntsville, Huntsville, AL 35899. The telephone number is (205) 895-6741.
Financial Information

Graduate Tuition

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<th>No.</th>
<th>Course Hours</th>
<th>Fee</th>
<th>Bldg. Fee</th>
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<th>Activity Fee</th>
<th>Registration Fee</th>
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THE ABOVE TOTAL DOES NOT INCLUDE LAB FEES, LATE-REGISTRATION OR CHANGE-OF-COURSE FEES.

An estimated average cost of books per term for full-time students is $85.00.

These fees do not apply to any short-term, off-campus, or noncredit offering. For additional information on these courses, see section on Division of Continuing Education.

BILLING AND PAYMENT PROCEDURE

Students participating in early registration will receive in the mail (see mailing date in calendar in the quarterly timetable of classes) a schedule of courses, a tuition bill, and an identification card. Tuition charges must be paid in full by the close of business on the due date indicated on the statement. Students whose payments have not been received by the deadline will have their registration canceled, and such students will be required to complete a new set of registration materials during open registration hours.

Tuition will be payable at the time of registration for all who register during periods of open registration.

Charges resulting from dropping, adding, or other changes will be due at the time the change is made.

Many students have all or part of their tuition and other costs paid by various sponsoring agencies (including tuition assistance for faculty, staff and their dependents). It is the student’s responsibility to see that the Bursar’s Office receives the approved tuition assistance authorization from his sponsor. In many cases the sponsor does not pay the entire statement. These students should contact the Bursar’s Office to determine the unpaid amount and make full payment before the due date to avoid cancellation of their registration.
Fees for courses being audited are the same as those being taken for credit. Full-time students may include full-term, regular credit courses offered through the Division of Continuing Education under the maximum fee structure of UAH. Standard fees and fee conditions, however, do not apply for short-term, off-campus, or noncredit offerings.

### Other Charges

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<th>Service</th>
<th>Cost</th>
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<tr>
<td>Application (non-refundable)</td>
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<td>International student deposit</td>
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<td>Change of schedule (non-refundable)</td>
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<tr>
<td>Drop/add/change to audit/reinstatement</td>
<td>$15.00</td>
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<tr>
<td>Late registration (non-refundable)</td>
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<tr>
<td>Examination (deferred or special)</td>
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<td>Credit by examination or validation, per semester hour</td>
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<tr>
<td>Laboratory and studio instruction</td>
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</tr>
<tr>
<td>Level 1</td>
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<td>Level 2</td>
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<tr>
<td>Replacement of I.D. card</td>
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<tr>
<td>Transcript</td>
<td>No Charge</td>
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<tr>
<td>Graduation If qualifications for graduation are not met and if diploma has been ordered, $10.00 will be refunded</td>
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<tr>
<td>Duplicate Diploma</td>
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<tr>
<td>Thesis binding (4 copies)</td>
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<tr>
<td>each additional copy</td>
<td>$6.00</td>
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<tr>
<td>Vehicle registration</td>
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<tr>
<td>regulations concerning traffic and parking are available at the Campus Safety Office</td>
<td>$10.00</td>
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</tbody>
</table>

### College of Nursing

<table>
<thead>
<tr>
<th>Service</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Liability Insurance (per year)</td>
<td>variable</td>
</tr>
<tr>
<td>College of Nursing Pin (graduation)</td>
<td>variable</td>
</tr>
<tr>
<td>Annual health examinations</td>
<td>variable</td>
</tr>
</tbody>
</table>
School of Primary Medical Care

General fee (per year)* .......................................................... $3904.00
Out-of-state residents (per year) ........................................... 12616.00
UAH student health service fee (per year) .......................... 75.00
Student activity fee (per year) ............................................. 48.00
General building fee (per year) ............................................. 253.50
Medical building fee (per year) ............................................ 102.00
Hospitalization insurance (per year) ...................................... variable
Personal liability insurance (per year) ................................. 25.00

*The complete student curriculum for the University of Alabama School of Medicine normally takes 12 quarters to complete.

Withdrawals and Refunds

After classes have begun, students may withdraw from one or more classes until the end of the sixth week of classes. A student desiring to withdraw from school or a class must complete a withdrawal request form at the Office of Student Records, Room 116, University Center. Date of withdrawal is the date the written request is received at the Office of Student Records. Date of withdrawal will determine the amount refunded. Only course fees, lab fees, building fees, student activity fees, out-of-state fees and Union fees are refundable.

Date of Withdrawal from School

Withdrawal after registration is completed but before classes begin .................................................. Registration fee $15.00
During first two weeks: Registration fee $15 and Withdrawal fee 30.00
After first two weeks of class .............................................. 100% of fees charged plus withdrawal fee of 15.00

Dates of withdrawal from courses which are scheduled on other than a full-term basis will be prorated.

Refund checks will be issued as quickly as they can be processed after the second week of classes.

Students suspended for disciplinary reasons shall have no right to refund of any portion of any fees paid or due to be paid.

University Housing

For current rate information contact the Housing Office at: Housing Office, The University of Alabama in Huntsville, Huntsville, Alabama 35899, (205) 895-6108.

In addition to rental charges, each occupant is charged for gas and/or electricity. Residents desiring a telephone assume responsibility for proper installation of telephone and payment of all bills.
Financial Aid

Financial Aid is available in the form of teaching and research assistantships, tuition scholarships, work-study programs and loans, and Co-op programs.

Interested students should consult their advisors and department chairmen for other types of aid.

Graduate Assistantships

Graduate assistantships are offered to encourage graduate work and to promote research. Graduate assistants have as their primary goal a graduate degree, and the assistantships are part of their graduate education. Such appointments are available through various departments of instruction and under the auspices of the School of Graduate Studies.

Eligibility

Any student qualified for admission to the School of Graduate Studies is eligible to apply for a graduate assistantship.

Assistantships

A student eligible for an assistantship may be appointed as a Graduate Teaching Assistant (TA) or Graduate Research Assistant (RA). Assistantships usually require half-time (twenty hours per week) service to the university but may be appointed more or less than half-time in exceptional cases. The graduate assistant may not hold other employment during any term in which this assistantship is in effect. The graduate assistant is registered for a minimum of six semester hours and not more than nine during any term in which an appointment is held. Two kinds of assistantships are available:

1. Graduate Teaching Assistantships

As the title implies, graduate teaching assistants (TA's) share the faculty's responsibility for teaching. The purpose of this assistantship is twofold: one is to support departmental teaching program, and another is to aid the student's professional development. The teaching assistant is not intended to be a grader only; however, grading papers may be a part of the assigned duties of the assistant.

The TA's fractional teaching load will necessarily vary from one department to another, and the load should be proportional to the normal full-time teaching load carried by other staff members in the department.

2. Graduate Research Assistantships

A graduate research assistant (RA) does research under the supervision of a faculty member. At times, a research project to which the research assistant is appointed may eventually lead to a thesis or dissertation topic; however, a research supervisor cannot guarantee that a particular project will provide suitable material for a thesis.
All assistantship appointments are subject to the continuing availability of funds. Appointments are made only when resources to support them are assured, but a financial emergency in the university could cause positions, including those of graduate assistants, to be terminated prior to the end of the appointment period. Assistantship support normally will not continue past the graduation of the assistant.

**Tuition**

Tuition and fees are paid for a graduate assistant who holds one-half time (20 hours per week) appointment and is registered for six to nine semester hours. An assistant who holds one-quarter time (10 hours per week) appointment is eligible for one-half tuition support only for a full course load.

Departments should submit to the graduate office the Tuition Support Request (Form 23) for the appointees before the close of the early registration period for entry into the Student Accounts System. Upon its receipt and approval, the form will be forwarded to the Office of Financial Aids.

**Tuition Scholarships**

Full tuition scholarships may be awarded to qualified students without assistantship appointments. Tuition grants are limited to a maximum of two per department at any given time.

1. **Eligibility**
   A department may award a full tuition grant to a qualified student. Recipient must:
   a. be a full-time student;
   b. be a U.S. citizen;
   c. have unconditional admission status.

2. **Appointment Procedure**
   a. The departmental faculty chooses the awardees from qualified applicants.
   b. An appointment letter (similar to the assistantship letter without duties) is written to each awardee and approved by the chairman. The letter is then forwarded to the graduate dean's office along with a copy of the Summary Information sheet (Form 1-A) for final approval.

3. **Tuition Request**
   Departments submit to the graduate office tuition requests for the awardees on the Tuition Support Request (Form 23), along with those of the graduate assistants, by the close of the early registration period.

**Nurse Traineeship Program**

This program was established by the Nurse Training Act of 1975 and provides grant assistance to currently licensed professional nurses who wish to enroll full-time in a graduate nursing program. Several full tuition grants are awarded yearly. Contact the College of Nursing.
Work-Study and Loans

The College Work-Study Program provides employment for students who need financial assistance. A student works part-time on campus while attending the university and during vacation periods. Preference will be given to students with the greatest financial need.

Loans

Although it is sometimes necessary to borrow money to finance an education, caution is advised. Generally, a student should not rely primarily on loans and is advised not to borrow more than half of what is needed to meet expenses.

The National Direct Student Loan Program is available to all students enrolled at least half time and who have financial need indicated by the Family Financial Statement. Graduate or professional students may be eligible to borrow a maximum of $18,000, including their undergraduate loans. The program contains a provision that part of the loan plus interest may be canceled if the borrower performs military service in hostile areas. Forgiveness is also provided for teachers of handicapped or disadvantaged students and for those teaching in other special programs designated by the U.S. Office of Education.

The Guaranteed Loan Program provides state backing for loans made through private lending agencies such as banks, savings and loans, and credit unions.

A maximum of $7,500 per academic year may be applied for in most states if the educational costs warrant borrowing this much. The aggregate maximum may be extended to $54,750 for students who borrow for graduate study.

Graduate Record Examination Fee Waiver Program

UAH is a corporate institute for the Graduate Record Examination (GRE) Fee Waiver Program. These waivers are limited to senior students receiving financial assistance through the university whose parents' financial contribution is estimated to be zero for the applicant's senior year in college.

Information and fee waiver certificates may be obtained in the Office of Financial Aid.

Miscellaneous

Some businesses and industries provide tuition assistance to employees attending UAH. An employed student should consult the personnel office of his place of employment to determine its policy regarding tuition assistance.
Student Services and Activities

Career Planning and Placement

The Career Planning and Placement Office offers the following services to students and alumni: information about part-time employment opportunities in Huntsville and surrounding areas; full-time placement referral and on-campus interviews; career planning assistance with professional staff; workshops to develop skills in resume writing, interviewing, and job search planning; use of the DISCOVER computer-assisted guidance system to assess interests, abilities, and values and relate them to 426 occupations; access to a computerized guidance information system with occupational and college information through Montgomery; a Career Resource Center of occupational information, company literature, salary information and graduate school information; lists of job openings throughout the United States; and a Job/Career Fair each Spring.

A credentials file which includes a resume, an authorization form, and list of college activities is established for each graduating student who registers with this office. Information in the candidate's file is available to employers upon request. Each registered student receives a monthly newsletter, Career Directions, which provides current employment trends, job-hunting hints, and the monthly on-campus recruitment schedule.

Students may register for any of the services at the Career Planning and Placement Office, 212 University Center. Appointments may be made with a Placement staff member by calling 895-6612 between 8:15 a.m. and 5 p.m., Monday through Friday.

Vocational Rehabilitation

Students with a physical disability may obtain grants-in-aid covering fees, books, and supplies through the Vocational Rehabilitation Service, which is supported by federal and state appropriations. For further information, write to: Alabama Vocational Rehabilitation Service, 407 Governors Drive, S.W., Huntsville, Alabama 35801 or the Director of Vocational Rehabilitation, Room 416, State Office Building, Montgomery, Alabama 36104.

Medical Services

UAH students who need a family physician may become patients of the UAH Family Practice Center by going to the UAH medical clinics in the Huntsville Medical District and completing the intake forms. All UAH students registering as patients are required to have valid UAH identification cards.

UAH students planning to become patients of the UAH Family Practice Center are urged to register before they actually need medical care. UAH students who are not already registered patients of the Family Practice Center are eligible for emergency medical care only. Emergency care information for UAH students who do not have a doctor is available from 8 a.m. to 5 p.m. Monday through Friday by phoning 536-5511 (5 p.m. to 8 p.m.).
All patient care services provided by UAH School of Primary Medical Care are on a fee-for-service basis.

Veterans Affairs

UAH offers a full range of services to the student attending under the Veterans Administration Educational Assistance Program. These services include veterans advisement, educational loans, and the Veteran Tutorial Program.

Under the current Veterans Educational Assistance Programs, which affect most veterans, the veteran receives an allowance directly from the government. The veteran is responsible for paying fees directly to the university and meeting payment deadlines applicable for all students.

The Veterans Administration will make full payment only when the student carries a full academic load. To facilitate the prompt and accurate reporting of the veteran’s status and course load, the veteran must complete a brief form every term enrolled. This form must be turned in to the veterans affairs clerk in the Office of Student Records.

It is the student’s responsibility to remain in good standing with the Veterans Administration and to respond to notification of changes in regulations. For additional information, write to: Veterans Administration Regional Office, 474 South Court Street, Montgomery, Alabama 36104.

Many students who are children of veterans of World War I, World War II, or the Korean War may be eligible for benefits under the War Orphans Educational Assistance Act (PL 634). Write the nearest Veterans Administration Regional Office for additional information.

The Alabama G.I. and Dependents Education Benefits Act grants tuition assistance to eligible veterans, their children, widows, and wives. Tuition is paid directly to the school. For additional information, write to: Assistant to the Director, Department of Veteran’s Affairs, P.O. Box 1509, Montgomery, Alabama 36102.

University Housing

The University of Alabama in Huntsville offers a variety of housing facilities to meet the needs of its diverse student population. The apartment-type housing combines the convenience of living at home with accessibility to the entire campus. The apartments are located within walking distance of the academic buildings, the library, the gymnasium with its swimming pool, racquetball courts and tennis courts, and the University Center. The apartments are also convenient to supermarkets, drugstores, movie theaters, restaurants and department stores.

Each apartment has its own entrance and is air-conditioned, carpeted and equipped with a stove and a refrigerator. All residents have full use of coin operated laundry rooms which are conveniently located within the housing complex. A recreation room and study lounges are provided for residents’ social and educational needs.

University Housing is administered by a Director of Housing in the University’s Division of Student Affairs. The Director is aided by student Resident Assistants who are available to assist residents with any problems or emergencies which may arise when the housing office is closed. It is the desire of the entire housing staff to
assist students in their adjustment to college life and to be of service to all housing residents.

Access to University Housing is a privilege. The University reserves the discretionary right to evaluate each applicant for the purpose of determining eligibility and suitability for residence in University Housing. Any person, married or single, who has been admitted as a student to UAH is eligible for admission to University Housing. A prospective student need not be accepted for admission prior to applying for assignment in campus housing. A married couple is eligible if either the husband or wife is or will be a UAH student. If admission to the university is denied, the housing application deposit will be refunded.

A full-time student has priority for assignment over a part-time student. Priority for assignment is also based on date of application. The earlier a student submits an application with deposit, the better the chance for the requested assignment. Students may request roommates, or the Housing Office will attempt, by screening the applications, to assign roommates who have similar interests and characteristics.

Since University Housing space is limited, students interested in living in campus housing should apply at least two academic terms before enrolling at UAH. An application deposit submitted with the completed application form will reserve a place on the waiting list for campus housing. Rental charges are on an academic term basis with rent due when tuition is due. Housing policies and regulations are included in the Housing Rental Agreement that residents are required to sign. Housing application forms and additional information may be obtained from the Housing Office, University of Alabama in Huntsville, Huntsville, Alabama 35899 telephone (205) 837-9553 for information.

Preschool Learning Center

An on-campus preschool is provided by the University Preschool Parents Association to accommodate the students, faculty, and staff, as well as the public. A stimulating environment is provided daily at the center, according to a fundamental philosophy that learning should be fun. In addition to cognitive development, the center focuses attention on the social, physical, and emotional development of the children enrolled. The center is staffed by professional teachers and well-qualified teacher aides, each of whom is attentive to the needs of individual students. The center has several attendance plans to accommodate the various schedules of student parents. Call (205) 837-9553 for information.

University Center

The newly remodeled and enlarged contemporary University Center houses the Division of Student Affairs, the Office of Admissions and Records, the Academic Advisement and Information Center, Career Planning and Placement Office, Cooperative Education Office, University Bursar's Office, Student Government Association, and the Office of Testing Services and Exponent. It has facilities for dining, assemblies, meetings, dramatic presentations and recreational activities as well as housing the University Bookstore.
School of Graduate Studies

Dean: N.F. Audeh, Professor of Electrical Engineering.

The graduate programs of the University of Alabama in Huntsville foster a creative learning experience while further strengthening intellectual capabilities through intensive studies. Graduate studies are characterized by a greater degree of independence in the student and concurrently by a closer association with one or more members of the graduate faculty. Only those students showing distinct promise of completing the requirements for a graduate degree are admitted to the School of Graduate Studies.

The graduate degree is based on a Program of Study designed to reach a specific intellectual or professional goal. This Program of Study should be planned by the student at the earliest appropriate time (see specific degree programs) with the counsel of a faculty advisor. The Program includes advanced studies in subject-matter areas and, in most cases, a research phase in which the student demonstrates independent scholarly work. It is the student’s responsibility to be acquainted with all requirements related to a desired program and to fulfill these requirements.

History

Graduate courses have been offered in Huntsville since the earliest days of higher education in the area. With Redstone Arsenal, NASA’s George C. Marshall Space Flight Center, and other scientific and technical organizations concentrated in Huntsville, a demand was felt as long ago as 1950 for postgraduate coursework emphasizing theoretical and practical studies. Graduate courses were first given in Huntsville in 1951 under the direction of the Graduate School of the University of Alabama in what was then called the Redstone Institute of Graduate Study. The graduate program was then completely separate from the new undergraduate program, except that both held classes at what was then Butler High School. In addition, separately funded graduate courses in Education were being held elsewhere in Huntsville, independent of both. After a two-year lapse because of the cancellation of government sponsorship, the graduate program re-opened in January of 1956 with classes in Physics, Engineering, Mathematics, and Management. Even more than the undergraduate program, graduate studies grew with the space program. At the encouragement of Redstone Arsenal, the Research Institute was created in 1960. Three years later it was announced that Masters degrees could be awarded locally in Mathematics, Physics, Chemistry, and Engineering. The first Masters degree, in Mathematics, was awarded in 1964, and the following year two Masters degrees were awarded for work begun and completed at Huntsville. In 1971 doctoral programs in Engineering and Physics were initiated. The School of Graduate Studies was organized in its present form in 1976.
# GRADUATE DEGREE PROGRAMS

<table>
<thead>
<tr>
<th>Programs</th>
<th>Degrees</th>
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<tr>
<td>Administrative Science</td>
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<tr>
<td>Biological Sciences</td>
<td>M.S.</td>
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<tr>
<td>Business Administration</td>
<td>Ph.D.*</td>
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<tr>
<td>Chemistry</td>
<td>M.S., Ph.D.*</td>
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<tr>
<td>Computer Science</td>
<td>M.S., Ph.D.</td>
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<td>Developmental Learning</td>
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<tr>
<td>Electrical &amp; Computer Engineering</td>
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<tr>
<td>English</td>
<td>M.A.</td>
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<tr>
<td>History</td>
<td>M.A.</td>
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<tr>
<td>Industrial &amp; Systems Engineering</td>
<td>M.S.E., Ph.D.</td>
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<tr>
<td>Mathematics &amp; Statistics</td>
<td>M.A., M.S., Ph.D.*</td>
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<td>Mechanical Engineering</td>
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<tr>
<td>Nursing</td>
<td>M.S.N.</td>
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<td>Operations Research</td>
<td>M.S.O.R.</td>
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<tr>
<td>Physics</td>
<td>M.S., Ph.D.</td>
</tr>
<tr>
<td>Psychology</td>
<td>M.A.</td>
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</table>

*In cooperation with The University of Alabama, Tuscaloosa.*
Degree Requirements

The following scholastic requirements are those of the School of Graduate Studies (individual departments may add additional requirements):

1. Overall grade average must be B or better on all graduate credit hours at UAH. In addition, the grade average must be B or better on courses taken in the current graduate degree program.

2. No grade lower than a C may be counted toward a graduate degree.

3. At least 50 percent of the hours required for a graduate degree must be completed in courses numbered 600 or above.

4. At least 50 percent of the courses on a student’s Program of Study must be taught by UAH full-time faculty members.

Probationary Status

1. Students admitted conditionally with an overall grade average of B or better for all graduate work attempted up to and including the term in which 12 semester hours are completed assume the status of an unconditionally admitted student.

Any time a student’s overall grade average on graduate courses drops below a B, the student will be placed on probation.

2. A student on probation is not a candidate for a degree.

3. Probationary status is removed by raising the overall grade average to B or better on all graduate work attempted in all terms up to and including the term in which 12 semester hours of graduate work are completed following the term the student is placed on probation.

4. Failure to remove probation in the manner described results in dismissal from the School of Graduate Studies. In exceptional cases students may be re-admitted upon recommendation of the faculty in the major department and approval by the graduate dean.

English Proficiency

Success in the graduate school is strongly dependent upon a well-developed ability to communicate in English. A faculty member has the right to refuse written material submitted by a student if that material, in the opinion of the member, does not meet standards in English proficiency.

Students otherwise admissible to graduate studies but who have low verbal scores (less than the 25th percentile on a national standardized test such as: MAT 40, GRE Verbal 400, GMAT Verbal 20) must pass an English proficiency test, or pass a remedial English course within the first 12 hours of graduate study in order to continue in the graduate program.
The Master's Degree

Students may follow one of two plans for the Master's degree, except where modified by individual departments. To avoid delay, students are encouraged to plan a Program of Study with the help of a faculty advisor before the completion of 12 semester hours of coursework. Courses taken without an approved program of study may not apply toward a degree.

Plan I (Thesis)

Degree requirements under this plan include completion of 24 or more semester hours of graduate coursework and the writing of an acceptable thesis.

The thesis should show evidence of the student's capability for research, independent thought, and analysis. Furthermore, the thesis should be written in fluent, acceptable English. The subject must be in the major field and approved by a faculty committee of the major field, by the chairman of the department, and by the graduate dean. All theses must be accessible to the general public.

A completed copy of the thesis must be submitted to the major department at least four weeks before the date on which the candidate expects to receive the degree. At least three weeks before graduation, four copies of the thesis approved by the thesis committee and the graduate dean must be deposited in the Office of the Associate Registrar along with a receipt for the binding fee. Theses must comply with the regulations set forth in the Guide for Preparation of Theses and Dissertations at The University of Alabama in Huntsville, available at the Office of School of Graduate Studies.

In exceptional cases, theses may be written in absentia. Before leaving the university, students must 1) select a thesis subject, 2) submit to the chairman of the major department a satisfactory outline of the thesis, and 3) submit satisfactory evidence that adequate facilities are available where work is to be done.

Plan II (Non-Thesis)

Degree requirements for the Master's degree under this plan include the completion of a minimum of 33 semester hours of graduate coursework. A thesis is not required.

A candidate working under Plan II may be required to participate successfully in a seminar or in problem courses for acquaintance with research methods and appreciation of the place and function of original investigation in the field.

Transfer Credit

With permission of the major department, students may transfer a maximum of six semester hours of acceptable graduate credit earned in an approved institution and may count it toward a Master's degree. Students may also petition the major department to recommend to the graduate dean that six additional hours of
graduate credit be accepted. All transferred credit may not be more than six years old at the time of a student’s graduation from UAH. It is transferable only if the student was enrolled in a graduate school at the time it was taken and has an overall average at the institution of B or better. Students who have graduate credits from another campus of the University of Alabama must complete a minimum of 12 semester hours of acceptable graduate credit at UAH to receive a Master’s degree from UAH.

Candidacy for the Master’s Degree

A student admitted to a Master’s degree program is a candidate for the Master’s degree only if the student has met all admission requirements, is not on probation, has an approved Program of Study on file in the Office of Admissions and Records, and has an average of B or better on all graduate work attempted at UAH.

Final Examination

A final comprehensive examination is required of all candidates for a Master’s degree; this examination may be written, oral, or both. The candidate will be examined on the coursework and thesis in Plan I and on the coursework in Plan II. The examination is conducted by a committee of at least three members appointed by the graduate dean. The examination committee is usually (but not always) the same as the thesis supervisory committee. The members of the examining committee are selected by the advisor in consultation with the student. Moreover, the examining committee is composed of faculty members whose areas of expertise cover the areas listed on the student’s program of study insofar as possible. The majority of the committee must be composed of full-time UAH faculty members. A written notice of the time and place of examination is sent by the graduate dean to the candidate and each member of the committee at least two weeks before the examination date. The examination must be given at least one month before the date of graduation and the results reported promptly to the graduate dean. A student may take the final oral or written examination only twice.

Application for Degree

Each candidate for an advanced degree must apply for the degree through the Office of Student Records at least three months before the degree is to be conferred.

Time Limit

All requirements for the master’s degree must be completed in not more than six years. Credit for individual graduate courses completed at UAH more than six years but less than ten before the completion of all requirements for the degree may be validated by special examination. Such an examination, given by the department in which the course is offered, can be taken only once and will be the equivalent of a final examination in the course. When the student passes the examination, the course is considered valid through the tenth year only.
Credit for courses transferred from other institutions cannot be validated at UAH.

**Second Master’s Degree**

A student is permitted to apply no more than six semester hours of credit earned for one graduate degree toward an additional master’s degree at UAH. Such permission is granted at the discretion of the major department.

**Summary of Checkpoints Toward Completion of Degree Requirements**

The following checkpoints have been established to assist a student in proceeding from admission to graduation. Timely completion of the forms, in sequence, will help to insure that a student’s degree program is in order.

**Form 3:** Program of Study. This form must be filed as early as possible and definitely before the completion of 12 semester hours. If the program is developed by a supervisory committee, the student may be invited to the committee meeting.

**Form 3-A:** Petition for a change in Form 3, if any. A valid reason must be given for the change.

**Form 5:** Application for Advanced Degree. This is to be filed at least three months before graduation. It is available at the Office of Student Records.

**Form 6:** Notification of Final/Qualifying Examination. Notification of the examination date must be given at least two weeks in advance. The final examination must be taken at least one month before graduation, and not earlier than the term in which the student completed all required coursework.
The Doctor of Philosophy Degree

The Doctor of Philosophy degree is a research-oriented degree awarded upon the demonstration of scholarly competence. The degree program at UAH is based on the successful completion of a program of study designed by the student and a faculty committee. The program includes mastery of certain research skills (languages, computer programming, statistics, and others approved by the Graduate Council) and an independent research project, the results of which are presented in the form of a dissertation.

Degree Requirements

The following specific degree requirements are applicable to all Ph.D. degree programs within the university. Additional requirements may be specified by individual departments as shown in this catalog under the appropriate department.

Course Requirements

The School of Graduate Studies imposes no specific course or credit-hour requirements for the Ph.D. Course requirements are defined in the Program of Study and are determined by the appropriate department. Usually the student will take a majority of the courses in a given field with the remainder in a cognate field. This, however, is not a requirement. A maximum of nine semester hours credit in thesis/research work from the master's degree may be allowed to count toward the Ph.D. requirements.

The approval of the Program of Study should be accomplished as early as possible, but no later than the end of the first year of study. Once approved, the program may only be amended by the supervisory committee.

Transfer Credit

All credit toward the Ph.D. which has not been earned at UAH must be acceptable graduate credit, transferred from an approved institution. Such credit is transferred only with approval of the major department, and if the student was enrolled in a graduate school at the time it was taken and has an overall average at the institution of B or better.

Foreign Language Requirement

The requirement for foreign language competency may be satisfied by one of four methods, the particular method being determined by the department of the major:

1. Reading proficiency in two languages as determined by performance on the standardized Graduate School Foreign Language Tests of the Educational Testing Service (ETS) and administered at UAH. The required level of performance is to be established by the major department.
2. Reading proficiency in one language as above and demonstrated competence in a research skill.

3. An in-depth knowledge of one language as demonstrated by performance on the ETS Graduate School Foreign Language Test at a level appropriately higher than that for No. 1 above; or completion of 12 semester hours in one language with a grade average of B or better.

4. Competency in two independent research skills. Criteria for acceptability of these skills are to be determined by the department of the major.

Residence Requirement

For the award of a Ph.D., residence at UAH as a graduate student is required for evaluation of the student’s investigative abilities, independent thought, and scholastic progress by faculty members other than the major advisor.

Full-time residence at UAH for at least one continuous academic year or its equivalent during the student’s graduate career is judged to be minimum. All research effort presented for residence credit toward the Ph.D. degree must be performed under the direction of a full-time member of the graduate faculty.

Supervisory Committee

A supervisory committee is appointed for each student working toward the Ph.D., usually after satisfactory completion of a preliminary examination administered by the major department. The supervisory committee is composed of at least five members with a minimum of three from the department of the major and one or more from the department(s) of the minor(s). The supervisory committee is appointed by the graduate dean and will examine the student’s research proposal for the dissertation.

Qualifying Examination

The qualifying examination is given under the auspices of the supervisory committee. The examination is a demonstration of proficiency in the subject-matter phase of the Program of Study and shall be part written and part oral. The written portion shall become a part of the student’s permanent record. The examination may be taken twice if necessary. Further attempts will require the permission of the Graduate Council.

Admission to Candidacy

Upon successful completion of the qualifying examination and the foreign language requirement, the student may be admitted to candidacy for the degree. Admission to candidacy is based on the recommendation of the student’s supervisory committee and the appropriate department and is approved by the graduate dean. It is the responsibility of the student to secure the appropriate forms from the Associate Registrar’s Office and to initiate the procedure for admission to candidacy at least six months preceding the awarding of the degree. Candidacy is not transferable from another institution.
Dissertation

The dissertation is evidence that the student can independently identify a problem of contemporary significance through familiarity with the current literature in the major field, organize and execute a program of research, recognize and analyze the results, and present them in cogent, well-written exposition. Dissertation results are expected to be submitted for refereed scholarly publication. All dissertations must be accessible to the general public.

A completed copy of the dissertation must be submitted to the major department at least one month before graduation. At least two weeks before graduation, four copies of the dissertation, approved by the student’s committee and the chairman of the major department and the graduate dean, are to be deposited in the Associate Registrar’s Office with a receipt for the binding fee. A copy of the dissertation must be submitted for microfilming to University Microfilms International by the time of graduation. Dissertations must comply with the regulations set forth in the Guide for Preparation of Theses and Dissertations at The University of Alabama in Huntsville, available at the Office of the School of Graduate Studies.

Application for Degree

Each candidate for a Ph.D. degree must apply for the degree through the Office of Student Records as least three months before the degree is to be conferred.

Final Examination

The final examination is an oral presentation of the dissertation in the form of a seminar before the student’s committee and is open to the members of the university community.

Time Limit

All requirements for the doctoral degree must be completed in no more than five years after the student has passed the qualifying examination.

Summary of Checkpoints Toward Completion of Degree Requirements

The following checkpoints have been established to assist a student in proceeding from admission to graduation. Timely completion of the forms, in sequence, will help to insure that a student’s degree program is in order.

Form 4: Graduate Student Supervisory Committee. This committee (see above) supervises the student’s work throughout the doctoral program. It is selected by the student and the major advisor after the student has satisfactorily passed the preliminary examination.
Form 10: Program of Study for the Doctoral Degree. Subsequent to approval of Form 4, the committee should meet to develop a complete program for the student, who should be invited to the meeting.

Form 3-A: Petition for a change in Form 10, if any.

Form 6: Notification of Qualifying Examination. Students should consult with their advisors about specifics.

Form 11: Application for Admission to Candidacy for the Degree of Doctor of Philosophy. This form must be completed after passing the qualifying examination and the language requirement at least six months before graduation. (Available from the Office of Student Records.)

Form 5: Application for Advanced Degree. This should be filed three months before graduation. (Available from the Office of Student Records.)

Form 6: Notification of Final Examination. Notification of the final examination requires a minimum lead time of two weeks. This examination must be taken at least one month before graduation.

Cooperative Programs

Between UAH and the University of Alabama, Tuscaloosa

Close cooperation on Ph.D. programs exists between departments on the UAH campus and departments on the Tuscaloosa campus authorized for carrying on doctoral work. Applicants to programs in Mathematics, Chemistry, and Administrative Science who desire to make maximum use of services in Huntsville may submit application materials to the UAH School of Graduate Studies. Upon being admitted, the student will be advised of the procedures for program planning.

The minimum residence requirements on the Tuscaloosa campus include two consecutive semesters (or, if specifically approved by the faculty concerned, one full summer of two terms preceded by or followed by one regular semester) and 18 semester hours of credits (including research, seminars, dissertations, special problems, or other assignments for which a credit equivalency may be established).

Between Auburn University and the University of Alabama System

In some designated programs, a student enrolled in either Auburn University or any campus of the University of Alabama System may register as a transient student at the other institution with the approval of both graduate deans, or their representatives, and the department or school in which the student wishes to take the work. The amount of coursework that may be taken by a student under such an arrangement will be determined by the supervisory committee, with appropriate approvals at the other university.

A student earning a Master’s degree at either institution must complete at least one-half of the required coursework at the institution granting the degree.
For a course to be applicable for credit above the six hours presently transferable toward a Master's degree or beyond the Master's, the course must be approved in advance by the student's major department or school and the graduate dean.

The deans of the graduate schools will serve as liaison officers in arranging programs for which the additional hours may be transferred.

**Between UAH and Alabama A&M University**

A visiting student policy has been established between Alabama A&M University and UAH. Under this arrangement, a graduate student at one institution may request permission to attend a course at the other. Conditions governing the granting of permission include the following:

1. The student must be in good graduate standing.
2. The course desired is unavailable to the student at the home institution.
3. A visiting student is limited to one graduate course a term at the host institution except where the second course is a laboratory required to accompany the first course.
4. A visiting student must have prerequisites for the course.
5. The number of courses taken under this plan cannot exceed those allowed in the policy on transferred credit.
6. The student's request requires the approval of the advisor, department chairman, and graduate dean.
7. Permission of the host institution is dependent upon availability of space for the visitor after its own students are accommodated.

Interested students should contact the Office of Admissions and Records for appropriate forms.
College of Administrative Science

Degrees: Master of Administrative Science  
PhD in Business Administration in cooperation with the University of Alabama, Tuscaloosa

Dean: C. D. Billings, Professor of Finance  
Assistant Dean: Roscoe E. Bryson, Jr., Associate Professor of Accounting  
Chair, Graduate Program Advisory Committee: James K. McCollum, Associate Professor of Management  
Chair, Department of Accounting and Business Legal Studies: Grover L. Porter, Professor of Accounting  
Chair, Department of Economics and Finance: Margaret Bond, Professor of Economics  
Chair, Department of Management and Marketing: J. Daniel Sherman, Associate Professor of Management  
Interim Chair, Department of Management Information Systems and Management Science: Ernest P. Goss, Associate Professor of Management Information Systems

Professors:  
Billings, C.D.; government financial management, systems analysis, investments.  
Graves, B.B.; strategic planning, small business, international management.  
Lindbeck, R.S.; taxation, not-for-profit accounting.  
Porter, G.L.; managerial accounting, accounting information systems.  
Schroer, B.J.; project management, management science, manufacturing.

Associate Professors:  
Goss, E.P.; management information systems.  
McCollum, J.K.; labor relations, organizational theory.  
Paul, C.W., II; managerial economics.  
Sherman, J.D.; organizational behavior, organizational theory.  
Stafford, E.F., Jr.; production/operations management.  
Vozikis, G.S.; strategic management/policy, entrepreneurship.

Assistant Professors:  
Brooks, J.L.; organizational behavior.  
Busbin, J.W., II; advertising, consumer behavior.  
Floyd, S. A.; decision support systems, management science.  
Rezaee, Z.; auditing, financial accounting, managerial accounting.  
Schoening, N.C.; urban and regional economics.  
Schroeder, E.A., IV; managerial economics, econometrics.  
Sundaraiyer, V.H.; management science.  
Sweeney, L.E.; corporate finance.  
Tseng, F.T.; management information systems.

Lecturer:  
Wall, W.C., Jr.; project management
The College of Administrative Science is a professional school with the mission to provide learning opportunities which contribute to the development of professionally competent, creative, and socially responsible managers for careers in business, government and other organizations.

This mission is influenced by today’s rapidly changing environment, which is increasingly oriented toward the application of advanced technology in organizations.

This mission is also influenced by the location of the College in the third largest economic and cultural center in the State of Alabama, in a leading advanced technology center in the Southeast, and in a major space center in the nation. The faculty is committed to programs and activities that will help increase the contribution that this urban center makes to the economic and professional development of the state and nation.

The College seeks to accomplish three major objectives in serving the educational, research and service needs of regional public and private organizations. These objectives are:

1. To provide quality programs of undergraduate and graduate instruction in educating persons for the practice of administration at all levels of responsibility in diverse organizations;
2. To conduct productive applied research which furthers the accumulated knowledge of the operation of complex organizations and serves the needs of the local and regional business and public organizations;
3. To render public service to business, industry and government in the region.

The programs to achieve these objectives recognize the needs of specific constituencies, including minority groups, women, part-time, working and adult students. There is also a special obligation to provide applied research and public service to broad groups through college bureaus, centers, and institutes. The College is committed to serve society beyond the campus through professional development programs and to apply knowledge and expertise to the solution of problems of people, urban areas, rural areas, public bodies, and state and federal agencies whenever there are needs in which the College can be helpful.

Graduate Assistantships

A limited number of graduate teaching and research assistantships are available each year. The stipend begins at $5,000 per academic year plus tuition and fees. The assistantships require half-time service to the university (20 hours per week). Assistantships of less than half-time are available also. The graduate assistant may not hold other employment and must register for at least six but not more than nine hours per semester. For more information concerning graduate assistantships, see the financial aid section of the Graduate Catalog and call the College’s Graduate Coordinator at 205-895-6024.

Center for High Tech Management and Economic Research

The Center’s mission is to serve the business community, federal, state and local governments, individuals, and the University through management and technical assistance, dissemination of economic and socio-economic information, and support for faculty in seeking funding for research projects. Special emphasis is placed on businesses in technological fields. In addition, the Center staff does
contract research on business and economic problems for governmental organizations and private industry. The Center publishes the results of its research as monographs so that significant developments in business and economics can achieve wide exposure. The Center is an associate member of the Association for University Business and Economic Research (AUBER), a member of the Southern Technology Applications Center, and a member of the NASA Technology Transfer Network.

All graduate faculty members in the College of Administrative Science are staff members of the Center for High Technology Management and Economic Research. The purposes of the center are

• To offer technical and management assistance to new and emerging high technology businesses throughout Alabama;
• To provide managerial and technical assistance to entrepreneurial ventures in North Alabama;
• To conduct research on the business and economic environment of the Huntsville area, Alabama, and the Southeast region of the United States;
• To encourage and promote research by the College’s faculty members;
• To render technical assistance to faculty members and assist in securing funds for research projects;
• To publish monographs and other materials of practical use to business and government; and
• To plan and promote conferences and seminars conducted in the College.

A major subsidiary program is the Alabama High Technology Assistance Center (AHTAC), which offers technical and management assistance to new and emerging high technology businesses throughout Alabama. Using technical experts from within the University and from such sources as the Federal Laboratory Consortium and the NASA Technology Transfer Network, AHTAC supplies idea and product evaluation and technical problem resolution. AHTAC regularly sponsors seminars and workshops on subjects of special interest to the “high tech” community.

Another subsidiary program is the Small Business Development Center (SBDC), which provides managerial and technical assistance to entrepreneurial ventures in North Alabama. The SBDC advises potential and established entrepreneurs, assists in the development of private-sector jobs, and advocates the free enterprise system.

The staff of the Center’s Business and Economic Research Unit analyzes the business and economic environment of the Huntsville area, the state of Alabama and the southeast region of the United States. This unit provides a data base of statistical information and prepares research studies and statistical information on economic development in such areas as labor resources, transportation capabilities, financing, industrial sites, business services, public policy questions, science and technological services.

Automation and Robotics Research

The College works closely with the Cognitive Systems and Systems Simulation Laboratories on joint faculty research projects and supporting graduate assistantships.

The Cognitive Systems Laboratory’s research is focused on knowledge based expert systems emphasizing the cognitive systems aspect of detecting and understanding the environmental domain. Numerous expert systems have been prototyped within the laboratory in the areas of diagnostics, classification, natural language understanding, process control, decision support, and productivity enhancement.
The Systems Simulation Laboratory's research is focused on using simulation for space, military and industrial applications. One research aspect is the coupling of simulation with artificial intelligence and expert systems. Research projects include graphical simulation of space station docking, flexible manufacturing system simulation, mobile robotic vehicle simulation and manufacturing/production system simulation.

Institute for Development of Entrepreneurship in Alabama (IDEA)

IDEA's purpose is to bring together the student's knowledge and the entrepreneurial experience. By working with the Alabama Entrepreneur's Association, the Huntsville Venture Forum and individual entrepreneurs on a consultation basis, the student is able to determine his or her own interest in becoming an entrepreneur while offering assistance to entrepreneurs.

Master of Administrative Science

Purpose of the MAS

The Master of Administrative Science (MAS) is a generic management degree, providing entry-level and mid-career managers with the practical and theoretical knowledge necessary to manage public and private organizations. The program builds capable, creative managers able to face successfully the challenges of rapid technological change, changing employee expectations, and overall increased complexity. The program recognizes the influence of computer technology on all management processes by thoroughly integrating micro and mainframe computer applications into coursework. It increases skills in information management through the use of computerized classrooms and laboratories and computer-assisted instruction.

The total hours required of students and the level at which they begin participation in the MAS program depends on their academic preparation. Generally, the program extends for two years for full-time students with a nonbusiness administration background, and one year for full-time students with a business administration background. The total number of hours required for completion of an MAS ranges from 33 to 57, excluding any courses required to correct deficiencies in prerequisites that students have at the time of admission.

Most of the courses that can be taken for graduate credit and those on the 600 level are offered in the evening.

Goals of the MAS program are met through an interdisciplinary curriculum which develops skills in applying advanced technology and behavioral concepts crucial to management. This curriculum supplies students with critical knowledge about a wide range of organizations through coursework in accounting, economics, finance, management, quantitative methods, marketing, management information systems, the worldwide dimension of management of organizations, and the legal-social-political-ethical environment of organizations. This Foundation Curriculum allows students without the prerequisite undergraduate preparation to acquire the common body of knowledge in management.
The Core Curriculum then builds on this foundation through advanced study in the quantitative and human aspects of organizational problem-solving, including the communication, interpersonal, and negotiation skills indispensable to effective management.

These management skills are enhanced further by a wide range of options for elective coursework. Advanced study can be in one of the following options:

Accounting  
Management  
Management Information Systems  
Personnel and Human Resource Management  
Economics  
Operations Research  
Production Management  
Systems Analysis

Students may follow one of the two plans for the program of study: Plan I requires the presentation of a thesis; Plan II does not.

Admission Requirements

Admission to the MAS program is granted to students who show high promise of success in postgraduate management study and who hold baccalaureate degrees from regionally accredited institutions.

Individuals with baccalaureate degrees in any field of study are eligible to apply to the MAS program.

Students may have backgrounds in such diverse fields as engineering, liberal arts, education, science, and nursing. Admission to the program is competitive. It is based on an applicant's undergraduate academic performance, and scores on the Graduate Management Admission Test (GMAT). Scores on the Test of English as a Foreign Language (TOEFL) are also required for international applicants.

Applicants may arrange to take the GMAT by making application to: Graduate Management Admission Test, Educational Testing Service, P.O. Box 966, Princeton, N.J. 08540. Applications to take the GMAT may be obtained from the University's Testing Service in the University Center. In making application, request that a copy of the test score be sent to the College of Administrative Science, University of Alabama in Huntsville, Huntsville, AL 35899.

Once an applicant has submitted documents to satisfy all the above requirements, the applicant's file will be reviewed by a faculty committee. Applicants may be allowed to begin graduate study in one of the following two categories:

1. Unconditional Admission

Applicants may be admitted unconditionally if they obtain a total of at least 950 based on the formula: 200 times the overall undergraduate grade point average plus the GMAT total score.

2. Conditional Admission

Applicants not meeting the above criteria may be considered for conditional admission. Recommendation for conditional admission is based on the applicant’s prior academic performance, GMAT scores, relevant work experience, and any additional information the applicant may wish to submit. Students admitted
conditionally must maintain a "B" average for the first twelve hours of graduate work and meet any other conditions established.

**Policies**

**Advisement and Registration Procedures**

Advisement of graduate students is handled by the College’s Graduate advisor. Students must file a Program of Study outlining their degree program, including choice of electives, before they have completed 12 hours of graduate work.

During each registration period, all registration cards must be approved by the Graduate advisor. All students are encouraged to pre-register for classes during the early registration period seven weeks prior to the term. (See the UAH Calendar.)

**Course Load**

The usual course load for a full-time graduate student in management is 6-9 semester hours per term. The maximum load is ten semester hours. Students who are employed full time must obtain permission of the advisor to enroll in more than three semester hours per term.

**Transfer Credit**

Courses taken at the graduate level which are transferred to meet the Foundation Curriculum are excluded from the UAH policy on the maximum number of hours permitted to be transferred. Please refer to the Graduate School requirements.

**Degree Requirements**

*Advanced Standing*: Students with strong backgrounds in mathematics and business administration may be granted advanced standing in the MAS program through equivalent credit for "common body of knowledge" Foundation courses for which a minimum grade of C was received in an undergraduate program. Most students entitled to such credit hold baccalaureate degrees in business administration from accredited institutions. Students may be granted equivalent credit for any or all of the Foundation courses, depending on the depth of their undergraduate or previous graduate preparation. The MAS program may consist of as few as 33 hours for students who have no deficiencies in prerequisites, and who receive equivalent credit for all of the Foundation courses.

*Students Not Receiving Advanced Standing*: Students with baccalaureate degrees in non-business fields may not have enough background to warrant advanced standing except for work in economics, mathematics, and/or statistics. Determination regarding equivalency credit will be made by the Coordinator of Graduate Advisement following admission to the program.

In addition to meeting all degree requirements established by the School of Graduate Studies, all candidates for a Master of Administrative Science degree must meet the conditions of one of the following two plans to be eligible for graduation:
Plan I—MAS thesis option:
1. Completion of the Foundation of Management curriculum by undergraduate or graduate work;
2. Completion of the Management core curriculum (18 semester hours) including the Strategic Management requirement (MGT 698);
3. Completion of 15 hours of electives (an option) including 6 hours of thesis;
4. A minimum "B" average for all degree credit course work;
5. Successful completion of the comprehensive course work examination requirement;
6. Submission of an acceptable thesis describing original research;
7. Final oral examination.

Plan II—MAS non-thesis option:
1. Completion of the Foundation of Management Curriculum by undergraduate or graduate work;
2. Completion of a minimum of 33 hours of graduate level coursework, including the Management Core Curriculum, 15 hours of electives (an option) and the Strategic Management requirement (MGT 698, Strategic Management);
3. Successful completion of the comprehensive examination requirement;
4. A minimum "B" average for all degree credit coursework.

Foundation of Management Curriculum (30 semester hours)
The Foundation Curriculum gives students the necessary background to enter the Management Core curriculum, options, and Strategic Management course. With the approval of the Coordinator of Graduate Advisement, students who have completed equivalent coursework may be permitted to waive the Foundation coursework. The Foundation courses are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>SEM HRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA 151</td>
<td>Elementary Calculus</td>
<td>3</td>
</tr>
<tr>
<td>MSC 287</td>
<td>Statistical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MGT 621</td>
<td>Introduction to Administrative Science</td>
<td>3</td>
</tr>
<tr>
<td>MIS 609</td>
<td>Introduction to Management Information Systems</td>
<td>3</td>
</tr>
<tr>
<td>MSC 608</td>
<td>Quantitative Methods I</td>
<td>3</td>
</tr>
<tr>
<td>ACC 601</td>
<td>Introduction to Accounting</td>
<td>3</td>
</tr>
<tr>
<td>BLS 615</td>
<td>The Social, Legal, and Ethical Environment of Organizations</td>
<td>3</td>
</tr>
<tr>
<td>ECN 607</td>
<td>Survey of Economic Theory</td>
<td>3</td>
</tr>
<tr>
<td>MKT 606</td>
<td>Marketing Administration</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>International Business</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(one of MGT 550, ECN 546, FIN 554, MKT 515)</td>
<td>30</td>
</tr>
</tbody>
</table>

*Prerequisites to be taken only if a specific void exists.
Management Core Curriculum (18 semester hours)

The Management Core Curriculum provides students with a comprehensive understanding of effective management in public and private organizations. Emphasis is placed on the managerial aspects of complex organizations and their human elements. The Management Core Curriculum consists of the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGT 622</td>
<td>Human Behavior in Organizations</td>
<td>3</td>
</tr>
<tr>
<td>MGT 623</td>
<td>Organizational Theory</td>
<td>3</td>
</tr>
<tr>
<td>MGT 624</td>
<td>Organizational Problems</td>
<td>3</td>
</tr>
<tr>
<td>FIN 601</td>
<td>Managerial Finance</td>
<td>3</td>
</tr>
<tr>
<td>MSC 651</td>
<td>Production/Operations Management</td>
<td>3</td>
</tr>
<tr>
<td>MGT 698</td>
<td>Strategic Management</td>
<td>3</td>
</tr>
</tbody>
</table>

Management Options (15 semester hours)

The curriculum leading to the MAS degree is administrative or management oriented. It is an interdisciplinary and interdepartmental degree program. This interdisciplinary characteristic is desirable for future administrators because their work requires some knowledge of many facets of administrative activities. The curriculum is characterized by concentration on the managerial aspects of complex organizations and their human elements. Each student specializes in a particular aspect of management by completing an option.

Each student in the Administrative Science program must complete a minimum of 15 hours of electives, nine hours of which must be at the 600 level or above. Individual career needs may be met by choosing one of the following options:

Accounting, general management, economics, management information systems, operations research, personnel and human resource management, production management, and systems analysis (Project Management). Students who wish to tailor an option may do so within the general management option.

Strategic Management Requirement

While the entire MAS program is concerned with the development of managers, the Strategic Management requirement emphasizes the top management perspective. Strategic Management, MGT 698, serves as the final integrating course for the MAS program. Students will examine administrative processes under conditions of uncertainty, including such topics as integrating analysis and policy determination at the overall management level. It includes analysis of changing environments, organizational strategy development, strategic goal setting, organizational policy formulation, and management problem analysis. MGT 698 must be completed with a minimum grade of B.

1. General Management Option:

This option is for those who wish to study the planning, organizing and controlling aspects of organization. It includes the organizational, financial and
quantitative aspects of an organization with emphasis on various theories of management. It explores the knowledge and understanding necessary for managing people, functions and decision-making.

Students wishing to pursue this option may do so by choosing from graduate-level courses in various departments including accounting, finance, management, information systems, etc. The courses chosen must have the prior approval of the Graduate Program Advisory Committee.

2. Accounting Option:

This option provides advanced instruction in the concepts and procedures underlying organizing, maintaining, and auditing financial transactions of organizations. Students are required to complete the following coursework:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC 607</td>
<td>Advanced Accounting Information Systems</td>
<td>3</td>
</tr>
<tr>
<td>ACC 614</td>
<td>Advanced Managerial Accounting</td>
<td>3</td>
</tr>
<tr>
<td>ACC 642</td>
<td>Advanced Internal &amp; Operational Auditing</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Six hours from 500 or 600 level Accounting &amp; Business</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Legal Studies courses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>15</td>
</tr>
</tbody>
</table>

3. Economics Option:

This option is designed to develop an understanding of the principles and methods for organizing a business firm, combining resources to produce goods and services, taking account of costs, profits and the nature and extent of competition in markets.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC 600</td>
<td>Theory of Income and Employment</td>
<td>3</td>
</tr>
<tr>
<td>EC 610</td>
<td>Theory of Value and Distribution</td>
<td>3</td>
</tr>
<tr>
<td>EC 620</td>
<td>Econometrics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Six hours from 500 or 600 level Economics courses</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>15</td>
</tr>
</tbody>
</table>

4. Management Information Systems Option:

This option is for students seeking additional technical expertise in computer-based information systems as well as in the application of computer technology to management systems. It involves the application of advanced computer technology to the business/management environment.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester Hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIS 575</td>
<td>Information Resource Management</td>
<td>3</td>
</tr>
<tr>
<td>MIS 617</td>
<td>Modeling and Decision Systems</td>
<td>3</td>
</tr>
<tr>
<td>MIS 640</td>
<td>Seminar in Data Base Management</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Six hours from the following:</td>
<td>6</td>
</tr>
<tr>
<td>MIS 634</td>
<td>Seminar in Management Information Systems</td>
<td></td>
</tr>
<tr>
<td>MIS 660</td>
<td>Seminar in Telecommunications and Distributed Processing</td>
<td></td>
</tr>
<tr>
<td>MIS 672</td>
<td>Seminar in Systems Design Process</td>
<td></td>
</tr>
<tr>
<td>MIS 645</td>
<td>Applications of Artificial Intelligence</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>15</td>
</tr>
</tbody>
</table>
5. Operations Research Option

This option analyzes management problems through probability theory, continuous distributions, mathematical programming, queuing theory, Markov processes, replacement maintenance and inventory models, other mathematical models, and simulation and game theory. Additional prerequisites for this option are four quarters of calculus through MA 251. Interested students should consult the chairman of the Industrial and Systems Engineering Department to ensure they meet the necessary prerequisites.

ISE 626 Introduction to Operations Research ........................................3
ISE 636 Systems Modeling ........................................................................3
Nine hours from the following .................................................................9
ISE 527 Systems Simulation
ISE 621 Statistical Methods of Engineers
ISE 629 Optimization Methods in Operations Research
ISE 634 Value and Decision Theory
ISE 635 Linear Programming
ISE 737 Advanced Simulation Modeling

Total 15

6. Personnel and Human Resource Management Option

This option furnishes advanced study in leadership and motivation, personnel activities, labor law, and communication patterns in organizations. It primarily emphasises managing human resources within an organization.

MGT 631 Personnel Administration in Organizations ..............................3
CM 636 Seminar in Organization Communication ..................................3
Six hours from the following .....................................................................6
MGT 625 Labor Relations and the External Environment
MGT 629 Leadership and Motivation
MGT 635 Administrative Science Internship
MGT 650 Selected Research Topics
SOC 630 Industrial Sociology
Three hours from 500 or 600 level College of Administrative Science courses ..............................................................3

Total 15

7. Production Management

This option emphasizes systematic regulation and control of the manufacturing, fabricating, extracting, and processing of goods. Interested students should contact the Chair of the Industrial and Systems Engineering Department to ensure they meet the necessary prerequisites.

ISE 626 Introduction to Operations Research ........................................3
ISE 627 Introduction to Systems Engineering ........................................3
Nine hours from the following .................................................................9
ISE 523 Statistical Quality Control
ISE 526 Design and Analysis of Experiments
ISE 621 Statistical Methods of Engineers

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8. Systems Analysis (Project Management)

This option prepares individuals to examine organizational policies, structures, and administrative practices so they may recommend and install systems procedures and methods improvements. It includes advanced study in the design, implementation, testing, and maintenance of various systems procedures. The option stresses valid technical research to aid engineers, management personnel, and others in effectively installing efficient operations. Primary emphasis is on the development and management of matrix organizations and project management concepts.

MSC 640 Principles of Project Management ........................................... 3
MSC 641 Applied Project Management .................................................... 3
MSC 642 Quantitative Applications in Project Management ....................... 3
MSC 643 Simulation of Project Management ............................................. 3
Three hours from the following ............................................................. 3
MSC 648 Management of Computer Integrated Manufacturing
MSC 645 Applications of Artificial Intelligence

Total 15

Ph.D. in Business Administration

The Ph.D. in Business Administration may be obtained at UAH through co-operative study with the University of Alabama, Tuscaloosa (UA). The Ph.D. requirements of the Graduate School and the College of Commerce and Business Administration at UA must be fulfilled. Please consult the UA graduate catalog.

Doctor of Philosophy degree is a research-oriented degree awarded upon the demonstration of scholarly attainment. The program is designed principally for those who wish to prepare for college and university teaching and research or for careers in business and government.

Admission Requirements

Admission to the doctoral program is open to qualified individuals who hold undergraduate and/or graduate degrees from accredited colleges and universities. Individuals seeking admission to the doctoral program should request information on application procedures by contacting UAH’s Coordinator of Graduate Advisement for the College of Administrative Science at 205-895-6024. Applications for admission are carefully evaluated by the faculty of UAH’s Graduate School of Administrative Science and UA’s Graduate School of Business.
Student's Program Committee

A committee is established for each student. The Program Committee guides the student in the selection of courses and counsels the student regarding other aspects of the program. The chairperson and a majority of committee members are from the University of Alabama in Tuscaloosa campus. The Program Committee ceases to exist when the student passes the preliminary oral examination.

Degree Requirements

The degree requirements for the cooperative Ph.D. program in Business Administration have been jointly established by the graduate faculties of the University of Alabama, Tuscaloosa, School of Commerce and Business and UAH's College of Administrative Science. Requirements of both graduate schools must be fulfilled. Consult UA's Graduate Catalog for full degree requirements.

The following considerations are made for UAH cooperative Ph.D. students:

Courses at UAH. Coursework to meet general field requirements, language/research tool requirements, and quantitative methods requirements may be completed at UAH. Consult UA's Graduate Catalog for details on these requirements.

Courses at UA. Major and minor field coursework must be completed in residence at the University of Alabama in Tuscaloosa. This will require more than 18 credit hours at UA. Major fields are accountancy, economics, finance, industrial relations, management science, marketing, organizational behavior, production management, statistics, and transportation.

Written and Preliminary Oral Examinations. The student is required to pass a written comprehensive examination in the major field and in the minor field(s). A preliminary oral examination is given after the student has completed two years of graduate study (including work on the Master's degree, if any), and after the student has successfully completed the written examinations (both major and minor fields), and after the language/research tool requirement has been satisfied. The student's Program Committee administers and conducts the preliminary oral examination.

Student's Dissertation Committee and Dissertation Requirements. When the student is prepared to present a dissertation proposal, the Dissertation Committee is appointed by the UA department head in the student's major field in consultation with the faculty and the student. UAH faculty members will serve on the Dissertation Committee, although the chairman and majority of members shall be from the University of Alabama in Tuscaloosa. The Dissertation Committee is responsible for admission of the student to candidacy, supervision of the dissertation, and administration of the final oral examination.

A dissertation showing power of independent research and literary skill must be prepared on a topic in the major field. The subject of the dissertation must be approved by the student's Dissertation Committee. Consult the UA Graduate Catalog for additional information.
**Student Transfer.** The transfer of credit to meet degree requirements for the cooperative Ph.D. program depends upon the program of each student. For detailed information contact the Coordinator of Graduate Advisement, College of Administrative Science at (205) 895-6024.

## Graduate Administrative Science Courses

**Courses for Graduate/Undergraduate Credit.** Courses designated with a 500 number are graduate courses that are offered simultaneously with courses designated with a 400 number for baccalaureate candidates. Additional work will be required of the graduate students.

**Courses for Graduate Students Only.** Courses designated with a 600 number are reserved exclusively for graduate students.

### Accounting (ACC)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>507</td>
<td>Accounting Information Systems</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Design, operation, and analysis of accounting information systems with respect to data input, processing, storage, recall, security, internal control, and the audit trail. Emphasis is on computer-oriented systems. Prerequisites: ACC 212, MIS 301. Lab Fee: Level 3. (Same as MIS 507.)</td>
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<tr>
<td>513</td>
<td>Income Tax Accounting II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Tax accounting for partnerships, corporations, Sub chapter S corporations, estates, and trusts. Tax administration and research are emphasized. Prerequisite: ACC 313.</td>
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<tr>
<td>515</td>
<td>Advanced Financial Accounting</td>
<td>3 hrs.</td>
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<td></td>
<td>Analysis of issues and alternatives in advanced problem areas including partnerships, business combinations, and not-for-profit organizations. Prerequisite: ACC 312.</td>
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<tr>
<td>515</td>
<td>Advanced Auditing</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Practical application of auditing concepts and standards. An understanding of auditing principles is reinforced and expanded by exposure to problems and cases. Prerequisite: ACC 431.</td>
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<tr>
<td>550</td>
<td>Seminar in International Accounting</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Seminar on current topics in international accounting. Prerequisite: ACC 415, 515.</td>
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<tr>
<td>570</td>
<td>Seminar in Contemporary Accounting Issues</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Seminar on current topics in professional accounting. Prerequisite: ACC 431.</td>
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<tr>
<td>601</td>
<td>Foundations in Accounting for Management</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>An accelerated course in accounting fundamentals and business applications for students with non-business undergraduate degrees. The course provides such students with an introduction to accounting terminology, to construction of accounting reports, and to the use of accounting as a management tool. Prerequisite: Graduate standing. Lab fee. Level 3.</td>
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<tr>
<td>607</td>
<td>Advanced Accounting Information Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>An in-depth examination of accounting information systems. Emphasis is placed on computer-oriented systems and current developments in systems. Prerequisites: ACC 407 or 507 and graduate standing.</td>
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<tr>
<td>614</td>
<td>Advanced Managerial Accounting</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Examination of the framework underlying managerial accounting and description of how accounting information should be used to fulfill planning, control, and performance evaluation functions. The focus of the course is on understanding and utilizing advanced managerial accounting concepts, practices, and techniques. Prerequisite: ACC 314 and graduate standing.</td>
<td></td>
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</tbody>
</table>
642 Advanced Internal and Operational Auditing 3 hrs.
Introduction to the methodology of internal and operational auditing and to the utilization of the results of the audit by management in decision making. Prerequisites: ACC 431 and graduate standing.

670 Managerial Accounting 3 hrs.
The course examines the managerial uses of accounting information but is primarily non-technical. The focus of the course is on the MAS students’ gaining a comprehensive understanding of accounting concepts and the accepted methods of applying these concepts in decision-making, planning, and control. Prerequisites: ACC 601 and graduate standing. Lab fee level 3.

Business Legal Studies (BLS)

511 Business Law for Accountants 3 hrs.
An in-depth study of legal principles and problems encountered in practice by professional accountants. This course covers legal topics from a Uniform Commercial Code perspective. Prerequisite: BLS 211.

615 The Social, Legal and Ethical Environment of Organizations 3 hrs.
This course explores the external environment in which public and private organizations exist. Emphasis is given to the influence of legal and political forces on organizations in the operational and decision making processes. Prerequisites: graduate standing.

Economics (ECN)

546 International Economics and Trade 3 hrs.
Theoretical principles underlying international trade with application of these principles to recent historical developments and to current national policies. Prerequisite: graduate standing and ECN 345, or approval of AS Graduate Coordinator.

564 Regional Economics 3 hrs.
Location theory and regional economics, factors affecting location of economics activity, consideration of differential growth rate among regions, and introduction to methods of regional analysis. Prerequisite: graduate standing and approval of AS Graduate Coordinator.

585 Comparative Economic Systems 3 hrs.
Principle economic systems comparing resource allocation, consumption, pricing, production, investment, income distribution, and central planning. Prerequisite: graduate standing and approval of AS Graduate Programs Coordinator.

600 Theory of Income and Employment 3 hrs.
Continuation of ECN 340. More advanced treatment of theory of national income determination and associated concepts. Prerequisite: ECN 340 or equivalent. ECN 607 and the approval of AS Graduate Coordinator.

607 Survey of Economic Theory 3 hrs.
Rigorous treatment of basic principles underlying economic theory. Theory of national income determination, theory of market structures, principles of value and distribution theory. Prerequisite: approval of AS Graduate Coordinator.

610 Theory of Value and Distribution 3 hrs.
Continuation of EC 345. Consideration of classical and neoclassical theory of value and distribution. Prerequisite: ECN 345 or equivalent. ECN 607 and approval of AS Graduate Coordinator.

620 Econometrics 3 hrs.
Least-square estimation of single-equation linear models, properties of the estimators, significance tests and confidence intervals of estimation, and problems in estimation of single-equation models (autocorrelation, multi-collinearity, heteroscedasticity). Prerequisite: ECN 430, ECN 607, and approval of AS Graduate Coordinator.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>626</td>
<td>Managerial Economics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Analysis of economic problems or organizations and decision making techniques to solve these problems. Formal analysis of demand, supply functions, techniques used in demand analysis. Analysis of theory of cost, production, and cost estimation. Analysis of price, output and investment decisions including theory of optimal behavior, alternative price strategies, time value of money and project selection. Lab fee: Level 2. Prerequisites: ECN 607 or equivalent.</td>
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</tr>
<tr>
<td>630</td>
<td>Evolution of Economic Thought</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Methodology and social philosophy of outstanding economists and their part in shaping economic development. Selective treatment emphasizing systematic nature of theories involved. Prerequisite: ECN 448, 600 610, or equivalent.</td>
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</tr>
<tr>
<td>640</td>
<td>Seminar in Economics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Intensive analysis of selected theoretical and applied aspects of economics. Prerequisite: ECN 607 or equivalent.</td>
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<tr>
<td>700</td>
<td>Research in Economics</td>
<td>3 hrs.</td>
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<td>Special topics in area of student interest. Prerequisite: ECN 630.</td>
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<tr>
<td></td>
<td><strong>Finance (FIN)</strong></td>
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<tr>
<td>510</td>
<td>Principles of Real Estate</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>An introduction to principles and practices of Real Estate Business, including economics, finance, law, marketing, planning, development, valuation and brokerage. Prerequisites: FIN 301, ACC 601, or approval of AS Graduate Coordinator.</td>
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<tr>
<td>520</td>
<td>Principles of Risk and Insurance</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Introduction to basic principles of life, property, liability, and areas of insurance. Prerequisites: FIN 301, ACC 601, or approval of AS Graduate Coordinator.</td>
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<tr>
<td>530</td>
<td>Real Estate Finance</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>An introductory course in real estate finance—institutions, instruments, real estate financing, financial leverage, financial planning, investment strategies or decisions. Prerequisites: FIN 301, ACC 601, or approval of AS Graduate Coordinator.</td>
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<tr>
<td>554</td>
<td>International Finance</td>
<td>3 hrs.</td>
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<td></td>
<td>Behavior of foreign-exchange rates under different monetary standards, methods of financing international trade, historical development of international financial institutions, current and proposed methods for fostering international trade, and problems of international liquidity. Prerequisite: FIN 352 (ECN 352), graduate standing and approval of AS Graduate Coordinator.</td>
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<tr>
<td>560</td>
<td>Monetary and Credit Policy</td>
<td>3 hrs.</td>
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<td></td>
<td>Influence of governmental policies on money supply, price level, interest rates, and employment with emphasis on maintenance of economic stability and progress. Prerequisite: FIN 352 (ECN 352); ECN 340 optional but recommended, graduate standing and approval of AS Graduate Coordinator.</td>
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<tr>
<td>570</td>
<td>Seminar in Finance</td>
<td>3 hrs.</td>
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<td></td>
<td>Extensive readings and reports reflecting current developments and trends in financial theory and its applications to the decision-making process. Development of a logical approach to financial problems using accepted techniques of financial analysis. Prerequisite: FIN 431, and approval of AS Graduate Coordinator.</td>
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<tr>
<td>601</td>
<td>Introduction to Managerial Finance</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Corporate financial planning and decision making. Financial analysis, working capital management, Capital budgeting, cost of capital, and long-term financial decisions. Prerequisite: graduate standing.</td>
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<tr>
<td>602</td>
<td>Investments</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Overall view of the investment-decision process, study of portfolio construction and management utilizing quantitative analysis. Prerequisite: ACC 601 or equivalent.</td>
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</tbody>
</table>
603 Business Finance Problems and Policy 3 hrs.
A case study course designed to give the student an opportunity to apply financial theory to analyze specific managerial problems. Prerequisite: FIN 601 or equivalent.

670 Advanced Managerial Finance 3 hrs.
Study of working capital management including cash management, credit policy, and inventory policy. Prerequisite: FIN 603.

Management (MGT)
505 Small Business Management 3 hrs.
Application of principles and practices of modern management start-up operation and control of small businesses in the economy. Opportunities and operational problems of small firms. Prerequisite: Approval of the College’s Graduate Advisor.

540 Small Business Counseling 3 hrs.
Practical exposure to problems and opportunities of small business firms. Assignment of student teams as counseling unit to assist local business managers with identification of problems and formulation of alternative solutions, as well as identification of areas of opportunity within the organization. A selection of students with demonstrated ability to understand and apply knowledge from several disciplines to day-to-day operations of business enterprise. Prerequisite: Graduate standing and approval of the College’s Graduate Advisor.

550 International Management 3 hrs.
Management of the multinational business enterprise in interaction with its political, economic, social, cultural, and legal environments. Prerequisite: graduate standing and approval of the College’s Graduate Coordinator.

570 Seminar in Management 3 hrs.
Selected Topics in management. Prerequisite: approval of College’s Graduate Coordinator.

621 Introduction to Administrative Science 3 hrs.
Elements of the managerial process fundamental to successful operation of various types of enterprises including a study of organization theory, behavior, and interpersonal communication.

622 Human Behavior in Organization 3 hrs.
Organization as a continuing social system. Problems of motivation and incentives, organizational communication, and their blockages. Selection, training, promotion, and severance of organizational members. Prerequisite: MGT 621.

623 Organizational Theory 3 hrs.
Theories of organizations and their structures. Organizations from the perspectives of management, psychology, sociology, political science, and economics. Organizations as groups of people and as systems in multiple environments. Goals, resources, effectiveness, equilibrium, and change relating to organizations. Administration’s relationships with organization with emphasis on research and assessment. Prerequisite: MGT 621.

624 Organizational Problems 3 hrs.
Organizational and group interface problems and processes and principles bearing on their solutions by simulations, case analysis, and structured interactions. Prerequisites: MGT 622 and MGT 623.

625 Labor Relations and the External Environment 3 hrs.
Relationships between management and organized labor and between organizations and the world outside their confines. Development of organized labor in the U.S. and major legislation-affective relations between management and labor. Collective bargaining process and administration of the resulting contract from the standpoints of management and labor. Effects of the social, economic, political, and technological environments of labor relations and on the organization’s relations with the external environment. The public and news-media impact upon management actions.
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>629</td>
<td>Leadership and Motivation</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Authority and leadership styles and their effectiveness in different types</td>
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<td>and levels of organization. Theories of personnel motivation and their</td>
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<td></td>
<td>practicality and effectiveness. The critical role of effective communication</td>
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<td></td>
<td>in leadership and motivation. Prerequisite: MGT 622.</td>
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<tr>
<td>631</td>
<td>Personnel Administration in Organizations</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Traditional and contemporary theories of purposes, functions, and processes</td>
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<td></td>
<td>of personnel administration needs of large complex organizations in both</td>
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<td>the private and public sector. Elements of a comprehensive personnel program</td>
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<td>in relation to the total management.</td>
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<tr>
<td>633</td>
<td>Socio-Economic Consequences of Government Procurement</td>
<td>3 hrs.</td>
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<td></td>
<td>The nature of federal government procurement, contracting.</td>
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<td></td>
<td>Government’s organization and procedures for managing the contractual</td>
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<td>system and its impact upon participating private industry. Implication of</td>
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<td>the contractual system on the political, economic, and social system-</td>
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<td>individual states, small business, minority groups, and labor employment</td>
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<td></td>
<td>areas.</td>
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<tr>
<td>634</td>
<td>Seminar in Administrative Science</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Social and behavioral concepts applicable to leadership, motivation,</td>
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<td></td>
<td>morale, decision-making, and communication. Student’s individual research</td>
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<td>projects based on their own investigation. Integration and application of</td>
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<td></td>
<td>acquired knowledge. Prerequisite: Administrative science majors with 27</td>
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<td></td>
<td>credit hours toward the degree including 15 credit hours of core courses.</td>
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<tr>
<td>635</td>
<td>Administrative Science Internship</td>
<td>1-3 hrs.</td>
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<td>Management internships will provide the opportunity to observe and</td>
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<td>participate in local industries and organizations. Students will be</td>
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<td>required to keep a log of activities and submit a final report. Prerequisite:</td>
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<td>minimum of 12 hours completed in AS Program.</td>
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<td>650</td>
<td>Selected Research Topics</td>
<td>3 hrs.</td>
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<td></td>
<td>Research in a particular topic relevant to administrative science by one</td>
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<td></td>
<td>student or a group of students. The research paper must be an original</td>
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<td>contribution showing a research design and results that meet the highest</td>
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<td>standards of social science research. Prerequisite: completion of 15 hours</td>
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<td>of student’s curriculum and approval of the College’s Graduate Program</td>
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<td></td>
<td>Advisory Committee.</td>
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<tr>
<td>698</td>
<td>Strategic Management</td>
<td>3 hrs.</td>
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<td></td>
<td>Administrative decision making with emphasis on analyzing a complex</td>
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<td>business situation, evaluating historical trends, current operational</td>
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<td>conditions, and environmental settings, in order to establish: a unifying</td>
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<td>strategy; implementation of integrated functional policies; and a plan of</td>
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<td>action to achieve established objectives. Prerequisites: Completion of all</td>
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<td></td>
<td>management core and option courses.</td>
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<tr>
<td>699</td>
<td>Masters Thesis</td>
<td>3 hrs.</td>
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<td></td>
<td>Required each term the student is working and receiving direction on his/</td>
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<td>her masters’ thesis. Maximum of six hours credit may be applied toward the</td>
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<td>degree. Prerequisites: Completion of core and major option.</td>
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</table>

Management Information Systems (MIS)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>507</td>
<td>Accounting Information Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Design, operation, analysis of accounting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>information systems with respect to data input,</td>
<td></td>
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<tr>
<td></td>
<td>processing, storage, recall, security,</td>
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<td></td>
<td>internal control, and the audit trail. Emphasis</td>
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<td></td>
<td>is on computer-oriented systems. Prerequisites:</td>
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<td></td>
<td>ACC 212, MIS 301. Lab fee Level 3. (Same as ACC</td>
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<td></td>
<td>507).</td>
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<tr>
<td>574</td>
<td>Information System Planning</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>An introduction to the financial, technical and</td>
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<td>strategic information systems planning processes.</td>
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<td>Prerequisites: MIS 411 or approval of AS</td>
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<td></td>
<td>Graduate Coordinator.</td>
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</tbody>
</table>
575 Information Resource Management 3 hrs.
A seminar course providing a broad overview of the information systems management function. Prerequisites: MIS 470 or approval of AS Graduate Coordinator. Lab fee: Level 3.

609 Introduction to Management Information Systems 3 hrs.
Examines the role management information systems play in organizations including design, planning for, implementation and use of the management information systems. Applications and examples will be from administrative science areas. Open only to MAS students without background in computer usage and information systems. Prerequisite: graduate standing.

617 Modeling and Decision Systems 3 hrs.
The use of information systems in decision making and performance evaluation. Behavioral aspects of decision making in the decision support environment. Prerequisites: MIS 340, 400, or approval of AS Graduate Coordinator.

634 Seminar in Management Information Systems 3 hrs.
Extensive readings and research into current developments and trends on management information systems. Prerequisites: Administrative Science majors with 27 hours toward the degree including 15 hours of core courses.

640 Seminar in Data Base Management 3 hrs.
Management of data as a resource. Development of a conceptual framework to evaluate, select, acquire, install and maintain commercial data base management packages for use in MIS. Data structures, data storage, data representation, data flow, data dictionaries, expert systems and programming languages are explored. Prerequisite: MIS 310 or equivalent. Lab fee Level 3.

660 Seminar in Telecommunication & Distributed Processing 3 hrs.
Overview of geographically distributed computer-communications facilities. Network design, structure and optimization are addressed. Regulated common carriers, data transmission, routine techniques, reliability, protocols, error detection, modems and controllers are included. Prerequisite: MIS 609. Lab fee Level 2.

672 Seminar in Systems Design Process 3 hrs.
Course is designed to integrate the areas of computer technology, system analysis, systems design and organizational behavior to aid the student in designing large scale application or decision support systems. Prerequisite: MIS 640. Lab fee Level 2.

699 Master's Thesis 3 hrs.
A course required each term a student is working and receiving direction on a master's thesis. A minimum of two terms is required but no more than six hours credit is allowed for the thesis. Credit awarded upon successful completion of thesis. Prerequisites: Common body of knowledge as defined in graduate catalog and completion of Administrative Science core courses.

Management Sciences (MSC)

570 Seminar in Production Management 3 hrs.
Seminar on current topics related to production management, such as materials requirements planning, flexible manufacturing systems, Japanese management systems, robotics. Lab Fee: Level 3. Prerequisites: CS 113, MSC 325, MSC 386, or approval of AS Graduate Coordinator.

608 Quantitative Methods I 3 hrs.
Administrative applications of quantitative methods including sampling, linear regression and correlation time series analysis, queuing, simulation, linear programming. Prerequisites: MSC 287 or equivalent and MIS 609 or equivalent, Lab fee: level 2.

640 Principles of Project Management 3 hrs.
The conceptual foundation and organization of project management. The project life cycle, planning, control, and financial management.
641 Applied Project Management 3 hrs.
Continuation of material developed in MGT 640. Project management as a career field, project initiation, and the project plan. Insight into the intricacies of organizing for project management. Techniques for controlling the three major parameters of project performance and consideration of substantive aspects of interpersonal management.

642 Quantitative Applications in Project Management 3 hrs.
For technical and nontechnical students, many of the quantitative techniques used in contemporary project management. Systems, cost, and consequence analysis and schedule methodology, as well as the critical topic of system integration.

643 Simulation of Project Management 3 hrs.
Federal and industrial decision-making, student participation in a simulation exercise involving a critical review point in the project life cycle, and current issues in project management.

645 Applications of Artificial Intelligence and Decision Making 3 hrs.
Basic concepts of the application of artificial intelligence to the decision making process. Prerequisites: MSC 643 and MIS 609.

648 Management of Computer Integrated Manufacturing 3 hrs.
Covers the implementation of computer integrated manufacturing. Pays particular attention to the human element and its interaction with advanced production technologies. Prerequisites: MSC 643 and MGT 622.

650 Selected Research Topics 3 hrs.
Research in a particular topic relevant to management's size by one student or a group of students. Each student's research paper must be an original contribution showing a research design and results that meet the highest standard of management science research. Prerequisites: MSC 608, 12 additional credit hours of graduate courses; and approval of the AS Graduate Coordinator.

651 Quantitative Methods II 3 hrs.
Study of organizational production and operation problems and techniques applied in solving them. Capacity planning, location and distribution demand forecasting, inventory control, maintaining system reliability, process and job design. Prerequisite: MSC 608.
Marketing (MKT)

515 International Marketing 3 hrs.
Procedures and problems associated with establishing and carrying our marketing operations in or with foreign companies. Institutions, principles, and methods involved in solving these business problems. Effect of national differences in business practices and regulation. Prerequisite: approval of AS Graduate Coordinator.

570 Seminar in Marketing 3 hrs.
Review of selected classics in the literature. Recent developments in marketing theory and application to marketing problem solving. Prerequisite: graduate standing and approval of AS Graduate Coordinator.

580 Marketing Management 3 hrs.
Management of marketing function of the firm: determination of objectives, organization and controls for effective utilization of marketing resources in coordinated effort with other major functional areas. Identification and selection of market opportunities. Competitive strategies and development of marketing policies and programs. Prerequisites: 15 hours in marketing or MKT 606, or approval of AS Graduate Coordinator.

606 Marketing Administration 3 hrs.
Development of analytical concepts and principles to design efficient strategies for solving marketing problems; major policy areas of product, price, channels, and promotion integrated in development of the firm's total marketing effort; includes application of non-profit organizations. (Not open to students who have taken MKT 301.) Prerequisite: graduate standing.
College of Engineering

Degrees: Master of Science in Engineering
Master of Science in Operations Research
Doctor of Philosophy

Interim Dean: R. M. Wyskida, Professor of Industrial and Systems Engineering
Assistant Dean: K. O. Thompson, Associate Professor of Mechanical Engineering

Engineering is the profession which translates scientific thought into reality. Through creative synthesis, analysis and design, the engineer produces systems, processes, and products for society's benefit.

The College of Engineering is based in an established urban area, and also in the state's high technology center. Close proximity to NASA's Marshall Space Flight Center, Redstone Arsenal, and much of Alabama's fastest-growing technological industry gives the College of Engineering a special character that leads to uncommon educational opportunities. This special setting, combined with high-quality faculty, affords maximum growth potential for those desiring an advanced engineering education.

Graduate Degrees and Programs

The College of Engineering offers programs leading to the degrees of Master of Science in Engineering, Master of Science in Operations Research, and Doctor of Philosophy. Specializations for the M.S.E and Ph.D. are in the following areas:

Communications and Information Theory
Control Sciences
Digital and Analog Computer Engineering
Electromagnetic Fields
Network Theory
Optical Engineering
Solid State Electronics
Engineering Management
Human Engineering
Reaction Engineering
Composites
Manufacturing Systems Engineering
Materials Engineering
Operations Research
System Engineering
Applied Mechanics
Energy/Power
Environmental Engineering
Solar Terrestrial Environment System
Thermodynamics, Heat & Mass Transfer
Process Dynamics
Structural Engineering

Admission Requirements

In addition to the admission requirements specified by the School of Graduate Studies, the following are further requirements for admission to graduate study in engineering.

1. For unconditional admission, a student is required (1) to have earned a minimum of a B average in all undergraduate work attempted and in all
engineering courses, (2) to have scored at least 1000 on the aptitude (verbal and quantitative) portion of the GRE, and (3) to have received a Bachelor's degree in an engineering curriculum accredited by the Accreditation Board for Engineering and Technology at the time the degree was conferred. Exceptions to (3) are permissible for students in the Master of Science in Operations Research degree program.

2. Conditional admission may be granted to other students who have baccalaureate degrees and, after evaluation of the quantity and quality of their work by the major department, are considered to be prepared and capable of successfully pursuing graduate work. To continue graduate study, students admitted conditionally are required to maintain at least a B average in their first 12 semester hours of graduate coursework and to remove any other conditions imposed at the time of initial enrollment.

3. Students admitted to the university as irregular postgraduates but denied admission to Graduate School because of a deficiency in quality point average or GRE score may be reconsidered for graduate admission if they are otherwise eligible to pursue a particular engineering discipline. To be reconsidered, they must successfully complete 12 hours of courses numbered 500 or above (as recommended by the department into which admission is sought) in engineering, mathematics, or science with an average of B or better.

**Master of Science in Engineering**

**Master of Science in Operations Research**

The following general requirements for the Master's degree are specified by the College of Engineering beyond those required by the School of Graduate Studies:

1. Average grade on the courses numbered 600 and above cannot be less than B.

2. Engineering courses numbered between 500 and 599 may be taken for graduate credit with prior approval of such courses on the student's plan of study. Graduate students will be required to do extra work of appropriate nature in 500-level courses. A minimum grade of B must be attained in each engineering course designated by a number less than 600 in the plan of study; otherwise a substitution of another approved course is necessary.

3. All courses are selected by students with the counsel of advisors and are subject to approval by the appropriate department chairman and the Dean of the School of Graduate Studies. Additional coursework may be required to correct deficiencies in undergraduate subjects.

4. Each department may require one or more seminar courses in addition to other requirements.

Upon admission to graduate study by the Dean of the School of Graduate Studies, students will be referred to the appropriate department chairman. A
supervisory committee, which usually is but does not have to be the same as the final examining committee, should be appointed after students have completed 12 semester hours.

**Special Requirements For The M.S.E. Degree: Basic Program Of Study**

The basic program of study, common to both Plan I and Plan II, contains a minimum of 24 semester hours of graduate-level coursework that must include (a) 12 hours of graduate courses in an engineering major, including supporting engineering courses; (b) first minor of 6 hours in an approved engineering area of specialization, (c) second minor of 6 hours in an engineering area other than those in (a) and (b) above or in any approved graduate area.

With prior approval, up to 12 hours of courses numbered 500–599 may be taken in fulfillment of these requirements.

**Plan I (Thesis).** Students selecting this plan must (a) successfully complete an approved basic program of study, (b) complete an acceptable thesis, (see statement with each 699 course), and (c) publicly present and defend the thesis.

**Plan II (No Thesis).** Students planning to complete degree requirements under Plan II must (a) be admitted to the Plan II program, (b) successfully complete an approved basic program of study, (c) successfully complete an approved extended program of study consisting of a minimum of 9 semester hours of courses numbered 500 or above, and submit an acceptable paper on independent work, and (d) pass a comprehensive final examination. Under certain conditions students may satisfy the degree requirements by satisfactorily completing thirty-six hours. A comprehensive oral exam is required for all options.

**Doctor of Philosophy**

Programs leading to the degree of Doctor of Philosophy are offered in the College of Engineering and are granted on the basis of general scholarly proficiency, distinctive achievement in a special field, and demonstrated ability to do independent, original investigation. These attributes are tested in comprehensive examination and in a dissertation that must clearly and effectively present the substantial results of research. These accomplishments, rather than mere accumulation of residence and course credits, are essential considerations in awarding the Ph.D. degree.

**Admission**

Ph.D. candidates must be admitted to the School of Graduate Studies before being admitted to the Ph.D. program. Admission is limited to those whose backgrounds show distinct promise of success in the program.
Examinations

Students must pass three examinations before being awarded the degree. They are:

1. The preliminary examination (or entrance examination) is a written test of the student’s capability to pursue successfully the Ph.D. and aids in developing a program of study appropriate for the student. The examination may be taken at any time after the accumulation of at least 24 semester hours of graduate work beyond the baccalaureate degree and is administered by the student’s department. Upon the recommendation of the department, a student who fails this examination may repeat it after a lapse of three months. The examination may not be taken more than twice.

2. The qualifying examination (or comprehensive examination) is a written and oral test of the student’s knowledge in the major and minor fields of study and is administered by the applying student’s advisory committee. An applicant must pass this examination to be admitted to candidacy for the Ph.D. degree. The following must be completed before taking the examination: (1) foreign language requirement, (2) basic program of study, (3) at least 18 hours of coursework in residence at UAH subsequent to passing the preliminary examination, and (4) advisory committee’s assurance of adequate preparation in the major and minor fields.

3. The final examination (or dissertation examination) primarily concerns research work in the candidate’s dissertation and will be taken after the dissertation has been approved by the advisory committee.

Advisory Committees

A faculty advisor appointed by the chairman of the department directs a student’s work until the preliminary examination is successfully completed. Thereafter the student immediately chooses an advisory committee, subject to acceptance by the faculty members chosen and approval by the Dean of Graduate Studies. This committee consists of at least five members of the graduate faculty—three representing the major field of study and one from each of the minor fields. The committee chairman must be a permanent faculty member.

Program of Study

Students should prepare an outline of the program of study as early as possible after the successful completion of the preliminary examination.

Major and Minor Subjects

A defined major subject or field of specialization is required of all candidates for the Ph.D. degree. The candidate must also have at least two minor subjects chosen with approval of the candidate’s advisory committee. One of the minors must be Mathematics, and/or engineering mathematics as defined by the student’s department. A mathematics professor may be invited to join the committee.
All students must complete at least 60 semester hours of graduate coursework. At least 33 semester hours must be in work within related departments, including credits for the major. Of these 33 semester hours, at least 18 must be within a defined major. Of the remaining 27 semester hours, a minimum of 15 semester hours of work is required for the first minor and a minimum of 12 semester hours for the second.

Transfer of Credits

Credits from other recognized institutions may be applied to the student’s program of study if so approved by the student’s advisory committee and by the Dean of Graduate Studies. These credits will generally not be evaluated until the student has been in residence study at UAH for at least one term and has passed the preliminary examination.

Admission to Candidacy for the Degree

A student should apply for admission to candidacy for the Ph.D. degree after passing the qualifying examination and obtaining approval of the dissertation subject from his advisory committee. The student must be admitted to candidacy at least six months before the degree is awarded.

Residence Requirements

The minimum period in which the doctoral degree can be earned is three full academic years in graduate study or their equivalent. The student must complete a minimum of 24 semester hours of graduate work in three consecutive terms during the second or third year, or both, of graduate study in the School of Graduate Studies at UAH. Half-time graduate assistants are required to complete a minimum of 18 hours of graduate work in three consecutive terms.

Language Requirements

The student must satisfy the language requirement before applying for permission to take the qualifying examination in one of the ways specified by the School of Graduate Studies.

Dissertation Registration

Students must register for a minimum of 18 semester hours of dissertation supervision during the time they are actively conducting research and consulting their dissertation advisor.
Electrical and Computer Engineering

Degrees: Master of Science in Engineering
        Doctor of Philosophy

Chair: Alexander Poularikas, Professor; electro-optics, digital and optical systems; communications.

Professors:
Audeh, N.F.; microwaves, antennas and fiber optics.
Biggs, A.W.; microwaves, antennas, remote sensing.
Halijak, C.A.; analog and digital computers, network synthesis and controls.
Kheir, N.A.; controls and networks; modeling, credibility of models.
Polge, R. J.; communications, radar, computer engineering, digital and optical systems

Research Professor:
Johnson, R.B.; electro-optics, infrared systems.

Associate Professors:
Ho, F.D.; solid state and electronics, VLSI design and modeling, digital hardware.
Thurstone, R.L.; networks.
Singh, N.; electromagnetics, plasmas, antennas.
Stern, H., (Adjunct); communications and controls.

Assistant Professors:
Abushagur, M.; electro-optics, electromagnetics, optical computers.
Adhami, R.; digital systems, signal processing.
Katsinis, C.; computer systems, image processing, pattern recognition.
Mirsalehi, M.; electro-optics, optical computers, electromagnetics.
Mohadjer, M.; controls and networks, robotics.
Stensby, J.; communications, signal analysis.

Lecturer:
Jones, C.; circuits and systems.

Electrical engineering today is concerned with the broad problem of generating, transmitting, receiving, and processing information and energy. Emphasis in the department is on "information" related areas: Antennas and Microwaves, Communications and Signal Processing, Computer Engineering, Control and System Theory, Electronics, Network Theory, and Solid State Devices. New thrust areas under development include optical engineering and robotics.
The faculty is active in publications and funded research. Support is available at attractive levels in the form of graduate teaching or research assistantships, and graduate Co-op’s with local industrial firms or government agencies.

**Admission Requirements**

For unconditional admission to the Electrical and Computer Engineering graduate programs, an Electrical Engineering Bachelor’s degree from an ABET accredited program is required, with a grade point average of at least 3.00 and a GRE score of 1000 (verbal plus quantitative). Outstanding non-EE graduates with Bachelor’s degrees in another engineering field, mathematics, computer or natural sciences, may be admitted to the ECE graduate programs if they take additional courses to satisfy certain minimal proficiency requirements in basic electrical engineering subject matter.

**Degree Requirements**

Like the general graduate school requirements, the MSE has two options: plan I which requires twenty-four of coursework hours plus thesis, or plan II of thirty-three hours plus a technical paper. Under certain conditions students may satisfy the degree requirements by satisfactorily completing thirty-six hours. A comprehensive oral exam is required for all options.

To be admitted to the Ph.D. program, students must pass a written preliminary examination. At the end of the coursework, Ph.D. students must pass a qualifying examination, which includes a written examination of the major and two minors, and a comprehensive oral. Finally, a student must write an acceptable dissertation which must be defended in front of the supervisory committee.

**Undergraduate EE Courses (partial listing)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>Electrical Circuits I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>307</td>
<td>Electricity and Magnetism</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>311</td>
<td>Electronic Instrumentation</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>313</td>
<td>Electrical Circuits II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>315</td>
<td>Electronics I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>382</td>
<td>Analytical Methods for Continuous Time Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>383</td>
<td>Analytical Methods for Multivariable and Discrete Time Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>402</td>
<td>Design of Digital Computer</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>407</td>
<td>Electromagnetic Waves</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>411</td>
<td>Electric Power Systems</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>414</td>
<td>Passive Electrical Networks</td>
<td></td>
</tr>
<tr>
<td>416</td>
<td>Electronics II</td>
<td></td>
</tr>
</tbody>
</table>

**Graduate EE Courses**

Courses at the 500 level are taken by seniors and first year graduate students. Up to 12 hours of 500 level courses may count towards a graduate degree with prior approval by the program committee. Courses at the 600 and 700 level are open only to graduate students.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>501</td>
<td>Electric Machines</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Direct and alternating current machines equivalent circuits and models, efficiency, input requirements and output characteristics, applications; graphical and mathematical aspects of electrical machines. Prerequisite: EE 313.</td>
<td></td>
</tr>
<tr>
<td>502</td>
<td>Advanced Logic Circuits</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Boolean algebra; the n-cube, star array, Karnaugh arrays; one-to-one transformations, partial transformations, DON'T-CARES; symmetric switching function synthesis and reduction with applications to multiple input adders; generator theory of flip-flops and stability condition; serial arithmetic and the binary comparator. Prerequisite: EE 202.</td>
<td></td>
</tr>
<tr>
<td>504</td>
<td>Instrumentation</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Measurement techniques and conventional and electronic instruments. Construction, theory of operation, and proper use of bridge circuits, oscilloscopes, transducers, and digital instruments. Prerequisite: EE 315.</td>
<td></td>
</tr>
<tr>
<td>505</td>
<td>Introduction to Control and Robotic Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>The basic theories and analytical techniques for modeling, analysis and control of dynamical systems. Transfer functions, block-diagrams, frequency response, stability criteria, series and feedback controller design, digital control. Introduction to the dynamic analysis and control of robotic systems. Prerequisite: EE 382 or permission of Instructor. (Same as EE 425.)</td>
<td></td>
</tr>
<tr>
<td>506</td>
<td>Communication Theory</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Transmission of information including effects of networks, modulation systems, noise, and use of statistics in analysis of information transmission. Prerequisite: EE 382.</td>
<td></td>
</tr>
<tr>
<td>509</td>
<td>Microcomputers</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>The microcomputer as a component in digital design. Laboratory experience in interfacing and design projects. Lab fee: Level 3. Prerequisites: EE 202 and 315; EE 516 recommended.</td>
<td></td>
</tr>
<tr>
<td>510</td>
<td>Selected Topics in Electrical Engineering</td>
<td>Credit to be arranged</td>
</tr>
<tr>
<td>512</td>
<td>Advanced Senior Design Project in Electrical Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Individual design project under the direction of an EE faculty member. Lab fee: level 3. Prerequisite: Senior standing.</td>
<td></td>
</tr>
<tr>
<td>513</td>
<td>Computer Simulation of Dynamic Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Techniques for analyzing the behavior of dynamic systems and processes using analog and digital computer simulation procedures. Emphasis on modern digital simulation techniques, including digital simulation languages. Review of modeling and model simplification techniques for lumped-parameter and continuum dynamic systems. Laboratory demonstrations and exercises. Prerequisites: EE 382/383. Lab Fee: Level 3. (Same as EE 433.)</td>
<td></td>
</tr>
<tr>
<td>516</td>
<td>Digital Electronics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Electronic devices. Integrated-circuit logic families (DTL, TTL, etc.) and their design theory. MOSFET circuits and their design theory. Flip-flop, registers and counters. Arithme-</td>
<td></td>
</tr>
</tbody>
</table>

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Prerequisites: EE 202, 310, 315.

519 Digital Electronics Laboratory 1 hr.
Experiments and reports related to logic circuit realization of digital hardware. RTL, DI, TT, ECI families for combinational and sequential switching circuits. Lab fee: Level 4. Must parallel EE 516.

532 Optical Systems Design 3 hrs.
Introduction to the geometrical design and analysis of optical systems, and to the design principles of lens systems. Prerequisite: EE 541 or equivalent. Lab Fee: Level 5. (Same as EE 452.)

541 Optics I 3 hrs.
Review of basic optics; Electromagnetic waves; Huygen’s principle; Fresnel’s laws, geometrical optics, optical systems; polarization and optical fibers. Prerequisite: EE 307. (Same as PH 541 and EE 461.)

542 Optics II 3 hrs.
Physical optics, and Electro-optics. Interference, Michelson & Febry-Perot interferometers; optical fiber gyros and sensors; Fraunhofer and Fresnel diffraction; coherence theory; light sources, lasers, optical detection and modulation. (Same as PH 542 and EE 462). Prerequisite: EE 541.

595 Microcomputer Development Systems 3 hrs.
A course on the development of general purpose stand-alone microprocessor systems using a microprocessor development system. Prerequisites: EE 509, 402. Lab fee. Level 4.

600 Bit-Slice Design 3 hrs.
Theoretical and practical aspects of computer hardware design using AMD 2900 family bit-slice components. Lab fee: Level 3. Prerequisite: EE 509.

601 Linear Systems 3 hrs.
Formulation and solution by transform methods of differential equations of linear electrical and electromechanical systems, state equations, signal-flow graphs, and discrete-time systems. Prerequisite: graduate standing.

602 Digital Computer Design 3 hrs.

603 Computer Methods in Power Systems 3 hrs.
System modeling and matrix analysis of three-phase power networks. Application of numerical methods and computers to solution of problems related to planning, design, and operation of electric-power systems. Prerequisites: EE 411 and 501.

604 Digital Image Processing 3 hrs.

605 Control System Design 3 hrs.
Control system synthesis by means of feedback, feedforward, minor loop, and cascade techniques. System designs by analog simulation. Laboratory sessions. Lab fee: Level 3. Prerequisite: EE 505.

606 Statistical Communications Theory 3 hrs.
Robotic Systems Control 3 hrs.
An in-depth study of information, decision and control problems associated with robotic
system design. Sensor systems, recognition and decision algorithms, kinematics and
dynamics, trajectory planning, analog and digital controllers, adaptive and optimal control.
Prerequisite: EE 425/505.

Electromagnetic Field Theory I 3 hrs.
Mathematical approach to electromagnetic phenomena. Basic field concepts. Radiation and
propagation. Waveguides and simple radiating and scattering systems. Perturbational and
variational techniques. Prerequisite: EE 407.

Electromagnetic Field Theory II 3 hrs.
Continuation of EE 608. Prerequisite: EE 608.

Selected Topics in Electrical Engineering Credit to be arranged.

Graduate Design Project 3 hrs.
Graduate design project in support of an MSE program. Prerequisite: approval by MSE
committee. Lab fee: Level 3.

Laser Electronics 3 hrs.
Resonant optical cavities. Atomic radiation. Laser oscillation and amplification. General
site: EE 416 or 516.

Linear Graphs and Electrical Networks 3 hrs.
Linear-graph theory with applications to electrical network theory. Classical network
equilibrium equations, formulation of state equations, topological formulas for network
functions, signal-flow graph method of circuit, and system analysis. Prerequisite: EE 414.

Active Networks Synthesis 3 hrs.
Properties and synthesis of RC and LC networks, active network elements, RC active filter
design, network sensitivity analysis, realization methods, approximation theory, and filter
design. Prerequisite: EE 414.

Microelectronic Devices and Integrated Circuits 3 hrs.
Solid-state theory applied to the analysis and design of devices for integrated circuits.
Properties of semiconductors important to solid-state device operation. Analysis and
modeling of MOS devices and circuits. Analysis and modeling of: metal-semiconductor
devices, junction diodes, bipolar transistors. Device-fabrication technology. Prerequisite: EE
516.

Very Large Scale Integration Devices 3 hrs.
Discussion of MOSFET characteristics. Second-order considerations for a MOSFET, Com­
puter modeling, VLSI device fundamentals, and scaling laws. Micron-length and submicron-
length semiconductor devices. Gallium arsenide (GaAs) digital integrated circuits for
ultra-high speed VLSI. Basic technology and applications of VLSI. Impact of VLSI on
computer architectures. VLSI computer aided design. Prerequisite: EE 616 or equivalent.

Very Large Scale Integrated (VLSI) Circuits 3 hrs.
The VLSI design route; MOS device electronics; MOS processing and design rules; circuit
design with MOS; MOS circuit technique; clocks and communication; circuit techniques for
array structures; system design styles and chip engineering; computer aids to design.
Prerequisite: EE 516 or equivalent. Lab Fee: Level 3.

Introduction to Radar Systems 3 hrs.
Topics include radar equation, CW radar, MTI and pulse doppler radar, tracking radar,
major systems components, detection in the presence of noise and clutter, ambiguity, and
resolution. Prerequisite: EE 606 or equivalent.

Detection of Optical and Infrared Radiation 3 hrs.
Thermal radiation and electromagnetic modes; ideal photon detector; coherent detection;
amplifier noise and its effect on detector performance; noise and efficiency of semiconductor devices; thermal detection; detection statistics. Prerequisite: EE 506 or equivalent. Lab Fee: Level 5.

632 Coherent Optical Systems and Holography 3 hrs.
Introducing the optical system as an invariant linear system, Sommerfeld's diffraction integral, propagation of Gaussian beams, coherence theory, frequency analysis of the optical imaging systems, image formation using coherent and incoherent light, on-axis and off-axis holography, and non-destructive testing using Fourier optics and holographic techniques. Prerequisite: EE 531 or equivalent. Lab Fee Level 5.

634 Optical Communications 3 hrs.
Optical communication systems; counting statistics; the optical detector response process; direct detection; heterodyne detection parameter estimation in optical communications; pointing, spatial acquisition and tracking. Prerequisite: EE 506 or equivalent. Lab Fee: Level 5.

635 Fiber Optics 3 hrs.
Propagation in dielectric slab and fibers with step and graded index of refraction; electromagnetic and ray optical methods; eikonal equations; ray trajectory; WKB method; paraxial approximation; weakly guiding structures. Prerequisites: EE 608, 609 or a graduate level EM Theory course. Lab Fee: Level 5.

642 Data and Digital Communications 3 hrs.
Introduction to digital and data communications; transmission channels; modulation and coding; telephone networks; data communication standards; noise and distortion; computer interfacing; protocols. Prerequisite: EE 506, 509. Lab Fee: Level 5.

645 Modulation and Phase Locked Techniques in Communication 3 hrs.

699 Master's Thesis 3 or 6 hrs.
Required each term student is working and receiving direction on his master's thesis. Minimum of two terms and 6 hours required for MSE students. A maximum of 9 hours of credit is awarded upon successful completion of master's thesis.

700 Sampled Data Control Systems 3 hrs.
Classical and modern methods for analysis and design of sampled data-control systems; Z-transforms, transport lags, z and w plane analysis, state variables, and the transition matrix. Prerequisite: EE 701.

701 Advanced Linear Control Theory 3 hrs.
Modern techniques for analysis and design of linear control systems. Matrix formulation, multivariable control systems, state variable concepts. Linear transformation, controllability, observability, discrete-time systems. Prerequisite: EE 605 or permission of instructor.

702 Theory of Automata 3 hrs.
Linear automata, efficient and inefficient coders analyzed with Z-transforms and cyclotomic polynomials. State description of autonomous automata. Multilinear automata and various machines. Prerequisite: EE 602.

703 Disturbance-Accommodating Control 3 hrs.
The theory and application of disturbance-accommodating control. Topics covered include the nature of disturbances in control problems; mathematical modeling of uncertain disturbances, modes of disturbance-accommodation, real-time disturbance observers, design of disturbance-accommodating feedback/feedforward control laws, adaptive control for internal disturbances; case-studies in disturbance-accommodation. Prerequisite: EE 701.

704 Nonlinear Control Systems 3 hrs.
Classical and modern methods for analysis and design of nonlinear automatic control
systems. State variables, phase plane, limit cycles, stability, describing functions, relay control, stabilization theory. Prerequisite: EE 701.

705 **Theory of Optimal Control** 3 hrs.
General theory of optimal control of dynamic processes. Calculus of variations. Hamilton-Jacobi theory. Pontryagin's maximum principle, dynamic programming. Prerequisite: EE 701 or approval of instructor.

706 **Stochastic Control Theory** 3 hrs.
The analysis and control of dynamical processes subject to random inputs, noisy measurements and uncertain parameter variations. Topics studied include the mathematical theory of random processes, linear operations on random processes, Wiener and Kalman filtering theories, the LQG control problem, the Separation Principle, the identification problem. Prerequisite: EE 701.

707 **Information Theory** 3 hrs.
Self-information, entropy, mutual information, and channel capacity, encoding, error detecting and correcting codes. Sampling theorem. Discrete and continuous channels. Prerequisite: EE 506.

708 **Digital Signal Processing** 3 hrs.
Theory and applications of signal processing by digital techniques. Difference equations, Z-transform theory, digital-filter design, fast Fourier transform, quantization effects, and discrete estimation. Applications in digital filtering, signal processing, data analysis and smoothing, and image processing. Prerequisite: EE 606 or 614 or 605 or 602.

710 **Selected Topics in Electrical Engineering** Credit to be arranged.

711 **Antenna Theory** 3 hrs.
Antennas and antenna arrays. Radiation patterns and impedance characteristics. Spheres, cylinders, horns, slots, microwave lenses, traveling-wave, and frequency independent antennas. Prerequisite: EE 608.

715 **Digital Filters with Switched Capacitors** 3 hrs.
Finite Time Laplace Transforms describe the reverse-switched and switched capacitors as current-voltage elements. Discretizations or resistors in RC passive and active networks. Realization of inductors and supercapacitors with operational amplifiers enables discretization of RLC filters. Prerequisite: EE 615.

716 **Device Modeling for Integrated Circuit Design** 3 hrs.

717 **Space Applications of Electromagnetics** 3 hrs.
Plasma as a dielectric; dielectric functions for cold, warm, isotropic and anisotropic plasmas, body-plasma interaction; space craft electrodynamics, antennas in plasmas; mode of radiation, input impedance and radiation pattern, scattering problems involving plasmas. Prerequisites: EE 608 or ME/PH 531 or permission of instructor.

718 **Microwave Techniques** 3 hrs.

719 **Advanced Electromagnetic Field Theory** 3 hrs.
Classical theory of electricity and magnetism. Potential theory, time-varying fields, boundary-value problems, stresses, theory of relativity. Prerequisite; EE 609. Lab fee: Level 5

720 **Computer-Aided Design of Multivariable Systems** 3 hrs.
Review of transfer function realization; controllability and observability; eigenstructure-
assignment; state feedback control; output feedback control; design with state observers; decoupling control; generalized design techniques; discrete-output feedback; applications. Prerequisite: EE 701.

721 Control Engineering for Large-Scale Systems 3 hrs.
Time-domain and frequency-domain modeling; control engineering techniques for multi-level (heirarchical) control of large scale systems; system aggregation, decomposition; decentralized control; robust and stochastic control; structural control problems; effects of unmodeled dynamics. Prerequisite: EE 701.

722 Adaptive and Self-Organizing Control 3 hrs.
Adaptive and self-organizing control techniques for deterministic and stochastic systems including model reference adaptive control; adaptive observers and optimal state estimation; on-line parameter identification; parameter adaptive and performance-adaptive controllers; stability of adaptive algorithms; introduction to learning control systems. Prerequisite: EE 701.

725 Advanced Radar Techniques 3 hrs.
Modern radar systems for search and tracking are analyzed with emphasis on signal processing. Modeling and simulation of system and environment are discussed. Advanced techniques include CFAR, binary modulation, frequency agility, polarization agility, and synthetic aperture. Prerequisite: EE 619 or equivalent. Lab Fee: Level 5.

726 Decision and Estimation Theory 3 hrs.
Classical detection theory, including maximum likelihood, Neyman-Pearson, Bayes and minimax criteria. Estimation theory concepts and criteria, linear estimators, Kalman filters, maximum likelihood and least-squares estimator, matched filters, Cramer-Rao lower bound. Introduction to pattern recognition. Prerequisite: EE 606 or equivalent.

727 Numerical Methods in Electromagnetics 3 hrs.

735 Statistical Optics 3 hrs.
Introduction to random variables and random processes; first-order properties of light waves; coherence of optical waves, partial coherence and imaging systems, imaging in randomly inhomogeneous media, fundamental limits in photoelectric detection of light. Prerequisite: EE 506. Lab Fee: Level 5.

737 Channel Characterization and Communication in Random Media 3 hrs.
Modeling stationary and not strictly stationary random media; scatter communications channels; line of sight communication channels—weak scattering and strong scattering. Prerequisite: EE 506 and 608 or equivalent. Lab Fee: Level 5.

738 Optical Transforms and Pattern Recognition 3 hrs.
Systems and transforms in diffraction theory; two-dimensional Fourier transform; Hankel transforms; generalized Hankel transforms; optical signals, correlation coherence; filtering; apodization; applications to optical pattern recognition. Prerequisite: EE 632 or equivalent. Lab Fee: Level 5.

744 Digital Communication and Spread Spectrum 3 hrs.

747 Random Fields, Image Processing and Pattern Recognition 3 hrs.
Fundamental analysis of random fields; second-order analysis of homogeneous random fields; spectral parameters, level average processes; image restoration; texture analysis and pattern recognition; parameter estimation in space-time domain. Prerequisite: EE 641 or equivalent. Lab Fee: Level 5.

799 Doctoral Dissertation 3-6 hrs.
Industrial and Systems Engineering

Degrees: Master of Science in Engineering  
Master of Science in Operations Research  
Doctor of Philosophy

Chair: R.A. Brown, Professor; systems engineering, microcomputer applications, applied statistics.

Professor:  
Wyskida, R.M.; operations research, engineering economic analysis.

Associate Professors:  
Dorsett, M. (adjunct); operations research, statistics.  
Lovett, J.N.; operations research, work design, manufacturing processes.  
Walker, J.R.; engineering management, engineering economy, applied statistics.  
Yarbrough, L.S.; simulation, statistics, operations research.

Assistant Professor:  
Lawler, P. (adjunct); engineering economy, quality control.

The Department of Industrial and Systems Engineering encourages students to tailor their graduate programs with a blend of theory and applications. Major and minor subject areas within the department are Applied Statistics, Engineering (Technical) Management, Manufacturing Systems, Operations Research, and Systems Engineering. The Master of Science in Operations Research (M.S.O.R.) degree is specifically intended for students with undergraduate degrees in science or mathematics who do not desire to take the additional undergraduate engineering courses needed to qualify for the MSE degree.

The Engineering Management Option meets the needs of practicing engineers who find themselves performing engineering management functions without the benefit of formal management education. The program builds upon the mathematical and analytical expertise gained from both a formal engineering education and professional experience.

The Systems Engineering Option is for persons with a Bachelor's degree in a traditional engineering area who desire to broaden their background into systems-oriented aspects of engineering. Methods of needs identification, cost-benefit analysis, the system life cycle concept, quality control, logistics planning and control, forecasting, etc., will provide students with the analysis and design tools to supplement those learned in their baccalaureate engineering degree program. Admission and degree requirements are those outlined by the School of Graduate Studies and the College of Engineering.
The M.S.O.R. Degree

The Master of Science in Operations Research (M.S.O.R.) is primarily for graduate students with an interest in operations research, that is, the solution of real-world problems through diverse methods, techniques, tools, and algorithms. The M.S.O.R. program is concerned with optimization, stochastic systems analysis, and operations research applications. Areas of application include large-scale systems analysis, analysis of urban and socioeconomic systems, and management sciences. This program is open to students not holding an Engineering undergraduate degree.

Admission Requirements

The requirements for admission to the O.R. program conform to policies of the School of Graduate Studies. In addition, the following are required: (1) a minimum score of 500 on the quantitative portion of the GRE, (2) mathematics through calculus (MA 251), and (3) 6 hours of either applied or mathematical statistics.

Degree Requirements

The program of study in Operations Research contains a minimum of 24 semester hours of graduate-level coursework that includes: (a) 12 semester hours of graduate-credit courses in operations research, including ISE 626, 636, 629 or 527; (b) 6 hours of courses in approved minor area; (c) 6 hours in another minor, i.e., statistics, mathematics, etc.; and (d) an acceptable thesis. A plan II is also available. Detailed instruction governing the M.S.O.R. program should be obtained from the chairman of the Industrial and Systems Engineering Department.

Undergraduate ISE Courses (partial listing)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hrs.</th>
</tr>
</thead>
</table>
| 321      | Engineering Economy                             | 3 hrs.
| 326      | Production and Operation Systems I              | 3 hrs.
| 327      | Production and Operation Systems II             | 3 hrs.
| 378      | Materials and Manufacturing Processes (Same as ME 378) | 3 hrs.
| 390      | Probability and Engineering Statistics I        | 3 hrs.
| 421      | Measurement and Instrumentation in Industrial Processes (Same as ISE 521) | 3 hrs.
| 422      | Logistics Planning and Control (Same as ISE 522) | 3 hrs.
| 423      | Statistical Quality Control (Same as ISE 523)   | 3 hrs.
| 424      | Introduction to Ergonomics: Work Development (Same as ISE 524) | 3 hrs.
| 425      | Metal Processing and Metrology                  | 3 hrs.
| 426      | Design and Analysis of Experiments (Same as ISE 526) | 3 hrs.
| 427      | Management Systems Analysis                     | 3 hrs.

88
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>428</td>
<td>Systems Analysis and Design I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>429</td>
<td>Systems Analysis and Design II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>430</td>
<td>Modern Manufacturing/Production Systems (Same as ISE 530)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>431</td>
<td>Microprocessor Applications in Manufacturing (Same as ISE 531)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>439</td>
<td>Selected Topics in Industrial and Systems Engineering</td>
<td>Credit to be arranged</td>
</tr>
<tr>
<td>447</td>
<td>Introduction to Digital Simulation (Same as ISE 547)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>471</td>
<td>Systems Simulation Laboratory I—GPSS (Same as ISE 571)</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>472</td>
<td>Systems Simulation Laboratory II—SIMAN (Same as ISE 572)</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>473</td>
<td>Systems Simulation Laboratory III—DYNAMO (Same as ISE 573)</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>490</td>
<td>Probability and Engineering Statistics II</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

**Graduate ISE Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>521</td>
<td>Measurement and Instrumentation in Industrial Processes</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Principles and methods of measurement used in the collection of operating information from industrial processes. Laboratory work includes the use of currently available transducers. Lab fee: Level 7. Prerequisites: EE 301, 311. (Same as ISE 421)</td>
<td></td>
</tr>
<tr>
<td>522</td>
<td>Logistics Planning and Control</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Basic nature of logistics systems. Quantitative analysis of two networks and their interaction, the logical network for project-planning and control, and the physical distribution network. Charting, milestone method, lines of balance, PERT-CPM, resource allocation and leveling, and maximum flow and minimum cost algorithms. Lab fee: Level 2. Prerequisite: ISE 390. (Same as ISE 422)</td>
<td></td>
</tr>
<tr>
<td>523</td>
<td>Statistical Quality Control</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Statistical theory and techniques to control quality of manufactured products. Prerequisite: ISE 390. (Same as ISE 423)</td>
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<tr>
<td>524</td>
<td>Introduction to Ergonomics: Work Development</td>
<td>3 hrs.</td>
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<td></td>
<td>Philosophy, methodology, and techniques related to providing optimal match between job requirements and worker skills. Intensive use of actual industrial requirements and experience in practical applications. Lab fee: Level 3. Prerequisites: ISE 390; ISE 327 or graduate standing. (Same as ISE 424)</td>
<td></td>
</tr>
<tr>
<td>526</td>
<td>Design and analysis of Experiments</td>
<td>3 hrs.</td>
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<td></td>
<td>Advanced topics in statistical experiments with emphasis on design aspect. Confounding, fractional replication, factorial and nested design. Prerequisite: ISE 490. (Same as ISE 426)</td>
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<tr>
<td>530</td>
<td>Modern Manufacturing/Production systems</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Overview of modern manufacturing and production systems, including principles, theory and practical applications of integrated manufacturing systems with and without robotics and automated materials handling. Includes review of classical systems, Japanese production systems, and group technology. Lab fee: Level 2. Prerequisite: Senior standing. (Same as ISE 430)</td>
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<tr>
<td>531</td>
<td>Microprocessor Applications in Manufacturing</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>The use of minicomputers, microprocessors, and programmable controllers to control manufacturing processes with extensions into adaptive control. Real systems will be modeled in the laboratory using concepts of physical systems simulation. Lab fee: Level 7. Prerequisite: ISE 521. (Same as ISE 431)</td>
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</tr>
<tr>
<td>539</td>
<td>Selected Topics in Industrial Engineering</td>
<td>Credit to be arranged</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Hours</td>
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</tr>
<tr>
<td>547</td>
<td>Introduction to Digital Simulation</td>
<td>3</td>
</tr>
<tr>
<td>571</td>
<td>System Simulation Laboratory I GPSS</td>
<td>2</td>
</tr>
<tr>
<td>572</td>
<td>System Simulation Laboratory II - SIMAN</td>
<td>2</td>
</tr>
<tr>
<td>573</td>
<td>Systems Simulation Laboratory III</td>
<td>2</td>
</tr>
<tr>
<td>620</td>
<td>Engineering Management I</td>
<td>3</td>
</tr>
<tr>
<td>622</td>
<td>R &amp; D Management</td>
<td>3</td>
</tr>
<tr>
<td>624</td>
<td>Advanced Ergonomics: Man-Machine Interfaces</td>
<td>3</td>
</tr>
<tr>
<td>626</td>
<td>Introduction to Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>627</td>
<td>Introduction to Systems Engineering</td>
<td>3</td>
</tr>
<tr>
<td>628</td>
<td>Engineering Management II</td>
<td>3</td>
</tr>
<tr>
<td>629</td>
<td>Optimization Methods in Operations Research</td>
<td>3</td>
</tr>
</tbody>
</table>
630 Automation: Numeric Control to Computer-Aided Manufacturing 3 hrs.
Numerical Control, CNC, DNC, FMS, unmanned cellular manufacturing systems, robotics,
automation and other aspects of programmable automation systems found in CAM.
Includes introduction to adaptive control, NC and robot programming. Lab fee: Level 5.
Prerequisite: ISE 530.

631 Management Information Systems 3 hrs.
Design of integrated information systems necessary for effective management. Methods of
systems design, basic concepts of computer processing systems, design of management
information procedures and reports, and their application to mechanized and electronic
data-processing equipment. Prerequisite: EE 197 or CS 113.

632 Stochastic Systems 3 hrs.
Processes whose outputs are governed by probabilistic laws. Gaussian processes, processes
with correlated and uncorrelated variables, and Markov processes. Lab fee: Level 2.
Prerequisite: ISE 490 or 690.

633 Industrial Forecasting and Analysis I 3 hrs.
Industrial forecasting methods. Simple forecasting models, multivariate regression, correla-
tion, and spectral analysis, exponential smoothing, and Box-Jenkins forecasting. Lab fee:
Level 3. Prerequisite: ISE 490 or ISE 690.

634 Value and Decision Theory 3 hrs.
Mathematical development of decision-making process. Statistical decision theory and game
theory applied to decision making under risk and uncertainty. Consideration of utility,
benefit functions, opportunity loss and value of additional information. Prerequisite: ISE
390 or 690.

635 Linear Programming 3 hrs.
Application of linear programming to complex allocation problems. Methods for determin-
ing maximum or minimum of objective functions whose variables are subject to constraints.
Simplex methods, degeneracy, modified simplex, transportation problems, network flows,
goal programming, and sensitivity analysis. Lab fee: Level 4. Prerequisite: ISE 626.

636 Systems Modeling 3 hrs.
Philosophy and methodology for modeling probabilistic systems. Team project required.
Lab fee: Level 4. Prerequisites: ISE 390 or 690, ISE 626 or 627.

637 Engineering Reliability 3 hrs.
Methodology of reliability prediction including application of discrete and continuous
distribution models. Reliability estimation, reliability logic diagrams, life testing, and
reliability demonstrations. Prerequisite: ISE 490 or 690.

638 Selected Topics in Industrial and Systems Engineering Credit to be arranged

647 System Simulation 3 hrs.
Methods and procedures for simulation of large and complex systems. Discrete increment,
continuous time and combined models. Comparison of discrete-event simulation languages.
Model verification and validation. Statistical inference. Input data collection and analysis.
Lab Fee: Level 5. Prerequisites: ISE 547.

690 Statistical Methods for Engineers 3 hrs.
Application of probability and statistics useful in research work. Descriptive statistics,
theoretical distribution functions, point and interval estimates, tests of hypotheses, linear
regression, and analysis of variance. Prerequisites: MA 251 and graduate standing.

699 Master's Thesis 3 or 6 hrs.
Required each term student is working and receiving direction on his master's thesis.
Minimum of two terms and 6 hours required for M.S.E. students. A maximum of 9 hours of
credit is awarded upon successful completion of master's thesis.

729 Advanced Nonlinear Programming 3 hrs.
Continuation of ISE 629 with emphasis on development and application of nonlinear
programming algorithms. SUMI algorithm, Zoutendyk's method of feasible directions, Rosen's gradient method, and selected algorithms from current literature. Lab fee: Level 5. Prerequisite: ISE 629.

730 Multi-criteria Decision Analysis 3 hrs.
Methods for analysis of management-decision problems involving multiple goals and constraints. Linear and nonlinear goal programming; risk programming and decision making in fuzzy environments. Prerequisite: ISE 635.

733 Industrial Forecasting and Analysis II 3 hrs.
Industrial forecasting methods. Box-Jenkins model diagnostic checking, seasonal models, and transfer function modeling. Lab fee: Level 3. Prerequisite: ISE 633.

735 Discrete Optimization 3 hrs.
Integer programming and network analysis. Zero-one problem formulation and Balas method, cutting plane techniques, branch and bound, out-of-kilter algorithm, and special applications of integer programming. Lab fee: Level 4. Prerequisite: ISE 635.

739 Selected Topics in Industrial and Systems Engineering Credit to be arranged

747 Advanced Simulation Design and Analysis 3 hrs.
Advanced aspects of simulation modeling of large scale, real-world, industrial and service systems. Optimal model selection. Specialized problems of dealing with large-scale systems. Survey of state-of-the-art, applications, and research needed. Lab fee: Level 5. Prerequisites: ISE 647.

790 Advanced Statistical Applications 3 hrs.
Continuation of ISE 690 with extension to nonparametric methods, multivariate analysis and clustering techniques. Lab fee: Level 3. Prerequisite: ISE 690.

799 Doctoral Dissertation 3-6 hrs.
Mechanical Engineering

Degrees: Master of Science in Engineering
Doctor of Philosophy

Chair: G.R. Karr, Professor; fluid mechanics, heat transfer and cryogenic systems.

Professors:
Chung, T.J.; finite element analysis, mechanics, combustion and acoustics.
Cogley, A.C.; radiative transfer, fluid mechanics, and heat transfer.
Cost, T.L.; finite element applications, structural dynamics, composite materials.
Gilbert, J.A.; solid mechanics, experimental stress analysis, and applied optics.
Hung, R.J.; ionospheric research, remote sensing, robotics, numerical computation.
Liu, F.C.; dynamics and control, orbital mechanics, and vibrations.
Shih, C.C.; high energy lasers and fluid-thermal aspects of chemical lasers.
Wessling, F. (Adjunct); fluid mechanics, heat transfer.
Wu, S.T.; magnetohydrodynamics, gasdynamics, and solar phenomena.

Associate Professors:
Brainerd, J.J.; computational fluid mechanics and hypersonic aerodynamics.
Smith, J.E., Jr.; catalysis, powdered metals, and high temperature furnace.
Thompson, K.O.; numerical methods and fluid mechanics.
Wallace, D.B.; solar energy, photovoltaic cells, CAEDM, and robotics.

Assistant Professors:
Bower, M.; nonmetallic materials, fluid mechanics, and CAEDM.
Rutzler, W.; chemical processes, process control, and process synthesis.
Schonberg, W.P.; impact dynamics, elasticity theory, and large space structures.
Thomas, D.L.; electrochemical mathematical modeling, and convective transport.

Assistant Research Professors:
Chen, C.P.; computational fluid mechanics, chemical processes.
Hwang, K.S.; space plasma, nonlinear electrostatic waves.

The range of faculty research interests in the Department of Mechanical Engineering, which includes programs in Civil and Chemical Engineering, is broad. It affords graduate students opportunities for advanced work in fluid and solid mechanics, heat transfer, aerodynamics, thermodynamics, transport phenomena, combustion, chemical processes, and systems. The Master and Ph.D. degrees granted by the Department in these areas are equivalent to those available in traditional Mechanical, Chemical, Civil, and Aerospace Engineering programs. Support is available at attractive levels for all qualified students, including assistantships, tuition grants and graduate Co-op’s with many local research and industrial organizations. UAH has the intellectual and social environment to provide a well-rounded, technologically-oriented degree.
Admission Requirements

The Department of Mechanical Engineering rarely accepts students who have below a 3.00 GPA (undergraduate) from an ABET accredited school. Outstanding (3.5 GPA) students from other technical fields may gain admittance to M.E. by completing certain undergraduate courses. Please contact the M.E. Department for further details.

M.S.E. In Mechanical Engineering

All M.S.E. students in the Mechanical Engineering Department are guided through one of two specialized areas of concentration; each area has a core of three required courses. The fluid and thermal science area requires ME 649, 651, and 671. The structures and materials area requires ME 561, 574 and 671. Other areas of concentration also have particular requirements. The remainder of the program and elective courses are chosen with the approval of the student’s advisor. M.S.E. students must enroll in the departmental seminar, ME 683, for one term.

Ph.D. In Mechanical Engineering

The Department of Mechanical Engineering offers a program leading to the degree of Doctor of Philosophy. The program is based on scholarly, independent and original investigation coherently reported as a dissertation. Such work is supervised by an experienced researcher and recognized authority in the field. Course work, written and oral exams, and the dissertation are all essential components of the Ph.D. Because the Department also offers advanced work in certain areas in civil and chemical engineering, the Ph.D. studies are rather broad and include areas not associated with the traditional mechanical engineering advanced degree. All Ph.D. students must enroll in the departmental seminar, ME 683, for three terms.

Ph.D. students in Mechanical Engineering must meet the minimum requirements set by the School of Graduate Studies. ME doctoral students must also meet some additional requirements set by the Department (Contact the chair.)

Undergraduate ME Courses (partial listing)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>442</td>
<td>Intro. to Heat &amp; Mass Transfer</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>446</td>
<td>Design of Thermal Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>449</td>
<td>Intro. to Environmental Eng.</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>454</td>
<td>Fluid Mechanics II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>459</td>
<td>Selected Topics in Engineering</td>
<td>TBA</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------</td>
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</tr>
<tr>
<td>465</td>
<td>Mechanical Engineering Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>470</td>
<td>Mechanics of Materials II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>485</td>
<td>Numerical Methods and Computation II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>486</td>
<td>Numerical Engineering Analysis</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>488</td>
<td>Analysis of Engineering Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>489</td>
<td>Computer-Aided Engineering</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

**Graduate ME Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>531</td>
<td>Introduction to Plasma dynamics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>540</td>
<td>Physical Properties of Fluids</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Theoretical, experimental, and correlation methods for determining and predicting the thermodynamic and transport properties of various fluids. Critical properties, equations of state, vapor pressure and latent heat, heat capacity. Viscosity, thermal conductivity, diffusion coefficient, phase equilibrium, heat and free energy for formation. Prerequisite: ME 342. Offered upon demand.</td>
<td></td>
</tr>
<tr>
<td>542</td>
<td>Internal Combustion Engines</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Application of principles of thermodynamics, heat transfer, and fluid mechanics to combustion engines and turbines. Basic engine types, engine components, idealized cycles, combustion, fuels, engine variables, testing, exhaust gas analysis, and air pollution as related to spark-ignition, compression-ignition, and turbine engines. Prerequisites: ME 342, 442, 454.</td>
<td></td>
</tr>
<tr>
<td>545</td>
<td>Heat Distribution System Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Design of hydronic and air distribution systems used in heating and air conditioning. Piping design, pump selection, heat coils, room air distribution, ducting design, fan selection, controls, and complete systems. Prerequisites: ME 454, 544; ME 446 recommended.</td>
<td></td>
</tr>
<tr>
<td>546</td>
<td>Solar Energy Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Components for solar-energy systems (collectors, heat exchangers, thermal storage). Numerical simulation of solar energy systems, and solar energy system design. Residential and commercial space heating, process heating, and hybrid system applications. Prerequisites: ME 446, 544, ME 446 recommended.</td>
<td></td>
</tr>
<tr>
<td>547</td>
<td>Energy Conversion and Power Generation I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Application of principles of thermodynamics and fluid mechanics and economics to analysis and design of conventional hydro and steam power plants. Energy sources and end uses, fossil fuels, combustion equipment, steam generators, and pollution control devices. Hydro, steam and wind turbines. Prerequisites: ME 352, 442, 454, ME 446 recommended.</td>
<td></td>
</tr>
<tr>
<td>548</td>
<td>Energy Conversion and Power Generation II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Application of principles of thermodynamics, heat transfer, and fluid mechanics to combustion engines and turbines. Basic engine types, engine components, idealized cycles, combustion, fuels, engine variables, testing, exhaust gas analysis, and air pollution as related to spark-ignition, compression-ignition, and turbine engines. Prerequisites: ME 342, 442, 454.</td>
<td></td>
</tr>
</tbody>
</table>
551 Atmospheric Fluid Dynamics 3 hrs.
A study of fluid dynamics in the atmosphere. Coriolis acceleration, scale analysis, and appropriate approximations of the complete governing equations. Numerical analysis and interpretation of weather phenomena. Prerequisites: MA 352, ME 341, ME 352 or equivalent. (Same as ME 451 and ES 551.)

553 Atmospheric Radiation 3 hrs.

558 Dimensional Analysis and Similitude 3 hrs.
Nature and use of dimensions, principles of dimensional analysis, systematic calculation of dimensionless products, algebraic theory of dimensional analysis, similarity and model testing. Applications to problems of stress and strain, dynamics, fluid mechanics. Theory of heat and electrical phenomena, differential equations and similarity. Prerequisite: ME 352. Offered upon demand only.

559 Selected Topics in Mechanical Engineering Credit to be arranged

561 Vibrations of Elastic Systems 3 hrs.
Formulation of the equations of motion of discrete and continuous systems, analytical and numerical methods of solution, eigenvalue problems, and dynamic response. Prerequisite: ME 488.

563 Intermediate Dynamics 3 hrs.
Kinematics and dynamics of particles, system of particles, and rigid-bodies. Variational principles and Lagrangian mechanics. Prerequisite: ME 362.

570 Mechanical Behavior of Engineering Materials 3 hrs.
Structure, properties, and behavior of materials. Structural defects and their influence on mechanical properties, point defects, dislocation and lattice imperfection in crystals, plastic deformation of single crystal and polycrystalline alloys, strengthening mechanisms and fracture. Strain rate, time to failure, and cyclic life from a microscope viewpoint. Prerequisites: ME 294, 370.

574 Applied Mechanics of Solids 3 hrs.
Stresses and strains at a point, theories of failures, stress concentration factors, thick-walled cylinders, torsion of noncircular members, curved beams, unsymmetrical bending, and shear center. Prerequisite: ME 370.

577 Fundamentals of Experimental Mechanics 3 hrs.
Experimental methods to determine stress, strain, displacement, velocity, and acceleration in various media. Theory and laboratory applications of electrical resistance strain gages, brittle coatings, and photoelasticity. Application of transducers and experimental analysis of engineering systems. Lab fee: Level 5. Prerequisites: ME 370 and Junior Standing. (Same as ME 477.)

578 Matrix Methods in Structural Mechanics 3 hrs.
Matrix application to formulation and solution of linear problems in structural mechanics. Applications to trusses, beams, and frames. Prerequisite: CE 471. (Same as ME 478.)

580 Aircraft Stability and Control 3 hrs.
The stability and control of aerodynamic vehicles. The design of aircraft to obtain good flying characteristics. The complete governing equations and analog solutions of linearized equations. Lab fee: Level 5. Prerequisites: ME 454, 488. (Same as ME 480.)

581 Atmospheric Thermodynamics 3 hrs.
An introduction to thermodynamics of the atmosphere and relation to weather phenomenon. Review first and second laws, special atmospheric thermodynamics variables, treatment of air-water systems, atmospheric thermodynamic diagrams, atmospheric statics and vertical stability. Prerequisites: MA 352, PH 321. (Same as ES 581.)

96
Numerical Methods and Computation II  
3 hrs.  
Advanced topics in numerical methods and computation including Gaussian quadrature; 
interpolation, integration and differentiation using cubic splines; eigenvalue and eigenvector 
analysis of large systems; round-off error analysis; stability and convergence analysis of 
iterative methods. Lab fee: Level 5. Prerequisite: ME 396. (Same as ME 485).

Numerical Engineering Analysis  
3 hrs.  
Finite elements and finite differences in solving various engineering problems. Numerical 
applications to fluid mechanics, heat transfer, structural mechanics, and machine design. 
Prerequisite: ME 396. (Same as ME 486)

Computer-Aided Engineering  
4 hrs.  
Application of computer methods in the analysis and design of structural, thermal, and 
dynamical systems. Use of state-of-the-art finite element and finite difference computer 
programs. Practical guidelines for discrete modeling; analysis of modeling errors. Comparison 
of exact and approximate solutions to boundary value problems. Use of microcomputers 
in engineering design and analysis. Prerequisite: ME 396. (Same as ME 489.)

Physical Metallurgy  
3 hrs.  
Deformation of crystals. Theories of work hardening of metals. Dislocation theory. Growth 
of new phases. Transformation of new phase. Nucleation and growth. Annealing of 
deformed metals. Prerequisite: Permission of instructor.

Advanced Thermodynamics  
3 hrs.  
Application of classical thermodynamics. Treatment of problems involving nonideal gases 
and liquids, phase equilibrium, and chemical equilibrium. Prerequisite: ME 342.

Radiative Sources and Detectors  
3 hrs.  
Optical and thermal radiative sources and detectors. Sources of detector noise and its 
Prerequisite: Graduate Standing.

Intermediate Heat Transfer  
3 hrs.  
Continuation of ME 442 in the study of heat transfer by conduction, convection, and 
radiation. Emphasis is on solution of convective and radiative heat transfer by numerical 
methods. Lab fee: Level 5. Prerequisite: ME 442.

Information Retrieval in Remote Sensing  
3 hrs.  
Methods for extracting engineering and scientific information content from indirect sensing 
measurements. Multi-spectral sensing and spectral pattern recognition. Linear and non­
linear inversion methods. Application to remote sensing from space. Prerequisite: Permis­
sion of instructor.

Propulsion  
3 hrs.  
Aerothermodynamics of rocket propulsion systems; rocket propellants and combustion; heat 
transfer and cooling problems. Application to ramjets and hybrid systems. Prerequisite: ME 
651.

Transport Phenomena  
3 hrs.  
Mass, energy, and momentum transport in steady and transient motions in real and 
rheological substances. Prerequisite: ME 442.

Viscous Fluid Mechanics  
3 hrs.  
Fundamentals of incompressible viscous fluid motion, including development of Navier-
Stokes equation. Exact and approximate solutions for both large and small Reynolds 
number. Laminar and turbulent boundary layers. Lab fee: Level 5. Prerequisite: ME 454.

Potential Flow  
3 hrs.  
Inviscid flow theory and its applications in aerodynamics and atmospheric flows. Laplace 
equation, singularities and distributions of singularities, complex potential, conformal 
mapping. Lab fee: Level 5. Prerequisite: ME 454.

Selected Topics in Mechanical Engineering  
Credit to be arranged
660 Structural Dynamics 3 hrs.

661 Advanced Dynamics 3 hrs.
Variational methods, optimization, and dynamic stability. Lagrangian and Hamiltonian formulation for dynamical systems and Hamilton-Jacobi methods to orbital mechanics. Prerequisite: ME 563.

663 Astrodynamics 3 hrs.
Astronomical coordinates and time systems; the many-body problems and disturbing functions. General perturbation methods, and application of classical mechanics and Hamilton-Jacobi methods to orbital mechanics. Prerequisite: ME 563.

671 Continuum Mechanics 3 hrs.
Kinematics and kinetics, various coordinate systems, constitutive equations for continuous media; applications to solids, liquids, and gases. Prerequisites: ME 352, 370.

672 Theory of Elasticity 3 hrs.

673 Plasticity 3 hrs.

674 Finite Element Analysis I 3 hrs.
Finite element theory, variational methods, weighted residuals; applications to linear partial differential equations in continuous media; solution of boundary-value and initial-value problems. Prerequisite: ME 671.

676 Viscoelasticity 3 hrs.

677 Experimental Stress Analysis 3 hrs.
Conventional methods for experimental stress analysis. Introduction to applied optics with emphasis on non-destructive, laser-based testing methods, fiber optic recording systems, photoelectronic-numerical data acquisition, and computer aided analysis. Lab fee: Level 5. Prerequisite: ME 577.

678 Mechanics of Composite Materials 3 hrs.
Introduction to composite materials, micro- and macromechanical behavior of laminae; bending, buckling and vibration of laminated plates. Prerequisites: ME 671, 672.

683 Graduate Seminar No Credit
Minimum one-term requirement of M.S.E. students in mechanical engineering and minimum three-term requirement of Ph.D. students in mechanical engineering.

692 Graduate Engineering Analysis I 3 hrs.
Linear algebra, matrices, and applications to system of differential equations, vector analysis, integral theorems, and introduction to tensor analysis. Prerequisite: MA 352.

693 Graduate Engineering Analysis II 3 hrs.
Fourier series, Fourier integrals, Laplace transformations, partial differential equations, boundary-value problems, and special functions. Prerequisite: MA 352, ME 692.
Master's Thesis
3 or 6 hrs.
Required each term in which student is working and receiving direction on his master's thesis. Minimum of two terms and 6 hours required for M.S.E. students. A maximum of 9 hours of credit is awarded upon successful completion of master's thesis.

Statistical Thermodynamics
3 hrs.

Direct Conversion of Energy
3 hrs.
Systems for direct conversion of heat to electricity including thermionic, magneto-hydrodynamic, fuel cells, and semiconductor devices. Prerequisite: ME 641.

Combustion Theory
3 hrs.
Development of theory of chemical reactions in fluid flow, Shrab-Zeldovich formulation, Rankine-Hugoniot relations, diffusion flames and droplet burning, laminar flame, turbulent flame, solid propellant deflagration, combustion instability, spray combustion, and chemical reactions in boundary layers. Lab fee: Level 5. Prerequisite: ME 651.

Convective Heat Transfer
3 hrs.
Advanced theory of convective transport processes in fluids, including transport of momentum and energy in laminar flow, boundary layers and turbulent transport in shear flow. Engineering applications include boiling and two phase processes. Lab fee: Level 5. Prerequisite: ME 643.

Radiative Transfer
3 hrs.
Physics and modeling of radiative transfer. Scattering, remote sensing, and absorption in participating media. Infrared through optical wave lengths. Computational methods in radiative transfer. Permission of instructor. Lab fee: Level 5.

Mass Transport
3 hrs.
Mass transfer in solid and fluid systems under steady and transient conditions. Integration of momentum, heat and mass transfer equations with application to reactive, rheological and multicomponent systems. Prerequisite: ME 643, 651. (Same as CHE 749).

Boundary Layer Theory
3 hrs.
Development of boundary layers using singular perturbation theory. Curvature and compressible effects and the order of their importance. Modern applications and computational approaches. Lab fee: Level 5. Prerequisite: ME 651.

Mechanics of Rarefied Gases
3 hrs.
Application of kinetic theory to rarefied gas-flow problems. Boltzmann statistical distribution; gas-surface interaction, transport properties, free molecule flow; heat-free molecule flow; procedures for non-equilibrium flows. Prerequisite: ME 651. Offered upon demand.

Magneto-Gas Dynamics
3 hrs.
Equations of motion for ionized gases with critical analysis of transport properties in steady and varying electric and magnetic fields. MHD shock waves and radiation effects. Prerequisite: ME 651.

Compressible Fluid Mechanics
3 hrs.
Fluid mechanics and thermodynamics of flows of ideal and real gases. Shock waves, Prandtl-Meyer fans, wave interactions, method of characteristics, linearized theory and shock-expansion method with applications to shock tubes, Laval nozzles, wind tunnel, flows about wedges, cones, and supersonic thin airfoils. Lab fee: Level 5. Prerequisite: ME 651.

High Speed Flow Theory
3 hrs.
Transonic, supersonic, and hypersonic flows. Compressible potential flows, similarity rules, perturbation methods, and numerical methods for determining the flow of ideal and chemically reacting gases about slender and blunt two-dimensional and three-dimensional bodies. Lab fee: Level 5. Prerequisite: ME 754.
Turbulence  3 hrs.
Turbulence in gases and liquids; boundary layers, atmospheric phenomena. Lab fee: Level 5. Prerequisite: ME 656.

Selected Topics in Mechanical Engineering  Credit to be arranged

Analytical Methods in Nonlinear Dynamics  3 hrs.
Application of averaging methods and perturbation methods to vibrations of nonlinear systems. Analysis of linear systems with periodic coefficients (Floquet theory). Elements of stability theory, Liapunov functions, and Liapunov's direct method. Prerequisite: ME 660 or 661.

Wave Motion of Continuous Elastic Bodies  3 hrs.
Elements of stress wave propagation in bounded elastic media. Propagation of elastic waves in infinite and semi-infinite bodies, cylinders, rods and beams. Prerequisite: ME 660.

Random Vibration of Elastic Systems  3 hrs.

Dynamics of Aerospace Vehicles  3 hrs.
Elements of advanced rotational kinematics of rigid bodies. Attitude motion of space vehicles in circular and elliptic orbits. Methods of gravitation and spin stabilization of gyrost ate. Prerequisite ME 660 or 661.

Theory of Structural Stability  3 hrs.

Theory of Shells  3 hrs.
The first-approximation theory of thin shells, higher approximations, and transverse-shear deformations. Illustration of theories by selected problems. Prerequisite: ME 671.

Finite Element Analysis II  3 hrs.
Advanced topics in finite element analysis; application to nonlinear partial differential equations in continuum mechanics; theoretical studies of convergence and stability of solutions. Prerequisite: ME 674.

Fracture Mechanics  3 hrs.
Theory of crack propagation, stress intensity factors, mapping techniques, series expansion, asymptotic approximations, alternating method, field singularities, integral transforms, numerical solutions. Prerequisites: ME 671, 672.

Theory of Acoustics  3 hrs.
Basic properties of acoustic waves, reflection and transmission of sound, plane waves, spherical waves, cylindrical waves, sound emission, sound absorption, applications to industrial acoustic problems. Lab fee: Level 3. Prerequisite: ME 671.

Nonlinear Effects in Plasma  3 hrs.
Fundamental physical concepts and methods of estimating various nonlinear interactions in plasmas. Both analytical and numerical methods to deal with these problems will be presented. Prerequisite: PH 531.

Plasma Turbulence  3 hrs.
The methodology that deals with plasma turbulence together with current numerical techniques to solve these problems approximately, via super-computing. Prerequisite: PH 531.

Doctoral Dissertation  3-6 hrs.
## Civil Engineering

### UNDERGRADUATE CE COURSES

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>449</td>
<td>Introduction to Environmental Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>450</td>
<td>Environmental Control</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>471</td>
<td>Structural Analysis II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>472</td>
<td>Hydraulic Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>473</td>
<td>Transportation Engineering &amp; Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>475</td>
<td>Hydrology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>476</td>
<td>Sanitary Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>477</td>
<td>Civil Engineering Project I</td>
<td>1 hr.</td>
</tr>
<tr>
<td>478</td>
<td>Matrix Methods in Structural Mechanics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>479</td>
<td>Selected Topics in Civil Engineering</td>
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<tr>
<td>480</td>
<td>Civil Engineering Project II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>481</td>
<td>Advanced Soil Mechanics (Same as CE 581)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>482</td>
<td>Soil Dynamics (Same as CE 582)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>485</td>
<td>Foundation Engineering (Same as CE 585)</td>
<td>3 hrs.</td>
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### GRADUATE CE COURSES

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<tbody>
<tr>
<td>549</td>
<td>Introduction to Environmental Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Engineering aspects of air, water, and thermal pollution. Hydrologic cycle, water sources and uses; industrial and other sources of primary and secondary pollutants. Transport process in environmental problems and in their control. Prerequisite: ME 442.</td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>Environmental Control</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Engineering design and synthesis of environmental control systems. Control of multi-phase systems with application to air and water pollution control. Prerequisite: ME 442. (Same as CE 450.)</td>
<td></td>
</tr>
<tr>
<td>559</td>
<td>Selected Topics in Civil Engineering</td>
<td></td>
</tr>
<tr>
<td>578</td>
<td>Matrix Methods in Structural Mechanics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Matrix application to formulation and solution of linear problems in structural mechanics. Stresses, vibrations, and stability of engineering structures. Prerequisite: CE 471. (Same as CE 478.)</td>
<td></td>
</tr>
<tr>
<td>581</td>
<td>Advanced Soil Mechanics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Continuum mechanics applied to soil behavior; cap model. Theoretical approaches to consolidation, shear strength, slope stability and soil stabilization. Lab fee: Level 5. Prerequisite: CE 372. (Same as CE 481.)</td>
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</tr>
<tr>
<td>582</td>
<td>Soil Dynamics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Behavior of soils under dynamic, earthquake and blast loading. Analysis of foundation vibration and isolation. Lab fee: Level 5. Prerequisite: CE 372. (Same as CE 482.)</td>
<td></td>
</tr>
<tr>
<td>585</td>
<td>Foundation Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Application of principles of soil mechanics to the determination of bearing capacity of</td>
<td></td>
</tr>
</tbody>
</table>
spread footings, mats, and pile foundations. Drilled piers and caissons. Methods and techniques of site investigation. Lab fee: Level 5. Prerequisite: CE 372. (Same as CE 485.)

652 Introduction to Air Pollution 3 hrs.
Technology of air pollution dealing with air pollutants, effects, sources, combustion processes, and abatement and control technology. Engineering contributions to both the problems and their solutions. Nature of air pollution problem and fundamental technological approaches to its solution. Prerequisite: graduate standing. Offered upon demand. (Same as CHE 652.)

659 Selected Topics in Civil Engineering Credit to be arranged

660 Constitutional Laws of Engineering Media 3 hrs.
Physical basis for relationship between stress and strain for various materials. Introduction to index notation; application of higher order elastic, incremental and advanced plasticity laws. Linear viscoelasticity. Lab fee: Level 5. Prerequisite: ME 342, 370.

663 Plasticity 3 hrs.

665 Rock Mechanics 4 hrs.
Principles of continuum mechanics applied to the design of structures in rock; tunnels, underground structures and foundations. Joint behavior; stresses; analysis of rock slopes; instrumentation. Lab fee: Level 3. Prerequisite: CE 377.

666 Viscoelasticity 3 hrs.

668 Mechanics of Composite Materials 3 hrs.
Introduction to composite materials, micro- and macro- mechanical behavior of laminae; bending, buckling and vibration of laminated plates. Prerequisites: ME 671, 672.

759 Selected Topics in Civil Engineering Credit to be arranged

765 Random Vibration of Elastic Systems 3 hrs.
Dynamic analysis of elastic systems including the response of complex structures to random excitations. Typical excitations include random wind, thermal, earthquake, aerodynamic, and ocean wave phenomena. Probabilistic mechanics methods. Concepts of reliability. Stationary and ergodic processes. Prerequisite: ME 561. (Same as ME 765).

772 Theory of Structural Stability 3 hrs.

773 Theory of Shells 3 hrs.
The first-approximation theory of thin shells, higher approximations, and transverse-shear deformations; geometrical nonlinearities and shell instability. Illustration of theories by selected problems. Prerequisite: ME 671.

778 Fracture Mechanics 3 hrs.
Theory of crack propagation, stress intensity factors, mapping techniques, series expansion, asymptotic approximations, alternating method, field singularities, integral transforms, numerical solutions. Prerequisites: ME 671, 672.
## Chemical Engineering

### Undergraduate CHE Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>440</td>
<td>Unit Operations Laboratory</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>441</td>
<td>Chemical Kinetics &amp; Reactor Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>443</td>
<td>Mass Transfer Operations</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>445</td>
<td>Chemical Process Control</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>447</td>
<td>Chemical Engineering Design I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>448</td>
<td>Chemical Engineering Design II</td>
<td>3 hrs.</td>
</tr>
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</table>

### Graduate CHE Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>540</td>
<td>Physical Properties of Fluids</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Theoretical, experimental, and correlation methods for determining and predicting the thermodynamic and transport properties of various fluids. Critical properties, equations of state, vapor pressure and latent heat, heat capacity. Viscosity, thermal conductivity, diffusion coefficient, phase equilibrium, heat and free energy for formation. Prerequisite: ME 342. Offered upon demand.</td>
<td></td>
</tr>
<tr>
<td>541</td>
<td>Chemical Kinetics and Reaction Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Fundamental principles of chemical kinetics and chemical reactor engineering along with the design of both thermal and catalytic reactors. Prerequisites: CHE 344, 443.</td>
<td></td>
</tr>
<tr>
<td>549</td>
<td>Introduction to Environmental Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Engineering aspects of air, water, and thermal pollution. Hydrologic cycle, water sources and uses; industrial and other sources of primary and secondary pollutants. Transport process in environmental problems and in their control. Prerequisite: ME 442.</td>
<td></td>
</tr>
<tr>
<td>559</td>
<td>Selected topics in CHE</td>
<td>Credit to be arranged</td>
</tr>
<tr>
<td>641</td>
<td>Advanced Thermodynamics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Application of classical thermodynamics. Treatment of problems involving nonideal gases and liquids, phase equilibrium, and chemical equilibrium. Prerequisite: ME 342.</td>
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</tr>
<tr>
<td>644</td>
<td>Introduction to Electrochemical Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Thermodynamics, transport, and kinetics of electrodes and cells. Systems analysis of batteries, fuel cells, porous electrodes, electroplating, electrowinning, and corrosion processes. Convective diffusion at high Schmidt numbers. Lab fee: Level 2. Prerequisites: CHE 443 or equivalent.</td>
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<tr>
<td>646</td>
<td>Thermodynamics of Materials</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Treatment of thermodynamic topics as they apply to behaviors observed in metallic and non-metallic materials. Lab fee: Level 5. Prerequisites: Ch 341 or equivalent. (Same as CH 646).</td>
<td></td>
</tr>
<tr>
<td>649</td>
<td>Transport Phenomenon</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Mass, energy, and momentum transport in steady and transient motions in real and rheological substances. Prerequisite: ME 442.</td>
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<tr>
<td>652</td>
<td>Introduction to Air Pollution</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Technology of air pollution dealing with air pollutants, effects, sources, combustion processes, and abatement and control technology. Engineering contributions to both the problems and their solutions. Nature of air pollution problem and fundamental technological approaches to its solution. Prerequisite: graduate standing. Offered upon demand. (Same as CE 652.)</td>
<td></td>
</tr>
</tbody>
</table>
657 Advanced Process Control 3 hrs.
Application of modern control theory to chemical processes; multivariable control; estimation and adaptive control, optimal control. Prerequisite: ECE 505.

658 Catalysis and Reactor Design 3 hrs.
Treatment of homogeneous and heterogeneous reaction kinetics, transport in fluid-solid reactions, catalyst deactivation and their effects on the analysis and design of chemical reactors. Prerequisite: CHE 541.

659 Selected Topics in Chemical Engineering Credit to be arranged
Lab fee: Level 5

699 Master's Thesis 3 or 6 hrs.
Lab fee: Level 5

749 Mass Transport 3 hrs.
Mass transfer in solid and fluid systems under steady and transient conditions. Integration of momentum, heat and mass transfer equations with application to reactive, rheological and multicomponent systems. Lab fee: Level 5. Prerequisite: ME 643 and 651. (Same as ME 749.)
College of Liberal Arts

Degrees: Master of Arts, Master of Administrative Science
Dean: R.L. Meek, Professor of Political Science

Graduate study in the College of Liberal Arts brings together faculty and advanced students to share the excitement of creative learning. All degree candidates plan a graduate program in consultation with faculty members who share the student's intellectual interests. Within the framework of the requirements established by the department and the School of Graduate Studies, students design, in consultation with a faculty advisor, a program of study fitted to their particular interests and needs.

The College of Liberal Arts offers programs of study leading to the Master of Arts and Master of Administrative Science Degrees.

Education

Degree: Master of Arts

Chair: T.M. Butts, Assistant Professor; school psychology, language development, learning theory.

Professors:
Engle, H.A.; (Emeritus); administration and curriculum.
Wharry, R.E.; developmental learning and psychology, learning disorders and assessment.

Associate Professors:
Brindley, T.A.; education theory, social change, foundations, secondary education.
Gibson, J.E.; educational psychology, psychological evaluation, secondary education.
Kilgo, R.D.; marriage and family sociology, counseling and guidance, children's literature.

The Department of Education offers programs in Secondary Education (with Master's degrees and Alabama Class A certification in English, History, Biology, Chemistry, Mathematics, and Physics); and certification in the Elementary and Secondary principalship. Certain individual courses are also offered, on demand, for in-service training of personnel. The programs in Secondary Education and Administrative Science are offered in conjunction with the other departments. A complete listing of courses will be found in the catalog sections describing graduate offerings from those departments.

The graduate education program requires a broad and liberal education base,
in-depth study of one or more disciplines, and professional study of the teaching arts. The department’s purpose is the preparation of qualified and competent elementary, middle, and high school faculty, the training of personnel in allied fields, and the continuous professional development of all educational personnel through graduate and academic field service programs. It provides educational systems and other institutions within the region with assistance in program, staff, and curriculum development. Likewise, it recognizes a research mission to expand the body of knowledge which has as its core the teaching-learning process. Another prime function of the department is to recommend to the State Department of Education certification in conjunction with the graduate degrees offered (where appropriate).

While it is not a requirement for UAH graduation, the State Department of Education requires that a student hold or be eligible to hold a Class B certificate as a prerequisite for issuance of the Class A certificate. Similarly, the State also requires proof of one year of teaching experience before the Class A certificate will be issued. Further, if the appropriate Alabama Initial Teacher Certification Test has not been passed, that, too, will be required. Note that the new non-traditional fifth-year program has somewhat different requirements.

Special Facilities

The Department maintains a Teacher Materials Center where current teaching materials are available and where laboratory classes are held. Testing facilities are also available for psychometric evaluation. Some in-field training is handled in cooperation with the local school systems.

Degree Programs:

(1) Secondary Education (Middle and High School options, traditional and strengthened subject matter available)

Middle School (traditional)

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ED 604, ED 606, ED 626</td>
<td>Required</td>
<td>9 sem. hrs.</td>
</tr>
<tr>
<td>ED 510</td>
<td></td>
<td>3</td>
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<tr>
<td>ED 601 or ED 603</td>
<td>(select one)</td>
<td>3</td>
</tr>
<tr>
<td>Teaching Field</td>
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<td>24</td>
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<tr>
<td>Special Education Requirement*</td>
<td></td>
<td>(3)</td>
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</table>

High School (traditional)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED 604, ED 606, ED 630</td>
<td>Required</td>
<td>9 sem. hrs.</td>
</tr>
<tr>
<td>ED 510</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>ED 601 or ED 603</td>
<td>(select one)</td>
<td>3</td>
</tr>
<tr>
<td>Teaching Field</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Special Education Requirement*</td>
<td></td>
<td>(3)</td>
</tr>
</tbody>
</table>
Middle School (Strengthened Subject Matter)
ED 510, ED 604, ED 626 (required) 9 sem. hrs.
Teaching Field 24
Special Education Requirement* (3)sem. hrs.

High School (Strengthened Subject Matter)
ED 510, ED 604, ED 630 (required) 9 sem. hrs.
Teaching Field 24
Special Education Requirement* (3)sem. hrs.

*Special Education Requirement: A survey course in special education is required (ED 593) if no such course has been taken at undergraduate or graduate levels prior to entering program.

(2) Non-Traditional Fifth-Year Programs (Available in: English, History, Biology, Chemistry, Mathematics, and Physics.)
ED 510, ED 593, ED 604, ED 608, ED 630 (Req.) 15 sem. hrs.
ED 698 (Req.) 6
Teaching Field 24
This is a new program leading to Class A certification in the teaching fields listed. The prerequisite of Class B certification is waived. Students may proceed directly from a degree in the subject field(s) to this program.

Prerequisites:
(a) A bachelor’s (or higher) degree from an accredited institution.
(b) Admissibility to the graduate school, and to subject field programs.
(c) An accumulation of no more than 12 semester hours of coursework, on any level, in professional education.
(d) A passing score on the Alabama State English Language Proficiency Exam.
(e) A passing score on the Alabama State Initial Certification Test in the field in which certification is being sought.
(f) Submission of proper application forms with documentation of items a-e above, to the Registrars office. Note: The student may be conditionally admitted and may take up to 12 semester hours while meeting the stated prerequisites.

(3) School Administration:
The Department offers a program leading to the Master of Administrative Science degree and certification at the Class A level in the principalship. The student may choose Elementary or Secondary certification. For additional information, contact the chairman of the Education Department.

(4) Developmental Learning:
Options are available leading to the Master of Arts degree in Developmental Learning. Two of the options lead to Class A certification: Learning Disabilities and School Psychometry. Two other options, Developmental Processes and Early Childhood Learning, are non-certifiable in teacher education. For additional information, contact the chair of the Education Department.

**EDUCATION COURSES (ED)**

500 Special Problems in Education 3 hrs.
Independent study, special projects, and special in-service programs. Prerequisite: senior standing.
502 Environmental Education 3 hrs.
The general nature of ecological life systems, relationships of humankind and environment, major conservation problems facing the world today, exploration of alternate solutions and the tasks for educators.

510 Foundations of Education Evaluation 3 hrs.
Measurement process with emphasis on its relationship to problems of educational evaluation. Evaluation as an integral part of overall educational planning in addition to its use in measurement and evaluation of academic achievement.

549 Audiovisual Instruction 3 hrs.
Audiovisual media in teaching and the selection, use, and maintenance of audiovisual materials in educational programs.

593 Education of Exceptional Children and Youth 3 hrs.
Introduction to the field of exceptional children and youth, including observations. This course, or equivalent, is a prerequisite to certification. (Same as DL 593)

600 Special Problems in Education 1-3 hrs.
Independent study, special projects, and in-service programs.

601 Public School Organization and Administration 3 hrs.
Systematic treatment of problems of local, state and national administration. New developments modifying educational administration, state authorization and organization, board of education, superintendent of schools, personnel and management, financial support, and public relations.

602 The Principal as Educational Leader 3 hrs.
Role of principal as supervisor, organizer, and administrator of schools, program of studies, teaching staff, pupil personnel, plant and equipment, and community relationships.

603 Sources of American Educational Thought 3 hrs.
Foundations of education in their philosophical, historical, social, and comparative aspects. Major relationships of schools and educative processes with society at large pointing to development of particular crucial issues.

604 Contributions of Psychology to Education 3 hrs.
Principles, theory, and practice of psychology for teaching and administrative service in educational institutions. Factors that determine learning and conditions of effective teaching. Administrator and supervisor as organizer of the milieu wherein teaching, learning, and growth occur.

606 Principles of Curriculum Development 3 hrs.
Principles of curriculum construction that underlie the reorganization of the program of studies for elementary and secondary schools. Origin and background of the curriculum, methods of organization, curriculum planning and development, and pertinent applications.

607 The Educational Leader as Evaluator 3 hrs.
Procedures and techniques of empirical evaluation including a sampling of available instruments, and research approaches complementary to the course AS 627 (Quantitative Methods of Management). Evaluation of teacher and staff performance. Curricula, achievement and ability, media, and equipment, and plant and facilities. Preparation for maintenance of accountability.

608 Reading in the Content Areas 3 hrs.
Instruction in developing reading skills and methods and materials in reading. Motivations of children and adolescents, functional reading and the atypical learner. Diagnosis and remediation of related deficiencies. Other related topics for regular and special education teacher. (Same as DL 609).
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>610</td>
<td>Legal Aspects of Public School Administration</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Legal status of schools in the United States. Alabama conditions, school laws, constitutional provisions, judicial decisions. Attorney General's rulings and regulations of State Board of Education.</td>
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<tr>
<td>611</td>
<td>Principles of Guidance</td>
<td>3 hrs.</td>
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<td></td>
<td>Sociological, psychological, and educational foundations of guidance; history and growth of the guidance movement; functions, scope, organization, and administration of guidance.</td>
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<tr>
<td>622</td>
<td>Modern Elementary School Programs</td>
<td>3 hrs.</td>
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<td></td>
<td>Evaluating new patterns of organization and the developing curriculum in elementary school.</td>
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<tr>
<td>626</td>
<td>Modern Middle School Programs</td>
<td>3 hrs.</td>
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<td></td>
<td>Survey of important viewpoints and issues, reorganization trends, typical research findings by subject fields and analysis of current curriculum proposals at the national, state, and local levels.</td>
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<tr>
<td>630</td>
<td>Modern Secondary School Programs</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Important viewpoints and issues, reorganization trends, typical research findings by subject fields. Analysis of current curriculum proposals at the national, state, and local levels.</td>
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<tr>
<td>631</td>
<td>Space Orientation for Educators (Secondary)</td>
<td>3 hrs.</td>
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<td></td>
<td>This course introduces the teacher to a variety of space-related subjects and techniques which may be used in the classroom. The curriculum is designed to reflect current research and technological development in a hands-on experience with the space program. It will include a number of experiments which can be duplicated in the classroom. It is offered in cooperation with the Alabama Space and Rocket Center.</td>
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<tr>
<td>641</td>
<td>Staff Development</td>
<td>3 hrs.</td>
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<td>A study of the principles and techniques for the continued professional development of individuals and groups who are responsible for establishing learning environments. The course is designed for those in instructional leadership positions who are responsible for the development (in-service) programs including conferences, workshops, single sessions, and comprehensive programs.</td>
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<tr>
<td>647, 648, 649</td>
<td>Field Experience Practicum</td>
<td>1 hr. each</td>
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<td></td>
<td>Student demonstration of performance competencies in school administration through field practicum. Students with committee approval may register for 647-648-649 individually or jointly. Course approval based upon committee's evaluation of student's readiness for field practicum. Courses individually scheduled to fit concurrently with student's regular employment assignment.</td>
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<tr>
<td>661</td>
<td>Major Issues and Trends in Instructional Leadership</td>
<td>3 hrs.</td>
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<td></td>
<td>This course is designed to stimulate student participation in the analytic process of examining issues and trends in the broad field of instructional leadership; serve as a vehicle for increasing proficiency in writing skills; refine participants abilities to analyze, synthesize, and formulate a position relative to controversial educational issues and areas.</td>
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<tr>
<td>662</td>
<td>Instructional Leadership</td>
<td>3 hrs.</td>
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<td>Upon completion of this course each student describes himself/herself in terms of leadership strengths, modality strength, cognitive strength, personality type, coping procedures, time management, and other pertinent leadership variables. The course is designed to promote peer interaction and intraspection such that each student receives feedback which enables him/her to analyze the conflict between self perception and peer perception.</td>
<td></td>
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</tbody>
</table>
698  **High School Internship**  6 hrs.
An internship in the student's teaching field in a secondary school setting. During the assignment, the role of the student teacher/intern will vary from that of observer to an active participant to full responsibility for teaching. A minimum of 125 hours of actual teaching and 300 hours of overall experience is required. Prerequisite: All required professional education courses and the majority of the teaching field courses should be completed before admission to the internship.

To be offered through University of Alabama in Birmingham:

621  **Space Orientation for Educators (Elementary)**  3 hrs.
This course introduces the teacher to a variety of space-related subjects and techniques which may be used in the classroom. The curriculum is designed to reflect current research and technological development in a hands-on experience with the space program. It will include a number of experiments which can be duplicated in the classroom. It is offered in cooperation with the Alabama Space and Rocket Center.
English

Degree: Master of Arts

Chair: Richard S. Moore, American Literature

Professors:
Francis, H.E.; Creative Writing, The Novel, Modern Literature
Martin, C. W.; American Literature
Wilson, J.L.; Linguistics

Associate Professors:
Moore, R.S.; American Literature
Munson, W.F.; Medieval Literature

Assistant Professors:
Davis, P.E.; Romantic Period
Dillard, N.F.; Milton, Seventeenth Century
Johnson, P.E.; Victorian Literature
Mebane, J.S.; Renaissance
Murray, C.D.; Eighteenth Century
Neff, D.S.; Romantic Period, Criticism
Schenker, D.; Modern British Literature

The Master of Arts with a major in English meets the needs of a variety of professional options. The M.A. sharpens the student’s scholarship to the level of professional competence and leads to new levels of appreciation and pleasure in English studies. It qualifies secondary school teachers to earn Class A certification. It also enables graduates to become faculty members in private schools, junior colleges, community colleges, and certain four-year institutions. Additionally, it prepares students to move into programs leading to the Ph.D.

Graduate courses are offered both as seminars and as lecture courses. They are focused both on specific topics (individual authors or genres) and broader subjects, such as the historical periods of literature. Classes are usually small, so that all students are given the benefit of personal counseling.

Degree Requirements

The English graduate faculty offers courses in English and American literature and language. In addition to the Graduate School requirements, the requirements for the M.A. in English are:

1. Eighteen semester hours of graduate work in English, six hours of which may be transferred credit approved by the department Graduate Committee.

2. Six additional semester hours of elective graduate courses in English or a related subject approved by the Graduate Committee.
3. At least half of the hours offered for the degree (exclusive of thesis credit hours) in courses numbered 600 or above and at least 9 hours in English courses at UAH numbered 600 or above (exclusive of thesis credit hours).

4. Master’s thesis with at least two terms (6 hours) of English 699. Upon petition to and approval by the Graduate Committee, a student may substitute 9 hours of graduate English courses for the thesis.

5. A minimum of 24 semester hours and a thesis (Plan I), or 33 semester hours (Plan II).

6. A maximum course load of 9 semester hours per term is permitted.

7. Oral comprehensive examination on courses taken and on the thesis. For students who choose plan II (non-thesis option), both oral and written examinations are required. The written examination must be passed before the oral examination is taken.

8. A reading knowledge of French, German, Spanish, or another language deemed by the department to be academically appropriate. Adequate reading knowledge must be demonstrated by one of the following options:

   a. Four semesters or their equivalent in one language with a minimum average grade of B at an accredited institution, completed not more than five years before the student’s first graduate course in the UAH program.

   b. Intermediate-level performance on a UAH examination in the language, given each term at an announced test date.

   c. A score not lower than the 25th percentile on the Graduate School Foreign Language Test (GSFLT). Registration is necessary 21 days before the examination, and fee is required. A student who plans to pursue the doctoral degree is urged to take this test and pass with a score in the 50th percentile.

In lieu of the language requirement, additional coursework of 3 semester hours of English 507 (English Linguistics) or English 508 (History of the English Language) or a designated course of a similar nature. This option makes a total of 33 hours required for an M.A. in English and 36 hours required for an M.A. in English with Class A teacher certification or on the regular Plan II.

**Class A Teacher Certification**

In addition to the requirements for the M.A. in English or in lieu of them (as indicated below), a student seeking Class A teacher certification must meet the following requirements:

1. Hold or earn before receiving the degree a Class B teacher certificate.

2. Take 9 hours of graduate courses in Education. These hours replace the thesis requirement; thus, of the 33 semester hours required, 24 are in English and 9 are
in Education. Under provisions for strengthened subject matter programs, English courses may be taken instead of Education courses if certain requirements have been met at the undergraduate level.

**Non-Traditional Fifth-Year Program**

Those who have a BA or BS degree with a major or its equivalent in English, who have not taken more than twelve semester hours in teacher education (graduate or undergraduate), and who are interested in obtaining Class A (Master's level) certification for secondary school teaching in English should consider the Non-Traditional Fifth-Year Program. See the description of the program in the Education section of the Graduate Catalog for more details. Contact the Education Department for preliminary advisement on admission and general program requirements. The English Department will assist in devising a program of study.

**TESOL Certificate**

The English Department offers a 12 credit hour certificate in the Teaching of English to Speakers of Other Languages (TESOL). The certificate courses in Applied English Linguistics prepare students for classroom instruction, testing, and material evaluation and preparation in the area of TESOL. The Certificate is awarded upon completion of the M.A. degree in English and the following four courses: EH 507, 508, 609, and 610. Students who wish to apply EH 507 and 508 towards completion of the certificate must take these courses at the graduate level. EH 507 and 508 may apply to requirements for both the M.A. degree and the certificate. EH 609 and 610 may only be counted towards completion of the certificate. Students who already possess an M.A. degree in English may earn the certificate by taking the four required courses; no more than 6 credit hours of relevant graduate level course work taken at another institution may be applied towards the certificate requirements.

**Graduate English (EH) Courses**

The following are advanced undergraduate courses (500 level) open to graduate students, who must carry out special assignments over and above those required of undergraduates.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>500</td>
<td>Literary Criticism and Theory</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Major texts and approaches from Plato to the present.</td>
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<td></td>
<td>An advanced grammar course which includes traditional and contemporary analyses of major English syntactic patterns; dialect studies; analysis of style; selected socio- and psycho-linguistic topics.</td>
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<tr>
<td>508</td>
<td>History of the English Language</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Phonological, morphological, syntactic, and semantic changes in the English language from the pre-Anglo-Saxon period to the modern English period; historical events that have influenced and effected these changes.</td>
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<tr>
<td>530</td>
<td>Special Studies in American Literature</td>
<td>3 hrs.</td>
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<td></td>
<td>Topics announced in advance.</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
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<tr>
<td>533</td>
<td>William Faulkner</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Biography, background, and critical study of the major novels.</td>
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</tr>
<tr>
<td>540</td>
<td>Special Studies in English Literature</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Topics announced in advance.</td>
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<tr>
<td>551</td>
<td>Middle English Literature</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>The literature of later medieval England, excluding Chaucer, chosen from the Gawain poet, Malory, romance and dream vision, the drama, and the short poem.</td>
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<tr>
<td>571</td>
<td>Renaissance Drama</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Major plays of the sixteenth and early seventeenth centuries, including Marlowe, Jonson, and others. Excludes Shakespeare.</td>
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<tr>
<td>572</td>
<td>Seventeenth-Century Poetry</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>A study of seventeenth-century poetry, excluding Milton.</td>
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<td></td>
<td>Major novelists: their depiction of reality in response to the post-Darwinian world.</td>
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<tr>
<td>595</td>
<td>The Idea of the Tragic</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Study of elements of the tragic in the theater and in the modern novel.</td>
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<tr>
<td>609</td>
<td>Applied English Linguistics II: Strategies for Research and Teaching in TESOL</td>
<td>3 hrs.</td>
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<td></td>
<td>Studies in the theoretical and applied aspects of contrastive analyses in teaching English as a second language (TESOL). Contrastive analysis between English and a variety of foreign languages with attention to pedagogical issues. Prerequisite: graduate standing and completion of EH 507 or 508.</td>
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<tr>
<td>610</td>
<td>Applied English Linguistics III: Practicum in TESOL</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Current issues, techniques and materials in teaching English to speakers of other languages (TESOL). Direct and supervised teaching of English to non-native speakers of English. Prerequisite: graduate standing and completion of EH 609, or permission of the instructor.</td>
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<tr>
<td>630</td>
<td>Studies in American Literature to 1865</td>
<td>3 hrs.</td>
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<td></td>
<td>Major movements from Colonial times to 1865; selected major figures or special problems.</td>
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<tr>
<td>631</td>
<td>Studies in American Literature since 1865</td>
<td>3 hrs.</td>
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<td></td>
<td>Major movements since 1865; selected major figures or special problems.</td>
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<tr>
<td>649</td>
<td>Special Studies</td>
<td>3 hrs.</td>
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<td></td>
<td>Study of one or more writers, genres, groups, or movements; announced in advance.</td>
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<tr>
<td>650</td>
<td>Chaucer</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td><em>The Canterbury Tales, Troilus and Criseide</em>, and other works studied in relation to relevant literary and religious traditions.</td>
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<tr>
<td>660</td>
<td>Shakespeare</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Selected Shakespearean plays, with special attention to the major criticism, problems of interpretation, and current issues in Shakespearean study.</td>
<td></td>
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<tr>
<td>665</td>
<td>Renaissance Poetry and Prose</td>
<td>3 hrs.</td>
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<td></td>
<td>The period defined in terms of its principal movements, with attention to the major English authors, such as More, Wyatt, Sidney, Spenser, Marlowe, and Shakespeare, and selected continental predecessors.</td>
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</tr>
<tr>
<td>670</td>
<td>Milton</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>A study of Milton's canon: the development of his thought and art through the early work and the prose culminating in a study of the three major works, especially <em>Paradise Lost</em>.</td>
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</tr>
<tr>
<td>Course</td>
<td>Title</td>
<td>Credits</td>
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<tr>
<td>680</td>
<td>Eighteenth-Century Studies</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>690</td>
<td>Studies in English Romanticism</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>691</td>
<td>Studies in the Victorian Period</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>699</td>
<td>Master’s Thesis</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>
History

Degree: Master of Arts

Chair: J.C. White, Professor; France, Age of Reason, administrative history.

Professors:
Roberts, F.C.; (Emerita); U.S. constitutional, U.S. South, Alabama.
Shields, J.N.; U.S. South, nineteenth-century U.S.
White, C.W.; Britain, modern Europe, historiography, U.S. constitutional.

Associate Professors:
Boucher, P.P.; early modern Europe, European expansion.
Williams, L.E., II; twentieth-century U.S. Black, U.S. South, Mississippi West.

Assistant Professors:
Gerberding, R.A.; ancient, early middle ages, high middle ages.
Phillips, H.D.; Russia, modern Europe, twentieth-Century diplomatic.

The M.A. program in History, like the department's undergraduate program, rests solidly upon the American and European fields of study, with more intensive focus in graduate studies upon historiography, research methods, and the writing of history. Course offerings are balanced between European and American history. Most thesis subjects are selected from topics in United States history or regional history, reflecting the strength of library holdings. The program serves teachers in the area's secondary schools, adults seeking personal enrichment or career advancement, and students who will pursue doctoral-level studies elsewhere. Career opportunities may be enhanced in all fields with familiarization courses in statistics and computer sciences. Students are encouraged to consult with their graduate advisors regarding the benefits of these ancillary skills.

Admission Requirements

Applicants for graduate study in history must present a satisfactory undergraduate scholastic record and satisfactory GRE scores in both the aptitude and advanced portions of the examination. Reading ability in French, German, Russian, or Spanish is required. Admission may be granted without this requirement, but students must demonstrate reading proficiency in one of the above languages before completing 15 hours of graduate course work. Proficiency will be determined by the Department of History and Philosophy in cooperation with the Department of Foreign Languages and Literatures. Students may also make arrangements through the Department Chair to take a standardized [ETS] foreign language test which is administered at the University.

Each applicant must: (a) have a minimum overall undergraduate GPA of at least 3.0 (A = 4.0) or at least a 3.0 for the last 60 hours of work, (b) score at least 1000 on the aptitude portion of the GRE, and (c) have an undergraduate major in History or its equivalent as determined by the departmental Graduate Committee.
Degree Requirements

The history graduate faculty offers courses in European and American history. In addition to the Graduate School requirements, the departmental requirements for the Master of Arts in History are:

1. Eighteen semester hours of graduate work in history, 6 of which may be transfer credit approved by the Graduate Committee. Equal course distribution of U.S. and European history is expected. 5 is required.
2. Six additional hours of elective graduate courses in history or a related subject approved by the Graduate Committee.
3. At least 50 percent of the hours for a graduate degree (exclusive of thesis credit hours) in courses numbered 600 or above. At least 9 hours must be in history courses numbered 600 or above (exclusive of thesis credit hours at UAH).
4. Master’s thesis carrying a minimum of 6 hours. Upon petition to and approval by the department Graduate Committee, a student may substitute 9 hours of graduate history courses for the thesis.
5. Oral comprehensive examination on courses and thesis. Students must demonstrate competency in at least two fields of history. A student who does not write a thesis must take both oral and written examinations.

The requirements for the Master of Arts degree for those students seeking Class A certification are the same as above with the following exceptions:
1. Nine hours of graduate courses in education may be substituted for the elective graduate courses in history or a related subject.
2. An additional nine hours in history may be allowed in lieu of thesis.
3. The student must hold Class B certification.
4. A student who does not write a thesis must take both oral and written comprehensive examinations.
5. The Department of Education will coordinate and direct any supplementary requirements.

Non-Traditional Fifth-Year Program

Those who have a BA or BS degree with a major or its equivalent in history as determined by the department of history, have not taken more than twelve semester hours in teacher education (graduate or undergraduate), and who are interested in obtaining Class A (master level) certification for secondary school teaching, should consider the Non-Traditional Fifth Year Program. Interested students should contact the Education department for preliminary advisement on admission and general program requirements. See the description in the Education section in the Graduate Catalog for more details.

Upper Level Undergraduate Courses In History (HY)

If an applicant has insufficient undergraduate hours in history for even probational admission to the graduate program, but demonstrates to the departmental graduate committee sufficient potential and determination to merit further consideration, 6 to 12 course hours at the 400 level (senior undergraduate) may be required. Courses listed below carry 3 hours semester credit, and are taught in alternate years. Senior undergraduate course credit can not be transferred or used for credit toward the Master of Arts in history.
413 The Old South  3 hrs.
414 The New South  3 hrs.
424 The Atlantic World  3 hrs.
426 Colonial America  3 hrs.
427 The Age of the American Revolution  3 hrs.
428 The Early American Republic  3 hrs.
437 The Transformation of the American Republic  3 hrs.
438 Modern America  3 hrs.
439 Recent American History  3 hrs.
473 The High Middle Ages  3 hrs.
474 The Renaissance and Reformation  3 hrs.
475 The Age of Absolutism  3 hrs.
476 The Ancien Régime and the Enlightenment  3 hrs.
477 The French Revolution and Napoleon  3 hrs.
478 Europe in the Nineteenth Century  3 hrs.
479 Europe in the Twentieth Century  3 hrs.

Graduate Courses In History (HY)

The courses listed below are offered at the senior/graduate level. Undergraduate students registering for 500 level courses must be history majors who have completed 24 hours in history and have senior standing.

513 The Old South  3 hrs.
A study of southern society, economics, politics and culture concentrating on the nineteenth-century South through Reconstruction.

514 The New South  3 hrs.
A study of the post-Reconstruction South emphasizing the economic, social, and political readjustments made during the twentieth century.

524 The Atlantic World  3 hrs.
A study of the Western European colonial empires in a comparative perspective from the 1450s to 1763.

526 Colonial America  3 hrs.
A study of the development of political, religious, and economic institutions in the United States, 1607-1763.

527 The Age of the American Revolution  3 hrs.
A study of political, economic, military, social, and cultural developments in the revolutionary period of American history, 1763-1789.

528 The Early American Republic  3 hrs.
A study of political, social, and economic changes in the United States and its sections from the adoption of the Constitution to the Compromise of 1850.
The Transformation of the American Republic 3 hrs.
A study of the nationalization and modernization of the United States from the period of the Civil War through the Populist movement.

Modern America 3 hrs.
A study of American society focusing on social and cultural change, reform, imperialism, and economic trends from the depression of the 1890s to the outbreak of World War II.

Recent American History 3 hrs.
A study of contemporary America from World War II to the present analyzing both domestic and foreign affairs.

The High Middle Ages 3 hrs.
A study of the political, economic, and cultural features of Europe when medieval civilization was at its height.

The Renaissance and Reformation 3 hrs.
A study of Europe during the Renaissance and Reformation with emphasis upon political, social, economic, and cultural developments.

The Age of Absolutism 3 hrs.
A study of Europe from the Edict of Nantes to the Peace of Utrecht with emphasis on political, cultural, and scientific change.

The Ancien Régime and the Enlightenment 3 hrs.
A study of European intellectual and social movements from the Peace of Utrecht to the outbreak of the French Revolution.

The French Revolution and Napoleon 3 hrs.
A study of European ideas, institutions, and events from the beginning of the French Revolution to the demise of the Napoleonic Empire.

Europe in the Nineteenth Century 3 hrs.
A study of major political, social, economic, and intellectual developments in Europe from the Congress of Vienna to World War I.

Europe in the Twentieth Century 3 hrs.
A study of major developments in Europe from 1914 to the present, including the two world wars and post-war reconstruction.

Research Seminar in History 3 hrs.
Historiography, research and writing, and recent interpretations in the field of history. Open only to seniors who are majoring or minoring in history or to graduate students.

Courses at the 600 level are open to graduate students or to senior history majors in accordance with specific Graduate School requirements.

Recent Interpretations of Modern History 3 hrs.
Development of the ability to appraise critical historical issues through study and discussion of recent interpretations of key historical problems in modern Western history. Prerequisite: Graduate standing or permission of instructor.

Studies in Southern History 3 hrs.
Research, writing, and critical examination of selected topics in nineteenth- and twentieth-century southern history.

Studies in Early American History 3 hrs.
Research, writing, and critical examination of selected topics in early American history form 1607 to 1800.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Research, writing, and critical examination of selected topics in nineteenth-century American history.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research, writing, and critical examination of selected topics in twentieth-century American history.</td>
<td></td>
</tr>
<tr>
<td>650</td>
<td>Research Methods in History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>An exploration of contemporary research methods such as archival research, prosopography, paleography, quantitative methods, and state/local research techniques.</td>
<td></td>
</tr>
<tr>
<td>655</td>
<td>Studies in British History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Research, writing, and critical examination of selected topics in British history.</td>
<td></td>
</tr>
<tr>
<td>656</td>
<td>Studies in French History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Research, writing, and critical examination of selected topics in French history.</td>
<td></td>
</tr>
<tr>
<td>657</td>
<td>Studies in Russian and Soviet History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Research, writing, and critical examination of selected topics on Imperial Russia and the Soviet Union.</td>
<td></td>
</tr>
<tr>
<td>670</td>
<td>Studies in Medieval History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Research, writing, and critical examination of selected topics in medieval history.</td>
<td></td>
</tr>
<tr>
<td>680</td>
<td>Studies in Early Modern Europe</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Research, writing, and critical examination of selected topics in the field of early modern European history.</td>
<td></td>
</tr>
<tr>
<td>690</td>
<td>Studies in Modern Europe</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Research, writing, and critical examination of selected topics in the field of modern European history.</td>
<td></td>
</tr>
<tr>
<td>699</td>
<td>Master's Thesis</td>
<td>1-3 hrs.</td>
</tr>
<tr>
<td></td>
<td>A course required each term a student is working and receiving direction on a master's thesis. A minimum of two terms is required but no more than six hours credit is allowed for the thesis.</td>
<td></td>
</tr>
</tbody>
</table>
Political Science

Degree: Master of Administrative Science in Public Affairs

Chair: Williams, T.J., Associate Professor; Public Administration, Public Policy

Professors:
Meek, R.L.; Administrative Theory
Spitz, A.A.; Public Policy

Associate Professor:
MacDougall, J.J.; International Relations, Third World Systems, Foreign Policy

Assistant Professors:
Brown, J.C.; Administrative Law, Statistics
Margolis, L.S.; Communist and Parliamentary Systems, Foreign Policy
Pottenger, J.R.; Ethics and Public Policy

The Master of Administrative Science in Public Affairs is a graduate program focusing on the study of the theory and processes of policy making with a general emphasis on management problems of public organizations.

Admission Requirements

Applicants must meet the general requirements for admission to the School of Graduate Studies, and be recommended for approval by the department's graduate committee prior to admission to the program.

Degree Requirements

The requirements for the Master of Administrative Science in Public Affairs are:
1. Thirty-six hours of approved graduate work from the following courses:
   A. Twenty-one hours required of all students: MGT 621, 622, 623; PSC 650, 660, 610; and ECN 607.
   B. Fifteen hours to be selected from the following courses: PSC 620, 652, 655, 678, 680, 685, 689, and 695.
2. Successful completion of a written and an oral examination to be taken at the end of thirty-six hours of coursework in the Program.

Graduate Courses

MGT 621 Introduction to Administrative Science 3 hrs.
Principles of organizational structure, planning and forecasting, directing, controlling, staffing, decision-making, communication, and their relation to one another. Preparation for higher-level administrative science courses.
MGT 622 Human Behavior in Organization 3 hrs.
Organization as a continuing social system. Problems of motivation and incentives, organizational communication, and their blockages. Selection, training, promotion, and severance of organizational members.

MGT 623 Organizational Theory 3 hrs.
Theories of organizations and their structures. Organizations from the perspectives of management, psychology, sociology, political science, and economics. Organizations as groups of people and as systems in multiple environments. Goals, resources, effectiveness, equilibrium, and change relating to organizations. Administration's relationships with organization with emphasis on research and assessment. Prerequisite: AS 621.

ECN 607 Survey of Economic Theory 3 hrs.
Rigorous treatment of basic principles underlying economic theory. Theory of national income determination, theory of market structures, principles of value and distribution theory. Prerequisite: approval of AS Graduate Programs Coordinator.

Introduction to public management as a field of study and practice. Review of basic literature. Emphasis on ethics in public service.

PSC 660 Public Policy Determination 3 hrs.
Study of economic, political, social, and institutional factors which influence the policy making process and the impact of policy decisions made by the national, state, and local levels of government. Examination of the steps in policy-program analysis and evaluation.

PSC 610 Statistics for Public Managers 3 hrs.
Review of basic statistical designs utilized by public managers.

The remaining fifteen (15) hours will be selected from the following courses:

PSC 620 Intergovernmental Relations 3 hrs.
Intergovernmental relations in the U.S. Specific government programs are discussed in terms of funding arrangements, policy decisions, and program administration.

PSC 652 Public Personnel Administration 3 hrs.
Purposes, functions, and processes of personnel management at the national, state, and local levels.

PSC 655 Budgetary Process 3 hrs.
Governmental revenue and expenditure policies. Budget as a method of administrative and fiscal control.

PSC 678 Administrative Law and Regulations 3 hrs.
Judicial influences and controls on exercise of administrative authority with analysis of governmental regulatory policies.

PSC 680 Special Topics in Public Administration 1-3 hrs.
Study of selected current issues in Public Administration

PSC 685 Problems in Public Administration 3 hrs.
Course will focus on case studies of major problems in Public Administration and examine the causes for the solutions to these problems.

PSC 689 Public Policy Seminar 3-6 hrs.
Course will focus on specific policy areas of the national government such as foreign policy, science policy or national security policy.

PSC 695 Internship in Government 1-6 hrs.
Graduate students may receive from one to 6 hours of academic credit for an internship with local, state, or federal governmental agencies. Students must attend internship seminars, keep a log of activities, and submit a report on their internship.
Psychology

Degree: Master of Arts

Chair: W. R. Sullins, Associate Professor; behavioral analysis, experimental, motivation, emotion.

Professor:
Rogers, J.G.; theory of abnormal, human factors, counseling.

Associate Professors:
Coffield, K. E.; personality theory and research.
Hays, D. G.; social psychology, symbol processing.
James, R. E.; learning theory, nonverbal communication, experimental aesthetics.
Kirkpatrick, S W.; developmental theory and research, research methodology.

The Psychology faculty offers courses leading to the Master of Arts degree as specified in Plan I of the School of Graduate Studies. This program is primarily directed toward the student whose goal is the continuation of scholarly study, research, and writing. Courses offered in the program are focussed on developmental theory and its empirical investigation, on relevant experimental and statistical methods, and on related subjects such as human learning and theory of abnormal psychology.

Admission Requirements

In addition to the general requirements for admission to the School of Graduate Studies, this program requires a minimum combined score of 1100 on the verbal and quantitative portions of the Graduate Record Examination, an overall gradepoint average of 3.25 or a minimum of 3.25 for the last 60 hours of work, and very strong positive recommendations. Fifteen hours of psychology, approved by the graduate committee of the department, are required for admission. Applications for admission must include three letters of recommendation from former professors, including at least one from a psychology professor. Recommendations should be sent to: The Graduate Committee, Department of Psychology. Applications are not acted upon until all materials are complete.

Degree Requirements

In addition to the Graduate School requirements, the requirements for the Master of Arts are:
1. At least 30 hours of graduate work, including 6 hours of thesis. A maximum of 6 hours may be transfer courses approved by the graduate committee of the department.
2. The following 4 courses are required of all students; Py 601, Py 603, Py 611 and Py 613. Three of these four must be completed before taking Py 641 or Py 643.
3. Each student must complete at least 6 hours of Directed Individual Study, Py 641 and Py 643, prior to beginning work on his/her required thesis.
4. The remaining courses will be selected, with faculty advice, from graduate level courses in Psychology, and may include up to 6 hours of graduate courses from related departments such as Biology, Developmental Learning or Administrative Science.

5. An oral comprehensive examination is required of all students. This examination covers both course work and the thesis.

**Upper Level Undergraduate Courses in Psychology (PY)**

Courses listed below are senior level undergraduate courses. Senior undergraduate course credit can not be transferred or used for credit toward a Master of Arts degree.

- 401 Personality
- 410 Human Research: Developmental
- 411 Human Research: Motivation and Emotion
- 412 Human Research: Personality
- 413 Human Research: Applied Social Psychology
- 414 Human Research: Learning
- 420 Seminar in Psychology
- 422 Individual Research
- 426 History and Systems in Psychology
- 433 Abnormal and Health Psychology for the Human Service Professions
- 436 Physiological Psychology

**Graduate Courses in Psychology (PY)**

The courses listed below are offered at the senior/graduate level. Undergraduate students registering for 500 level courses must be psychology majors who have completed 24 hours in Psychology and have senior standing.

- 502 Industrial and Organizational Psychology
  - Application of basic principles of learning, motivation, and perception to typical industrial and organizational problems.
  - 3 hrs.

- 503 Advanced General Psychology
  - Survey. Various major areas of psychology. Open only to senior psychology majors and graduate students. Prerequisite: 24 hours PY and senior standing.
  - 3 hrs.

- 513 Psychometrics
  - History and development of psychological testing with special emphasis given to both theory and process of effective evaluation.
  - Prerequisites: AHSS 300.
  - 3 hrs.

- 531 Individual Mental Testing: Stanford-Binet
  - Various assessment techniques; particular emphasis on Stanford-Binet. Use of theory and practice. Includes laboratory. Fee: Level 3. Prerequisite: approval of instructor.
  - 3 hrs.

- 532 Individual Mental Testing: Wechsler
  - Individual testing with Wechsler tests, along with practical experience. Includes laboratory.
  - Fee: Level 3. Prerequisite: PY 531.
  - 3 hrs.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>535</td>
<td>Theory of Abnormal Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Major behavior exceptionalities of childhood and adulthood with emphasis on empirical findings. Prerequisite: PY 433 or approval of instructor.</td>
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</tr>
<tr>
<td>601</td>
<td>Advanced Developmental Psychology: I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>An overview of major models of developmental theory and of theorists representing these models. Examination of issues, problems and research relevant to these theories. Prerequisites: PY 315 or equivalent as approved by instructor.</td>
<td></td>
</tr>
<tr>
<td>603</td>
<td>Advanced Developmental Psychology: II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Continuation of PY 601. Prerequisite: PY 601.</td>
<td></td>
</tr>
<tr>
<td>606</td>
<td>Language Development</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Stages of language development and techniques for stimulating language development and communication skills in the young child. Includes practicum.</td>
<td></td>
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<tr>
<td></td>
<td>Experimental design and appropriate statistical techniques for psychological research. Includes laboratory for statistical applications. Fee: Level 6. Prerequisites: AHSS 300 and PY 302 or equivalents as approved by instructor.</td>
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</tr>
<tr>
<td>613</td>
<td>Research Methods and Statistics II: Nonexperimental Designs</td>
<td>4 hrs.</td>
</tr>
<tr>
<td></td>
<td>Methods of psychological research in areas where direct manipulation of independent variables is infeasible. Observation, questionnaires, modeling, regression analysis, cluster and factor analysis and scaling processes. Laboratory included. Fee: Level 6. Prerequisites: AHSS 300 and PY 302 or equivalents approved by instructor.</td>
<td></td>
</tr>
<tr>
<td>615</td>
<td>Graduate Seminar</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Intensive analysis of selected theoretical or applied topics relating to psychological development. Prerequisite: graduate standing.</td>
<td></td>
</tr>
<tr>
<td>628</td>
<td>Human Learning Theory</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Critical examination of behavior changes commonly called “learning,” as well as closely related behavioral phenomena such as transfer, retention, and stimulus generalization.</td>
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</tr>
<tr>
<td>629</td>
<td>Behavior Modification</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Psychological principles concerning control of human behavior and current theoretical and experimental research in behavior modification.</td>
<td></td>
</tr>
<tr>
<td>641</td>
<td>Directed Individual Study and Research I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Independent readings and/or experiments in an area within the student’s field of specialization. May be taken more than once for credit. Prerequisites: Completion of any 3 of the following: PY 601, 603, 611, 613; and permission of instructor.</td>
<td></td>
</tr>
<tr>
<td>643</td>
<td>Directed Individual Study and Research II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Independent readings and/or experiments in the student’s area of specialization. One of the requirements of this course is a major research paper, of publishable quality, which will be reviewed by the faculty of the department. Prerequisites: PY 341 and permission of advisor.</td>
<td></td>
</tr>
<tr>
<td>655</td>
<td>Symbolic Processes</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Psychology of processing symbolic material.</td>
<td></td>
</tr>
<tr>
<td>699</td>
<td>Master's Thesis</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>A course required each term a student is working on, and receiving faculty direction on, the master's thesis. A minimum of two terms is expected, but no more than 6 hours is allowed, for the thesis. Credit awarded upon successful completion of the thesis. Prerequisites: PY 643.</td>
<td></td>
</tr>
<tr>
<td>SOC 630</td>
<td>Industrial Sociology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Development of modern work relations in an historical and dialectical framework. Consequences of modern work relations on cultural values such as democracy and individuality. Alternative work relations with attention to industrial sociology.</td>
<td></td>
</tr>
</tbody>
</table>
College of Nursing

Degree: Master of Science in Nursing

Dean: J.K. Shoemaker, Professor

Director:
Burge, J.M., Professor; medical-surgical nursing, foundations of education.

Professors:
Hincker, E.A.; public health nursing, administration in higher education.
Shoemaker, J.K.; medical-surgical nursing, curriculum and instruction.

Associate Professors:
Henze, R.L.; medical-surgical nursing, teaching.
Perrin, M.N.; psychiatric nursing, management of human services organization.
Williamson, J.W.; adult health nursing, teaching.

Assistant Professors:
Benedict, S.; family nursing, adult health nursing.
Cash, J.T.; adult health nursing, teaching.
Holder, P.; adult health nursing.
Stuart, G.; cardiovascular nursing, teaching.

The Master of Science in Nursing degree augments the professional base provided in baccalaureate-level study. It provides a theoretical and clinical base which enables the graduate to engage in advanced professional practice. The program is designed for five terms of full-time study.

Clinical experiences focus on the family. They provide opportunities for students to individualize the program while developing advanced skills in Adult Acute Care or as Family Nurse Practitioners. The Adult Acute Care track has the functional options of teaching or supervision; the Family Nurse Practitioner track has the functional component of Practice. Upon completion of the Family Nurse Practitioner requirements, the graduate is eligible to apply for state and national certification as a Family Nurse Practitioner.

Special Facilities

Madison County has three general hospitals with a licensed capacity of 1,013 beds, one army hospital licensed for 42 beds, a county health department, and five skilled nursing homes with approximately 685 beds. The University Medical Clinics are a clinical service facility for the UAH School of Primary Medical Care and serves also as a facility for the School of Nursing.

Huntsville Hospital (578 beds), the largest general hospital in the northern part of the state, is the regional medical care center for north Alabama and southcentral Tennessee. The hospital offers comprehensive emergency treatment facilities and the only newborn intensive care unit in north Alabama. Crestwood Hospital (120
beds) is a private general hospital fully equipped to handle most diagnostic and surgical procedures. Humana Hospital Huntsville (315 beds), the largest private hospital in the area, is a general, acute care hospital with a complete range of surgical, medical, and obstetrical services. Fox Army Community Hospital provides complete outpatient care and general medical and surgical short-term acute care. Rural health clinics in Jackson County are also used for student experiences as are other hospitals, clinics, and physicians’ offices on a selected basis.

**Admission Requirements**

In addition to meeting the requirements for admission to the School of Graduate Studies, requirements for admission to the graduate program in nursing are:

1. Graduation from a National League for Nursing accredited baccalaureate program with a major in nursing.
2. Grade point of 3.0 on a 4.0 scale in all undergraduate nursing courses.
3. Evidence of a current license to practice as a registered nurse in Alabama.
4. Three letters of reference, at least one of which is from a current nursing employer or supervisor and one of which is from a previous faculty member or dean.
5. One undergraduate (AHS 300 or MSC 287) course in basic statistics.
6. A minimum of one year of full-time professional nursing practice.
7. Personal interview (may be required).

Once a student has been admitted to the graduate program, and prior to registration in a clinical course, the following must be on file with the Director of the Graduate Program:

1. A health and dental examination by a medical physician and dentist with results of the examination submitted on forms provided by the College of Nursing.
2. Documentation of personal health insurance that covers cost of ambulatory or out-patient treatment.
3. Documentation of professional liability insurance.
4. Documentation of an approved CPR certification which is kept current throughout the program.

**Degree Requirements**

Students may follow one of two plans for their program of study: (1) Plan I: Thesis, or (2) Plan II: Professional Paper. Requirements for completion of the program in Plan I are a minimum of 50 semester hours of graduate coursework for
students enrolled in the Adult Acute Care track, and a minimum of 53 semester
hours for those enrolled in the Family Nurse Practitioner track. Requirements for
completion of the program in Plan II are a minimum of 54 semester hours of
graduate coursework for students enrolled in the Adult Acute Care track and a
minimum of 51 semester hours for those enrolled in the Family Nurse Practitioner
track. Both plans also require that all students successfully complete a written
comprehensive examination before progressing to the oral exam.

Financial Aid

Financial aid for graduate students in the College of Nursing comes primarily
from the following sources:

1. Alabama Board of Nursing Scholarships.

Fifteen scholarships are granted each year to graduate students attending schools
in Alabama. Funding is $3,800 for full-time study for one year or $950 per term
for one year. Students must make application directly to the Alabama Board of
Nursing by June 1 of each year.


The School of Nursing applies annually for a limited number of traineeships
for graduate students. These funds are granted to students enrolled for
full-time study in the program. Application forms may be obtained through
the Office of Financial Aid or the Office of the Director of the Nursing
graduate program.

3. Elizabeth M. Fisher Memorial Scholarship.

4. Graduate Teaching Assistantships.

5. Graduate Tuition Scholarships.

Nursing Tracks

Core Requirements:  

<table>
<thead>
<tr>
<th>Course</th>
<th>Semester Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of Nursing Theory (NUR 601)</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Statistics</td>
<td>4</td>
</tr>
<tr>
<td>Seminar in Research (NUR 602)</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Health Assessment (NUR 606)</td>
<td>3</td>
</tr>
<tr>
<td>Pathophysiology (NUR 612)</td>
<td>4</td>
</tr>
<tr>
<td>Use of Computers in Nursing (NUR 604)</td>
<td>3</td>
</tr>
<tr>
<td>Professional Practice Issues (NUR 641)</td>
<td>2</td>
</tr>
<tr>
<td>Family Nursing (NUR 627)</td>
<td>5</td>
</tr>
</tbody>
</table>

Total: 27
**Adult Acute Care Track**

In addition to the above 27 semester hours of required core courses, student selects one of the following options:

Option I: Adult Acute Care with Teaching Functional Area
- Acute Care Nursing (NUR 631, 632) ......................................................... 8
- Teaching Support Courses (NUR 634, 635) ........................................ 6
- Teaching Practicum (NUR 636) ................................................................. 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Care Nursing</td>
<td>8</td>
</tr>
<tr>
<td>Teaching Support Courses</td>
<td>6</td>
</tr>
<tr>
<td>Teaching Practicum</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

OR

Option II: Adult Acute Care with Supervision Functional Area
- Acute Care Nursing (NUR 631, 632) ......................... 8
- Supervision Support Course (AS 621, 622, 623 or 624) ........ 3
- Nursing Management (NUR 633) ........................................ 3
- Supervision Practicum (NUR 636) ............................ 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Care Nursing</td>
<td>8</td>
</tr>
<tr>
<td>Supervision Support Course</td>
<td>3</td>
</tr>
<tr>
<td>Nursing Management</td>
<td>3</td>
</tr>
<tr>
<td>Supervision Practicum</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

The remaining 6-10 hours required are selected on the basis of a thesis (Plan I) for 6 semester hours, or a professional paper (Plan II) for 4 semester hours plus 6 hours of electives. A minimum of 50 semester hours is required for the program in acute care nursing.

**Family Nurse Practitioner Track**

In addition to the above 27 semester hours of required core courses, student completes the following 24-26 semester hours of course work if enrolled in the family nurse practitioner track:
- Role Socialization (NUR 640) .......................................................... 2
- Community Nursing (NUR 628, 629, 630) ......................... 15
- Pharmacology in Advanced Practice (NUR 614) ..................... 3
- Professional Paper (NUR 603) .......................................................... 4

OR
- Thesis (NUR 699) .......................................................... 6

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role Socialization</td>
<td>2</td>
</tr>
<tr>
<td>Community Nursing</td>
<td>15</td>
</tr>
<tr>
<td>Pharmacology in Advanced Practice</td>
<td>3</td>
</tr>
<tr>
<td>Professional Paper</td>
<td>4</td>
</tr>
<tr>
<td>Thesis (NUR 699)</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24-26</strong></td>
</tr>
</tbody>
</table>

A minimum of 51 semester hours is required in the program preparing family nurse practitioners.

**Graduate Nursing Courses (NUR)**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td><strong>Special Topics</strong></td>
<td>2-4 hrs.</td>
</tr>
<tr>
<td>601</td>
<td><strong>Development of Nursing Theory</strong></td>
<td>3 hrs.</td>
</tr>
<tr>
<td>602</td>
<td><strong>Seminar in Research</strong></td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>
Professional Paper 4 hrs.
Application of research or investigative process with faculty guidance. Research or investiga­tion of a nursing problem and preparation of appropriate written report. Minimum of four hours required. Prerequisites: NUR 627 and Advanced Statistics. Corequisite: NUR 602.

Use of Computers in Nursing 3 hrs.
Instruction in use of computers in contemporary nursing practice, education and research. Applications will include the use of statistical software for data analysis and interpretation. Lab fee: Level 5. Prerequisites: NUR 602 and Advanced Statistics.

Advanced Health Assessment 3 hrs.

Pathophysiology 4 hrs.
Expansion upon previous knowledge of anatomy, physiology, adaptation, and disease process. Anticipated and existing physiological alterations as they affect the individual and the family. Corequisites: NUR 601, 606.

Pharmacology in Advanced Practice 3 hrs.
Advanced content in clinical pharmacology based on body systems and the physiological-biochemical relations with and between those systems. Prerequisite: NUR 612. Corequisite: NUR 627.

Family Nursing 5 hrs.

Family Nursing in Community I 4 hrs.

Family Nursing in Community II 4 hrs.
Advanced nursing concepts and clinical practice of health management of children in context of the family. Lab fee: Level 7. Prerequisites: NUR 628 and NUR 640.

Family Nursing in Community III 7 hrs.

Family Nursing in Acute Care I 4 hrs.

Family Nursing in Acute Care II 4 hrs.
Continuation of concepts and clinical practice begun in NUR 631. Lab fee: Level 7. Prerequisite: NUR 631.

Management Theory for Advanced Nursing Practice 3 hrs.
Selected topics are explored to increase knowledge of management theory related to preparation of nursing supervisors. Includes decision making, performance appraisals, resource and risk management, and politics of management and labor relations. Prerequisites: AS 621, 622, 623 or 624. Corequisite: NUR 631.

Curriculum Development in Nursing 3 hrs.
Theories and concepts of contemporary curriculum development and program evaluation in associate and baccalaureate nursing programs. Corequisite: NUR 627.
635  Teaching and Evaluation in Nursing  3 hrs.
Teaching strategies applicable to basic nursing education including process of formative and summative evaluation. Prerequisite: NUR 634.

636  Practicum in Supervision  3 hrs.

637  Practicum in Teaching  3 hrs.
Practicum in planning and teaching nursing to selected groups at the associate and baccalaureate degree levels. Lab fee: Level 7. Prerequisite: NUR 635. Corequisite: NUR 641.

640  Concepts of Role Socialization  2 hrs.
Seminar in leadership skills and role socialization to enhance effectiveness of master's prepared family nurse practitioner students. Corequisite with NUR 628.

641  Issues in Professional Practice  2 hrs.
Exploration of professional nursing's development and related social, political, and technological forces. Strategies for management and change are identified and evaluated. Corequisite with NUR 630, 636, or 637.

650  Independent Study  2-4 hrs.
The planning, implementation, and evaluation of related phenomena of special interest observed in nursing practice. Prerequisite: Dean's approval.

699  Thesis  6 hrs.
Independent research investigation related to practice of nursing under faculty guidance. Prerequisite: NUR 627 and Advanced Statistics. Minimum of six hours required. Corequisite: NUR 602.
The College of Science includes the departments of Biological Sciences, Chemistry, Computer Science, Mathematics and Statistics, and Physics. In addition, significant graduate course offerings are available in atmospheric and environmental sciences, biochemistry, materials science, and optical sciences.

The College offers programs leading to the Ph.D. degree in Computer Science and in Physics. Proposals to offer Ph.D. degrees in Materials Science and in Applied Mathematics are presently being reviewed by the Alabama Commission on Higher Education for implementation in the fall of 1987. A Ph.D. degree is also offered in chemistry and in mathematics through cooperative programs with other campuses in the University of Alabama system. All departments in the School offer programs leading to the M.S. degree. A program for the M.A. degree is offered in the Department of Mathematics and Statistics.

While the College of Science does not directly prepare students for professional degrees, provisions are available for public school teachers who wish to concentrate in the sciences while pursuing graduate professional degrees in education. In addition to the usual class A (master’s level) certification, a Non-Traditional Fifth Year Program (NTFYP) is available for individuals who already have a B.A. or B.S. degree with a major in Biological Sciences, Chemistry, Mathematics, or Physics but who do not already have the Class B (bachelor’s level) certification. Individuals interested in obtaining Class A (master’s level) certification through the NTFYP should contact the Education Department and also see the Education section in this catalog.

In formulating a strategic mission for the College, we continue to emphasize basic research while exploring every opportunity to strengthen our ties with production segments in the government and private sectors. Our strength lies in our ability to freely explore and investigate new and promising ideas. The College takes advantage of its strategic location in the midst of the heavy concentration of high technology-oriented private and government industries of the Tennessee Valley. In this regard, we offer unique opportunities for original investigations at the forefront of science and technology, including problems which are of direct interest to industry as well as to basic academic research. Dissertation and thesis
work may be undertaken in areas where numerous opportunities exist for testing theoretical models under experimental conditions. In several graduate program areas there is a close working relationship with the College of Engineering.
Atmospheric and Environmental Science

(Non-degree Program)

Acting Coordinator: McNider, R. T.; Assistant Professor, Mathematics and Statistics; numerical atmospheric modeling and environmental transport.

Faculty: Faculty members for this program have academic appointments in established University programs and local industry. University programs include Biological Sciences, Chemistry, Engineering, Mathematics and Statistics, Optics, Physics, and the Johnson Research Center.

The Atmospheric and Environmental Science graduate program is instituted to provide a series of courses which can be used to develop a coherent minor or area of specialty under M.S. and Ph.D. degree programs in Science, Mathematics and Statistics, and Engineering. The program is designed to allow students pursuing advanced degrees in the above programs to obtain the necessary background to successfully pursue research topics in atmospheric and environmental science. Research in atmospheric science now ongoing at UAH in academic departments and research centers coupled with excellent atmospheric research facilities at NASA's Marshall Space Flight Center allows students to be involved in state-of-the-science research in atmospheric and environmental science.

Requirements for a Minor/Certificate in Environmental Science:

Minors and certificates in environmental science may be earned by students in any field with the approval of the student's advisor. Individual advisors will tailor programs to meet the student's educational needs.

Atmospheric and Environmental Science (ES)

512 Environmental Transport 3 hrs

521 Environmental Data Management and Analysis 3 hrs
Overview of computer hardware, software, communications, and terminals. Management information systems, overview of techniques of data archival and retrieval. Introduction to graphical and image analysis systems. Prerequisites: computer programming and statistics.

525 Environmental Chemistry 3 hrs.
Principles of quantitative analyses related to minor components of a sample. Applications selected from principal analyses necessary to maintain environmental quality of air, water, and soil. Selection of conditions for collecting reliable samples, concentration of components with techniques for increasing concentration of selected component, relationships between physical and chemical changes in sample and signal output of predominant transducers, and translation of chemical analysis into meaningful specifications. Lecture only. Prerequisite: CH 521 or 123: EG 311, 342. (Same as CH 525).
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>551</td>
<td>Atmospheric Fluid Dynamics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>A study of fluid dynamics in the atmosphere. Coriolis acceleration, scale analysis and appropriate approximations of the complete governing equations. Numerical analysis and interpretation of weather phenomena. Prerequisites: MA 352, ME 341, ME 352 or equivalent. (same as ME 551)</td>
<td></td>
</tr>
<tr>
<td>553</td>
<td>Atmospheric Radiation</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>581</td>
<td>Atmospheric Thermodynamics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>An introduction to thermodynamics of the atmosphere and relation to weather phenomenon. Review first and second law, special atmospheric thermodynamics variables, treatment of air-water systems, atmospheric thermodynamic diagrams, atmospheric statics and vertical stability. Prerequisites: MA 352, PH 321 or ME 341. (same as ME 581)</td>
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</tr>
<tr>
<td>593</td>
<td>Directed Studies in Atmospheric and Environmental Science</td>
<td>1-4 hrs.</td>
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<tr>
<td></td>
<td>Supervised compilation, summarization, and discussions of special topics in atmospheric and environmental science. Prerequisite: permission of instructor.</td>
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<tr>
<td>643</td>
<td>Atmospheric Boundary Layers</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Operational characteristics of lasers or other optical devices in the atmosphere are dependent upon the turbulent structure of the atmosphere. In addition, the optical interference of smoke and dust is dependent upon both absolute and relative turbulent dispersion of the aerosols. Topics to be covered: structure of convective and stable boundary layers, similarity methods, turbulent intensity and scale, relative-two particle dispersion, absolute-single particle dispersion, Gaussian and statistical models. Prerequisites: ME 551 or ES 551.</td>
<td></td>
</tr>
<tr>
<td>653</td>
<td>Atmospheric Optics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Operational characteristics of optical or other radiative devices depends upon the radiative properties of the atmosphere-scattering, absorption, refraction, etc. Topics to be covered: Distribution and properties of atmosphere aerosols and gases, condensation and haze state, refraction of light by-air, crystals and water drops, Raleigh scattering, Mie scattering, visibility, air mass optical characteristics. Prerequisites: ES 553, PH 541.</td>
<td></td>
</tr>
<tr>
<td>663</td>
<td>Advanced Topics in Atmospheric Science</td>
<td>1-3 hrs</td>
</tr>
<tr>
<td></td>
<td>To include Satellite and Radar Meteorology and Numerical Atmospheric Modeling.</td>
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</tr>
<tr>
<td>681</td>
<td>Numerical Atmospheric Modeling</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Introduction to numerical methods applied to simulation of the atmosphere. Filtering radiative parameterization, thermodynamics, turbulent parameterization, initialization, coordinate transformation. Prerequisite: MA 415, ES 551.</td>
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</tr>
</tbody>
</table>
Biological Sciences

Degree: Master of Science

Chair: R.B. Young, Professor; gene expression in skeletal muscle, recombinant DNA.

Professors:

Associate Professors:

Assistant Professors:

The Department of Biological Sciences provides instruction, learning, and creative scholarly activities in the biological sciences. Scholarly investigations are undertaken by scientists and those who as graduate students (and sometimes advanced undergraduate students) undertake to become future scholars. The department does not offer courses in all areas of biological science; rather, it has chosen to emphasize instruction at the undergraduate and graduate levels in the following general areas:

1. cellular and developmental biology
2. microbiology
3. environmental biology
4. genetics and molecular biology

The graduate program is exceptional in at least two ways. First, the relatively small number of graduate students fosters an academic atmosphere stressing individuality and close interaction with the graduate faculty. Second, the graduate program is a cooperative venture with Alabama A&M University, with a combined faculty at both UAH and A&M of approximately 20. This arrangement provides a faculty resource and diversity of expertise available in large universities without sacrificing the close, personal supervision only small programs can accomodate.

Special Facilities
Facilities available for postgraduate research include well equipped laboratories in biochemistry, molecular biology, physiology, cell biology, microbiology, immunology, environmental biology and limnology. Graduate students also have access
to the following support units: A Univac 1100/70 computer with terminals in the Science Building; Sperry microcomputers; the Johnson Environmental and Energy Center's biomass conversion demonstration plant and research laboratories with extensive instrumentation; and the Marine Research Complex at the Dauphin Island Sea Lab, located on the northern shore of the Gulf of Mexico, with three ocean-going research vessels and a library with holdings pertinent to marine biology research. In addition, the UAH library houses over 6750 monographs and 450 journals in the biological and medical sciences. Specific accommodations and equipment for graduate research include an electron microscopy suite with a Phillips 201 transmission electron microscope, a variety of light microscopes, a laboratory animal care facility, radiotracer technology with both liquid and gamma scintillation counters, preparative centrifuges, ultracentrifuges, tissue culture facilities, recombinant DNA laboratory, electrophoresis equipment, numerous UV-visible recording spectrophotometers, physiograph, limnological research boat, arboretum, and greenhouse facilities. Biological research equipment at Alabama A&M University is also available.

**Admission Requirements**

In addition to fulfilling admission requirements set by the School of Graduate Studies, applicants must also:

1) show competence in an area of life science related to the proposed area of study;

2) complete one year of undergraduate chemistry, including at least one term of organic chemistry and biochemistry;

3) have a minimum GPA of 3.0 (A = 4.0) in the major area of concentration.

A course in statistics is also recommended.

**Degree Requirements**

The graduate faculty, in cooperation with the Biology graduate faculty of Alabama A & M, offers an M.S. in Biological Sciences with emphasis in cell and developmental biology, ecology, genetics and molecular biology, microbiology, physiology, and systematics. A minimum of 25 percent of biological sciences course requirements must be met at the cooperating institution. A minimum of 50 percent of the graduate program must be taken at the 600 level.

Students may elect one of the following three plans:

**Plan I—Master of Science with thesis**

a. Graduate course work of 24 semester hours of an approved program;

b. Comprehensive coursework examination;

c. Acceptable thesis describing original research;
d. Final oral examination.

Plan II—Master of Science without thesis

a. Approved program of 33 semester hours;

b. Acceptable master's report (Library search, survey, and/or experimentation);

c. Comprehensive final examination.

Plan III—Master of Science with Education option (Class A Certification)

a. Approved program of 24 semester hours in biological science and 9 semester hours in education;

b. Acceptable master's report;

c. Comprehensive final examination.

Non-traditional fifth-year program leading to the M.S. in Biological Sciences plus a class A Alabama high school teachers certificate

Those who have a BA or BS degree with a major or its equivalent in Biological Sciences as determined by the department of Biological Sciences and have not taken more than twelve semester hours in teacher education (graduate or undergraduate), and who are interested in obtaining Class A (masters level) certification for secondary school teaching, should consider the Non-Traditional Fifth Year Program. Contact the Education department for preliminary advisement on admission and general program requirements. See the description in the Education section in the Graduate Catalog for more details.

Undergraduate Biological Sciences Courses (BYS)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>Elementary Biochemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>312</td>
<td>Principles of Ecology</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>313</td>
<td>Anatomy and Physiology I</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>314</td>
<td>Anatomy and Physiology II</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>315</td>
<td>Ichthyology</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>317</td>
<td>Vertebrate Zoology</td>
<td>5 hrs.</td>
</tr>
<tr>
<td>318</td>
<td>Vertebrate Reproduction</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>319</td>
<td>General Genetics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>320</td>
<td>Genetics Laboratory</td>
<td>1 hr.</td>
</tr>
<tr>
<td>340</td>
<td>Introduction to Cellular and Developmental Biology</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>361</td>
<td>General Biochemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>362</td>
<td>General Biochemistry Laboratory</td>
<td>1 hrs.</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
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<tr>
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</tr>
<tr>
<td>364</td>
<td>Biogeography</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>368</td>
<td>Dendrology</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>371</td>
<td>Nonvascular Cryptogramic Botany</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>372</td>
<td>Biology of Vascular Plants</td>
<td>5 hrs.</td>
</tr>
<tr>
<td>378</td>
<td>Invertebrate Zoology</td>
<td>5 hrs.</td>
</tr>
<tr>
<td>421</td>
<td>Introduction to Medical Microbiology</td>
<td>5 hrs.</td>
</tr>
<tr>
<td>429</td>
<td>Animal Histology</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>430</td>
<td>Immunology</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>435</td>
<td>Bacterial Physiology and Metabolism</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>436</td>
<td>Physiological Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>464</td>
<td>Speciation and Evolution</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>490</td>
<td>Special Topics in Biological Sciences</td>
<td>1-4 hrs.</td>
</tr>
<tr>
<td>492</td>
<td>Undergraduate Research</td>
<td>2-4 hrs.</td>
</tr>
<tr>
<td>496, 497, 498, 499 Seminar</td>
<td></td>
<td>1 hr. each</td>
</tr>
</tbody>
</table>

**Graduate Biological Sciences Courses (BYS)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>519</td>
<td>Gene Structure and Function</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Molecular basis for inheritance and gene expression. Advanced studies of replication, transcription, translation. Includes regulation of gene expression, gene cloning and recombinant DNA technology. Prerequisites: BYS 319 and BYS/CH 361.</td>
<td></td>
</tr>
<tr>
<td>521</td>
<td>Medical Mycology (UAH)</td>
<td>4 hrs.</td>
</tr>
<tr>
<td></td>
<td>Comprehensive study of fungi pathogenic to man; their properties, pathogenesis, and laboratory diagnosis. Two 2-hour labs a week. Lab fee: Level 4. Prerequisite: BYS 421; BYS 430 is recommended.</td>
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</tr>
<tr>
<td>524</td>
<td>Mycology (UAH and A&amp;MU)</td>
<td>4 hrs.</td>
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<tr>
<td></td>
<td>Lines of phycomycetes using representative species; various series of actinomycetes; representative pathogenic (crop and vegetative pathogens) and nonpathogenic heterobasidio-mycetidae organisms; orders and families of homobasidio-mycetidae. Ontogenetics, cellular, and structural study applied to all divisions, classes, series, orders and families. Lab fee: Level 4.</td>
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</tr>
<tr>
<td>525</td>
<td>Medical Parasitology (UAH)</td>
<td>5 hrs.</td>
</tr>
<tr>
<td></td>
<td>Protozoa and helminths parasitic for man and their laboratory identification. Arthropods in relation to their roles as vectors. Two 2-hour labs a week. Lab fee: Level 3. Prerequisite: BYS 221 or equivalent.</td>
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<tr>
<td>531</td>
<td>Plant Physiology (UAH)</td>
<td>4 hrs.</td>
</tr>
<tr>
<td></td>
<td>A general introductory study of life processes of plants, including water relations, mineral utilization, metabolism, photosynthesis, digestion, respiration, assimilation, and growth as affected by growth hormones. One 3-hour lab a week. Lab fee: Level 3. Prerequisites: BYS 113, 371, or 372, CH 113 or 331).</td>
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</tr>
<tr>
<td>532</td>
<td>Animal Physiology (UAH)</td>
<td>4 hrs.</td>
</tr>
<tr>
<td></td>
<td>Basic course in organismal function. Membrane physiology with respect to transport phenomena, muscle, nerve, synapse, and sensory receptor physiology. Physiology of respiration, heart, circulation, kidney, and gastrointestinal tract as individual systems with</td>
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</tr>
</tbody>
</table>
emphasis on regulation. One laboratory session a week illustrating physiological principles discussed in lecture. Lab fee: Level 4. Prerequisite: senior classification with a major or cluster in biological science; 16 hours completed in AOC and CH 113 or 331 or graduate standing.

543 Cellular and Developmental Biology (UAH) 3 hrs.
Cellular structure and function coupled with relevant aspects of developmental mechanisms. Lectures on mitosis, gametogenesis, nuclear-cytoplasmic interactions, role of genes in development, mechanisms of hormone action on cellular function and development and cell movements and affinities. Prerequisites: BYS 113, 114, 319, CH 101, 105, and 113 or CH 123, 126 and 331 (may be taken concomitantly).

544 Cellular and Developmental Biology (UAH) 3 hrs.
Continuation of BYS 543 and selected morphogenesis of germ-layer derivatives. Prerequisite: BYS 543.

545 Cellular and Developmental Biology Laboratory (UAH) 2 hrs.
Experimental techniques illustrating concepts of cellular, molecular and developmental biology. Take course after BYS 543 and concurrently with BYS 544. Lab fee: Level 5.

547 Biochemistry I (UAH) 3 hrs.
Structural chemistry and function of biomolecules, mechanism of biochemical reactions, enzyme kinetics, and energy transfer. Prerequisite: CH 333 or CH or BYS 361. (Same as CH 561).

548 Biochemistry II (UAH) 3 hrs.
Metabolism, biosynthesis of macromolecular precursors, storage, transmission, expression of genetic information, and molecular physiology. Prerequisite: CH 561 or BYS 547. (Same as CH 562).

561 Physiological Ecology (UAH) 4 hrs.
Physiological and behavioral responses of organisms to natural changes in their chemical and physical environment. One 3-hour lab a week. Lab fee: Level 3. Prerequisite: BYS 312 or approval of instructor. BYS 361 or 532 recommended.

562 Community Ecology (UAH) 4 hrs.
Detailed consideration of ecological principles and concepts, as well as biotic and abiotic factors relative to development of plant communities and ecosystems. One 4-hour lab a week. Lab fee: Level 3. Field trips required. Prerequisites: BYS 312 and taxonomy.

563 Population Ecology (UAH) 4 hrs.
Distribution, population dynamics and behavior of animal population in relation to environmental factors. One 4-hour lab a week. Lab fee: Level 3. Field trips required. Prerequisites: BYS 312 and organic chemistry.

564 Limnology (UAH) 4 hrs.
Fresh-water environments and organisms exemplified by lakes, ponds, and streams in North Alabama. Laboratory and required field trips. One 4-hour lab a week. Occasional Saturday field trips required instead of week’s laboratory session. Lab fee: Level 4. Prerequisites: BYS 312 and 315. 371 or 378.

571 Plant Anatomy (UAH and A&MU) 4 hrs.
Ontogeny, differentiation, and maturation of tissues and organs of angiosperms. Problems in growth and development of an angiosperm, using histological techniques. Two 3-hour labs a week. Lab fee: Level 4. Prerequisite: BYS 372 or approval of instructor.

578 Aquatic Arthropod Biology 4 hrs.
Systematics, Physiology, Ecology and Importance of the Crustacea, Insecta and Arachnida that inhabit freshwater and estuarine ecosystems. Particular attention will be given to those arthropods common to the aquatic systems in and around Alabama. Since all field trips are required, prospective students should consult with the instructor prior to registration. Lab fee: Level 4. Prerequisite: BYS 378.
Pathogenic Bacteriology (UAH) 4 hrs.
Detailed study of bacteria that cause infections in man. Mechanisms of pathogenicity and host-parasite relationships. One 2-hour lab a week. Lab fee: Level 4. Prerequisites: BYS 361, 421, 430, or equivalents, or approval of instructor.

Immunology (UAH) 4 hrs.
Theoretical and practical aspects of immunology. Current areas of immunology that are controversial. One 4-hour lab a week. Lab fee: Level 4. Prerequisites: BYS 361 and BYS 430 or approval of instructor.

Endocrinology (UAH) 3 hrs.
Anatomy, physiology, and biochemistry of endocrine glands. Emphasis on hormone secretions, regulation, integration, and mechanisms of action. Prerequisites: BYS 361, 532 or equivalent, or approval of instructor.

Advanced Cell Biology (UAH and A&MU) 4 hrs.
Integrated approach to fine structure and function of various cellular processes. Particular aspects of cellular processes each term, e.g. motility in cells and cellular differentiation. Laboratory included. Lab fee: Level 4. Prerequisite: Cellular and Developmental Biology or approval of instructor.

Microscopy (UAH) 4 hrs.
Introduction to the various methods of preparation for transmission electron microscopy and analysis of electronmicrographs. Supporting techniques such as phase microscopy, autoradiography, scanning electron microscopy, negative staining, and cytochemistry. Lab fee: Level 6. Prerequisites; graduate standing and approval of instructor.

Topics in Cell and Developmental Biology and Biological Fine Structure (UAH) 2 hrs.
Discussion of current topics in cell biology with emphasis on student participation. Both plant and animal cells will be emphasized. Depending on the number of students, some terms may be devoted to short research problems. Prerequisites: BYS 543 or 643 or approval of instructor.

Molecular Genetics (UAH and A&MU) 3 hrs.
Molecular mechanisms underlying genetic principles. Structure of genes and chromosomes; primary, secondary, and tertiary structure of DNA; DNA replication; genetic recombination; RNA transcription; translation and genetic code; regulation of gene function; evolution at molecular level. Prerequisites: BYS 319 and BYS-CH 361.

Enzymology (UAH) 4 hrs.
Detailed study of enzymes including protein synthesis; primary, secondary, tertiary and quaternary structure; nomenclature, physiological and catalytic function; enzyme kinetics, and metabolic regulations of enzyme activity. Prerequisite: BYS 547 or CH 561 or approval of instructor.

Enzymology Laboratory (UAH) 2 hrs.
Techniques of isolation, purification, and characterization of enzymes. Prerequisite: BYS 647. Lab fee: Level 5.

Taxonomy of the Immature Insect (UAH and A&MU) 4 hrs.
Studies of the literature, comparative morphology and techniques of identification of immature stages of the insect, methods of collecting and preserving the immatures. Lab fee: Level 3. Prerequisite: BYS 455 or approval of instructor.

Ecosystem dynamics (UAH) 4 hrs.
An analytical approach (including simulation and modeling) to the interactions of organisms in terrestrial, aquatic, and marine ecosystems. One 4-hour lab a week. Lab fee: Level 3. Field trips required. Prerequisites: BYS 564 and 562.

Advanced Population Ecology (UAH) 4 hrs.
Interaction of population structure, genetic properties, and ecology factors in controlling
dynamics and evolutionary character of natural population. One 4-hour lab a week. Lab fee: Level 3. Prerequisites: BYS 312, BYS 564 or 565, or approval of instructor.

690 Seminar (UAH and A&MU) 1 hr.
Student reports on current journal articles. Graduate students should attend whether enrolled for credit or not.

691 Special Topics (UAH and A&MU) 1-4 hrs.
Literature search relative to topics of interest under supervision of instructor. For graduate students.

692 Research (UAH and A&MU) 2-4 hrs.
Individual investigations on graduate level of biological problems under supervision of graduate faculty member. A special problem may be carried out at Marine Environmental Sciences Consortium, Dauphin Island, Alabama. Available to thesis students. Lab fee: Level 2 for 2 hours; Level 3 for 3 hours; Level 4 for 4 hours; Level 4 for 5 or 4 hrs; Level 3 for 3 hrs; Level 2 for 2 hrs.

699 Master's Thesis (UAH and A&MU) 1-4 hrs.
Requirement each term student is working and receiving direction on master's thesis. Minimum of two terms required for MS students. Maximum of 9 hours credit upon successful completion of master's thesis.

Graduate courses offered at Alabama A&M (A&MU)

Advanced Undergraduate — Graduate Courses

510 Radiation Biology (A&MU) 4 hrs.
Characteristics of radioisotopes, detection and counting techniques and instrumentation, tracer techniques, health and safety system. Prerequisite: consultation with instructor.

511 Biological Control (A&MU) 4 hrs.
Components of resistance, use of parasites, predators and microorganisms, foreign exploration, shipment, release and establishment of imported parasites and predators.

512 Histotechniques (A&MU) 3 hrs.
Microscopic study of the various tissues and organs of the animal systems.

522 Microbial Physiology (A&MU) 3 hrs.
Relationships between structure and biochemical functions in microorganisms. Lab fee: Level 4. Prerequisite: microbiology, organic chemistry, and biochemistry.

523 Principles of Virology (A&MU) 4 hrs.
Principles of viral infectivity, multiplication, and chemical constitution; laboratory techniques for their isolation, cultivation, identification, and enumeration. Prerequisite: BYS 221.

526 Microbial Ecology (A&MU) 4 hrs.
Relationships of soil and aquatic microorganisms and their importance in ammonification, nutrification, and other biological processes. Prerequisite: BYS 221.

533 Medical Physiology I (A&MU) 4 hrs.
Nerve and muscle cell function, fluid and electrolyte environment of body tissues, blood, heart, circulatory, and nervous systems. Prerequisite: organic chemistry, preferably biochemistry.

534 Medical Physiology (A&MU) 4 hrs.
Continuation of Mammalian Physiology I with consideration of kidney function, respiratory, digestive, reproductive, and endocrine systems. Prerequisite: Medical Physiology I.

535 Endocrinology (A&MU) 4 hrs.
Current developments on anatomy, physiology, chemistry, and regulations of major endocrine glands. Laboratory sessions in biological and chemical assays of hormones. Prerequisite: ZOO 409.
540 Molecular Biology (A&MU) 4 hrs.
Structure, behavior, and function of larger biological molecules including biological oxidations, metabolism of carbohydrates, lipids, amino acids, and genetic aspects of metabolism. Prerequisite: CHE 301 Organic Chemistry.

546 Cytogenetics (A&MU) 4 hrs.
Analysis of composition, morphology, and behavior of genes, especially as the relate to function, development, and heredity. Prerequisite: BIO 406.

549 Analytical Biochemistry Laboratory (A&MU) 2 hrs.
Advanced laboratory course dealing with modern techniques of molecular biology and biochemistry.

551 Insect Physiology (A&MU) 4 hrs.
Metabolism and utilization of carbohydrates, lipids, and nitrogen compounds; energy production, neuromuscular mechanisms, hormones and morphogenesis; role of organs and organ systems in metabolism. Prerequisites: general entomology or equivalent, advanced biochemistry.

552 Insect-Pest Management (A&MU) 4 hrs.
Insect surveys, ecological basis for control, plant and animal resistance to insects, control by parasites, predators, microorganisms, management by genetics principles, chemical attractants, chemical repellents, sterilization, insecticides, and integrated systems of pest management. Prerequisite: general entomology or advanced applied entomology.

553 Insect Taxonomy and Morphology (UAH & A&MU) 4 hrs.
Classification of insects, external and internal anatomy of insects with emphasis on comparative and functional aspects. Lab fee: Level 3. Prerequisite: BYS 455.

560 Environmental Biology (A&MU) 3 hrs.
Principles of interaction between living systems and their resources. Current problems in management of our natural resources including new approaches in management of pest populations.

570 Plant Pathology (A&MU) 4 hrs.
History, nonparasitic, and parasitic diseases incited by bacteria, fungi, plasmodiophorales, nematodes, and viruses. Disease control through exclusion, eradication, protection, and post resistance. Prerequisite: BIO 344.

572 Plant Taxonomy (A&MU) 4 hrs.
Principles of classifying, naming, and identifying vascular plants with emphasis on flowering plants. Ecologic factors influencing vegetational distribution.

590 Problems in Biological Sciences (A&MU, Plan III Only) 4 hrs.
Problems of elementary and secondary school teachers of science in all areas of biological sciences. Relations of biological organisms to their environment, stressing climatic and soil factors that influence their distribution and adaptations. Provision for individual investigation in biological science.

622 Applied and Industrial Microbiology (A&MU) 4 hrs.
Examine by microbiological assay sewage disposal and waste water treatment plants. Microorganisms of industrial importance in biological production of antibiotics, vitamins, organic acids, and alcohols. Prerequisite: microbiology.

623 Advanced Virology (A&MU) 4 hrs.
Outline of field of virology stressing molecular biology of virus replication. Immunology, genetics, and epidemiology. Bacterial and vertebrate viruses although some discussion of plant and insect viruses. Prerequisites: Microbiology, Principles of Virology.

631 Medical Pharmacology (A&MU) 5 hrs.
Lecture and laboratory course. Drug-receptor interaction, kinetics of drug absorption, distribution and elimination, and discussion of drugs affecting different systems.
Pharmacogenetics, toxicity, mutagenesis, teratogenesis, carcinogenesis, and drug interactions. Mechanism of action of drugs, in relation to their use as therapeutic agents in medicine. Prerequisites: Medical Physiology I and II.

632  Cardiovascular Physiology (A&MU)  3 hrs.
Mechanisms of cardiac muscle excitation and interaction. Analysis of peripheral circulation. Neural regulation of circulation. Angiograph, electrocardiography, and vectorcardiography as diagnostic tools. Prerequisites: Medical Physiology I and II.

642  Advanced Cell Physiology (A&MU)  4 hrs.
Biochemical and biophysical cytology. The cell as matter, life history of the cell, molecular basis of cellular activities, enzymes and energy conversions, functional localizations in subunits of the cell, mechanisms of motility, structure and function of cell membranes, effects of radiation on cells, biochemical control mechanisms, cellular differentiation and interaction between cells, hypotheses of cellular origins. Prerequisites: molecular biology, physics, cytology, biochemistry. Laboratory included.

645  Human Cytogenetics and Its Clinical Application (A&MU)  3 hrs.
Review of normal human chromosome structure and normal chromosome segregation and morphology with clinical consideration.

Economic thresholds, economic injury levels, population dynamics, residues in food crops, chemical control, insect transmission of plant disease, and livestock. Prerequisite: general entomology.

672  Advanced Systematic Botany (A&MU)  4 hrs.
Classification, nomenclature, and taxonomic theory of vascular plants. Prerequisite: plant taxonomy.
Chemistry

Degree: Master of Science
Doctor of Philosophy in cooperation with The University of Alabama, Tuscaloosa and The University of Alabama, Birmingham.

Chair: J.K. Baird, Professor; theoretical aspects of radiation chemistry and crystal growth in microgravity.

Professors:
Arendale, W.F.; chemometrics, organoselenium compounds.
Harris, J.M.; polymers, proteins, organic reaction mechanisms, crystal growth in microgravity.
McManus, S.P.; functionalized polymers, nucleophilic displacement reactions.
Riley, C.; laser photochemistry, electrodeposition in low gravity.

Associate Professors:
Coble, H.D.; coordination compounds
Emerson, M.T.; x-ray structure analysis resolution enhancement of spectra.
Gregory, J.C.; cosmic ray astronomy, interaction of atomic oxygen with surfaces.
Loo, B.H.; surface enhanced Raman spectroscopy, electrochemistry.
Young, R.B., (Adjunct); regulation of gene expression in muscle.

Assistant Professor:
Setzer, W.N.; structure of organosulfur and organophosphorous compounds.

Research in the Department of Chemistry is pursued along all five of the main subdivisions of the subject (analytical, biochemistry, inorganic, organic, and physical). This work traditionally has been closely linked with projects underway at the nearby U.S. Army’s Redstone Arsenal and NASA’s Marshall Space Flight Center. For example, graduate students are currently investigating methods for the destruction of chemical warfare agents. Others are using state-of-the-art instrumentation to develop experiments in chemical hydrodynamics for test on flights of the Space Shuttle. Students have access not only to the University Library, with 5000 holdings in chemistry and 150 current chemical journal subscriptions, but also to the U.S. Army Redstone Scientific Information Center, which is one of the best scientific libraries in the country. This exposure to research in major U.S. Government laboratories provides students with a background, which is attractive to both industrial and government employers.

Equipment

Major equipment in the Chemistry Department includes: IBM 200 MHz Fourier transform nuclear magnetic resonance spectrometer equipped for both liquid and solid phase studies, Bruker 90 MHz nuclear magnetic resonance spectrometer, Varian X-band and K-band electron spin resonance spectrometers, mass spectrometers, molecular beam scattering machine, Perkin-Elmer and Beckman infrared spectrophotometers, Jarrell-Ash 2 meter spectrometer, Cary 14 scanning and
Beckman DB-G visible-ultraviolet spectrometers, Raman spectrometer with laser-excitor, Picker x-ray diffractometer and several atomic absorption spectrometers, differential scanning calorimeter, polarography system, stopped flow kinetics apparatus, Perkin-Elmer high pressure liquid chromatograph, gas chromatographs and various CW and pulsed lasers. The University has a recently upgraded UNIVAC 1100/70 computer, while the Chemistry Department has a PDP 11-50 and numerous Sperry personal computers available for student use.

Admission Requirements

General requirements of the School of Graduate Studies must be satisfied. In addition, students admitted to the graduate chemistry program are assumed to have training equivalent to the chemistry B.S. degree recommended by the American Chemical Society. The ACS-approved degree includes lecture and laboratory work in elementary chemistry, organic chemistry, physical chemistry, inorganic chemistry, analytical chemistry (including instrumental analysis), elementary physics, and mathematics through linear algebra and differential equations. Graduation from an undergraduate program not adhering to ACS standards does not preclude entrance into the UAH program. Students should realize, however, that if deficiencies exist, some additional undergraduate courses may be required. The time required to complete the M.S. Degree may then be proportionately increased.

Master of Science

General requirements of the School of Graduate Studies under Plan I or Plan II must be satisfied. The M.S. degree is a general degree in chemistry. As such, it is based upon a core sequence of courses emphasizing four of the five main subdivisions of chemistry.

Plan I. This plan requires 24 semester hours of graduate coursework, which must include the core sequence consisting of CH 531, 600, 631, 640, 642, and 561 or 621. CH 621 is preferred if students have not completed CH 421 or CH 521 at UAH or the equivalent elsewhere. Students must register for CH 780 during every term in which they are in residence at UAH. Additional requirements include a thesis and reading competence in German or Russian. The faculty may accept other languages under special circumstances. Demonstration of computer machine language skills or B grades or better in CS 113 and 208 may also be substituted. International students may replace CS 113/208 with English courses or by a demonstrated mastery of English. (See the department chair for further information.) A particular program of study must be planned in consultation with a member of the chemistry faculty assigned by the department chair as a temporary advisor. After a student following Plan I selects his thesis topic, a supervisory committee will be appointed.

Plan II. This plan requires 33 or more semester hours of coursework, of which 18 hours must be in chemistry. The coursework must include the core sequence CH 531, 600, 631, 640, 642, and 561 or 621. CH 621 is preferred if students have not completed CH 421 or 521 at UAH or the equivalent elsewhere. Students must register for CH 780 during every term in which they are in residence at UAH. Half of any coursework taken in departments other than chemistry must be at the 600 level or above. A particular program of study must be planned in consultation with
a member of the chemistry faculty assigned by the department chair as an advisor. A final comprehensive examination is required consisting of written examinations over each of two subdisciplines of chemistry. Foreign language proficiency is not obligatory, and a thesis is not required.

Because Plan II does not require any experimental work, it is not recommended for students seeking employment as industrial laboratory chemists.

Non-Traditional Fifth-Year Program Leading to the M.S. in Chemistry Plus a Class A Alabama High School Teachers Certificate

Those who have a BA or BS degree with a major or its equivalent in chemistry as determined by the department of chemistry and have not taken more than twelve semester hours in teacher education (graduate or undergraduate), and who are interested in obtaining Class A (masters level) certification for secondary school teaching, should consider the Non-Traditional Fifth Year Program. Contact the Education department for preliminary advisement on admission and general program requirements. See the description in the Education section in the Graduate Catalog for more details.

Doctor of Philosophy

The Ph.D. in Chemistry may be obtained at UAH through co-operative study with the University of Alabama in Tuscaloosa (UA) or the University of Alabama in Birmingham (UAB). The Ph.D. requirements of the School of Graduate Studies and the Chemistry Department at either UA or UAB must be fulfilled. Consult the respective graduate catalogs. The following considerations are made for UAH cooperative students:
1. Only nine months of residency are required in Tuscaloosa or Birmingham.
2. Cumulative examinations may be taken at UAH.
3. Research may be done at UAH.
4. One or two UAH chemistry faculty members may serve on the dissertation committee.

Undergraduate Chemistry Courses (CH)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>331</td>
<td>Organic Chemistry</td>
<td>3 hrs.</td>
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<tr>
<td>332</td>
<td>Organic Chemistry</td>
<td>2 hrs.</td>
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<tr>
<td>333</td>
<td>Organic Chemistry</td>
<td>2 hrs.</td>
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<tr>
<td>335</td>
<td>Organic Chemistry Laboratory I</td>
<td>1 hr.</td>
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<tr>
<td>336</td>
<td>Organic Chemistry Laboratory II</td>
<td>1 hr.</td>
</tr>
<tr>
<td>337</td>
<td>Organic Chemistry Laboratory III</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>341</td>
<td>Chemical Thermodynamics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>342</td>
<td>Chemical Dynamics</td>
<td>2 hrs.</td>
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</tbody>
</table>

148
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>343</td>
<td>Introduction to Quantum Chemistry</td>
<td>2 hrs.</td>
</tr>
<tr>
<td>345</td>
<td>Experimental Physical Chemistry I</td>
<td>1 hr.</td>
</tr>
<tr>
<td>346</td>
<td>Experimental Physical Chemistry II</td>
<td>1 hr.</td>
</tr>
<tr>
<td>361</td>
<td>General Biochemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>362</td>
<td>General Biochemistry Laboratory</td>
<td>1 hr.</td>
</tr>
<tr>
<td>401</td>
<td>Inorganic chemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>421</td>
<td>Instrumental Analysis</td>
<td>4 hrs.</td>
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</tbody>
</table>

**Graduate Chemistry Courses (CH)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>521</td>
<td>Chemical Instrumentation</td>
<td>4 hrs.</td>
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<tr>
<td></td>
<td>Use of basic instrumentation in electrochemical,</td>
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<td></td>
<td>chromatographic, and spectrophotometric</td>
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<td></td>
<td>analysis. Laboratory work emphasizes utility of</td>
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<td></td>
<td>operational amplifiers in making chemical</td>
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<td></td>
<td>measurements. Introduction to digital logic.</td>
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<td></td>
<td>Lab fee: Level 4. Prerequisite: CH 346.</td>
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<tr>
<td>525</td>
<td>Environmental Chemistry</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Principles of quantitative analyses related to</td>
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<td>minor components of a sample. Applications</td>
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<td>selected from principal analyses necessary to</td>
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<tr>
<td></td>
<td>maintain environmental quality of air, water,</td>
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<td></td>
<td>and soil. Selection of conditions for collecting</td>
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<td>reliable samples, concentration of components</td>
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<td>with techniques for increasing concentration of</td>
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<td></td>
<td>selected component, relationships between</td>
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<td></td>
<td>physical and chemical changes in sample and</td>
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<td>signal output of predominant transducers, and</td>
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<td></td>
<td>translation of chemical analysis into meaningful</td>
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<td></td>
<td>specifications. Lecture only. Prerequisite: CH</td>
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<td></td>
<td>521 or 123; EG 311, 342. (Same as ES 525.)</td>
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<tr>
<td>531</td>
<td>Theoretical Organic Chemistry</td>
<td>4 hrs.</td>
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<tr>
<td></td>
<td>Molecular orbital theory and bonding, molecular</td>
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<tr>
<td></td>
<td>structure, frontier molecular orbitals,</td>
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<td></td>
<td>pericyclic reactions, and reactive intermediates</td>
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<td></td>
<td>Extensive computational laboratory work included.</td>
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<td></td>
<td>Lab fee: Level 4. Prerequisites: Ch 333, 342, or</td>
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<td></td>
<td>approval of instructor.</td>
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<tr>
<td>540</td>
<td>High Polymer Chemistry</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Theory of polymer formation and structural</td>
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<td></td>
<td>dependence of polymer properties. Prerequisites:</td>
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<td></td>
<td>Ch 337, 342.</td>
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<tr>
<td>549</td>
<td>Spectroscopy and Molecular Structure</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Intermediate level treatment of principles of</td>
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<tr>
<td></td>
<td>spectroscopy and their application to determination of molecular structure. Prerequisite: CH 343.</td>
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<tr>
<td>553</td>
<td>Introductory Quantum Mechanics I</td>
<td>3 hrs.</td>
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<td></td>
<td>Prerequisites: CH 343, PH 351, MA 244, 251, 352.</td>
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<tr>
<td></td>
<td>(Same as PH 551).</td>
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<tr>
<td>554</td>
<td>Introductory Quantum Mechanics II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Prerequisite: CH 553. (Same as PH 552).</td>
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<tr>
<td>560</td>
<td>X-Ray Structure Determination</td>
<td>4 hrs.</td>
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<tr>
<td></td>
<td>The course will examine both theoretical and</td>
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<td></td>
<td>practical aspects of molecular structure</td>
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<td>determination by x-ray diffraction methods.</td>
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<td></td>
<td>Topics include diffraction of x-rays, symmetry</td>
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<td></td>
<td>operations and space groups, methods of data</td>
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<td></td>
<td>collection, theory of structure factors and</td>
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<td></td>
<td>Fourier synthesis, least squares methods of</td>
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<td></td>
<td>structure refinement. Extensive laboratory and</td>
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<td></td>
<td>computer work included. Lab fee: Level 4.</td>
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<td></td>
<td>Prerequisites: senior standing in chemistry or</td>
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<td></td>
<td>physics and approval of the instructor.</td>
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<tr>
<td>561</td>
<td>Biochemistry I</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Structural chemistry and function of biomolecules,</td>
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<td></td>
<td>mechanisms of biochemical reactions, enzyme</td>
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<td></td>
<td>kinetics, and energy transfer. Prerequisite: CH</td>
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<tr>
<td></td>
<td>333 or CH 361. (Same as BYS 547).</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
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<tr>
<td>562</td>
<td>Biochemistry II</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Metabolism, biosynthesis of macromolecular precursors, storage, transmission, and expression of genetic information, and molecular physiology. Prerequisite: CH 561. (Same as BYS 548).</td>
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<tr>
<td>565</td>
<td>Molecular Biochemistry Laboratory</td>
<td>2 hrs.</td>
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<tr>
<td></td>
<td>Practical experience in isolation and characterization of biomolecules. Lab fee: Level 4. Prerequisite: CH 562.</td>
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</tr>
<tr>
<td>600</td>
<td>Advanced Inorganic Chemistry</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Survey with emphasis on structure and reactivity of inorganic compounds. Prerequisite: CH 401.</td>
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<tr>
<td>601</td>
<td>Structural Methods in Inorganic Chemistry</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Physical methods applied to determination of structure of inorganic compounds. Prerequisite: CH 600.</td>
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<tr>
<td>602</td>
<td>Chemistry of Coordination Compounds</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Modern bonding theory and stereochemistry of coordination compounds. Prerequisite: CH 600.</td>
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<tr>
<td>603</td>
<td>Chemistry of Nonmetal Compounds</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Chemistry of selected nonmetal compounds. Prerequisite: CH 601.</td>
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<tr>
<td>621</td>
<td>Methods of Chemical Analysis</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Literature, seminar course. Theory and methodology of various techniques of chemical analysis. Prerequisite: CH 521 or CH 421.</td>
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</tr>
<tr>
<td>631</td>
<td>Advanced Organic Chemistry I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Organic synthetic reactions. Survey of certain reactions that enjoy widespread application to the synthesis of organic compounds. Prerequisites: CH 333, 342, or approval of instructor.</td>
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<tr>
<td>632</td>
<td>Advanced Organic Chemistry II</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Physical organic chemistry. Reactive intermediates, structure-activity relationships, reaction mechanisms and techniques used to determine them. Prerequisites: CH 531 or approval of instructor.</td>
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<tr>
<td>640</td>
<td>Advanced Chemical Thermodynamics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>First, second, and third laws of thermodynamics and applications. Brief introduction to statistical thermodynamics. Prerequisite: CH 343, MA 251, or approval of instructor.</td>
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<tr>
<td>641</td>
<td>Statistical Thermodynamics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Principles leading to the development of Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics. Thermodynamic properties calculated from partition functions. Prerequisites: CH 343.</td>
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<tr>
<td>642</td>
<td>Advanced Chemical Dynamics</td>
<td>3 hrs.</td>
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<td></td>
<td>Velocity of chemical reactions in homogeneous and heterogeneous systems. Absolute rate theory, collision theory, scattering, and concept of reaction cross sections. Prerequisite: CH 640.</td>
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<tr>
<td>643</td>
<td>Quantum Chemistry</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Application of quantum theory to the chemical bond. Prerequisite: CH 343.</td>
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</tr>
<tr>
<td>646</td>
<td>Thermodynamics of Materials</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Fundamental thermodynamic review, phase equilibrium, chemical reaction equilibrium, free energy, binary and ternary phase transformations, solution models and selected topics. Same as CHE 646. Prerequisite: CH 341 or equivalent.</td>
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</tr>
<tr>
<td>661</td>
<td>Biological Macromolecules</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Detailed analysis of structures of proteins, nucleic acids, and complex polysaccharides. Prerequisite: CH 562.</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
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<tr>
<td>699</td>
<td>Master's Thesis</td>
<td>3 or 6hrs.</td>
</tr>
<tr>
<td>705</td>
<td>Selected Topics in Inorganic Chemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>721</td>
<td>Selected Topics in Analytical Chemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>735</td>
<td>Selected Topics in Organic Chemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>745</td>
<td>Selected Topics in Physical Chemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>765</td>
<td>Selected Topics in Biochemistry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>780</td>
<td>Chemistry Seminar</td>
<td>1 hr.</td>
</tr>
<tr>
<td>799</td>
<td>Doctoral Dissertation</td>
<td>3, 6, or 9 hrs.</td>
</tr>
</tbody>
</table>
Computer Science

Degree: Master of Science
       Doctor of Philosophy

Chair: C.G. Davis, Professor: software engineering, requirements definition, simulation and modeling, distributed computing.

Professors:
Johannes, J.D.; artificial intelligence, operating systems, text processing.
Shiva, S.G.; artificial intelligence, VLSI design, distributed processing.

Associate Professors:
Amin, A.T.; computer system reliability, distributed systems, software engineering.
Hooper, J.W.; languages, simulation and prototyping, software engineering.
Ranganath, H.S.; image processing, pattern recognition, artificial intelligence.
Richards, P.G.; numerical analysis, modeling of ionosphere and plasmasphere.
Ryan, J.P.; artificial intelligence, software engineering, symbolic programming, database design.

Assistant Professors:
Bosworth, E.; expert systems, knowledge representation in A.I.
Graves, S.J.; distributed computing, data, knowledge, and software engineering.
Reed, T.; software engineering, programming languages.

Computer Science is a key ingredient in almost all technical endeavors undertaken today. The modern computer scientist must be trained to tackle a wide variety of tasks relating to the applications of computers to complex problems. The graduate program in computer science employs practical applications as well as theoretical fundamentals to prepare the student for contributions in a university, industrial or government environment.

The department has access to a wide variety of computing facilities including: a Sperry 7000 (UNIX) with terminals throughout the department, TI Explorer and Symbolics machines, Sperry 1100/73, VAX 11/785 and numerous personal computers. The Microcomputing laboratory in the department is used for instruction in logic design, computer architecture and microcomputer system design. It contains design stations employing state-of-the-art microprocessor systems. Access to the State of Alabama Supercomputer is in the planning stage. Additional near-by computational facilities which can be accessed include those at NASA Marshall Space Flight Center and the Army’s Strategic Defense Command.

Students pursuing graduate programs are allowed to tailor their studies to meet a variety of needs. The program requires the completion of core courses augmented with in-depth studies in several areas of interest. Specific areas in the department include: theoretical computer science, languages and systems, software engineering, artificial intelligence, image processing and vision systems, computer architecture and supercomputer applications.
Theoretical Computer Science

These courses develop the theoretical aspects of computer science and provide a basis and framework for further research either in theoretical computer science or in another research area having a theoretical basis. Emphasis may be achieved by selecting from among the following course offerings:

CS 603  Formal Languages and Automata Theory
CS 617  Design and Analysis of Algorithms
CS 703  Theory of Programming Languages
CS 717  Advanced Algorithm Design and Analysis

Languages and Systems

The languages and systems area includes instruction in programming languages, systems programming and data base systems, as well as their use in problem solutions.

CS 590  Programming Environments with UNIX
CS 612  Compiler Design
CS 624  Programming Languages
CS 645  Interactive Computer Graphics
CS 687  Data Base Systems
CS 690  Operating Systems
CS 787  Advanced Data Base Systems
CS 790  Advanced Operating Systems

Software Engineering

The difficulties in implementing and testing large software systems are many—resulting frequently in software being completed late, with many errors, and with cost overruns. Emphasis in software engineering may be achieved by selecting from among the following course offerings. CS 650 and CS 750 should always be included in any program emphasizing software engineering.

CS 550  Software Design and Development with Ada
CS 555  Theory of Program Development
CS 650  Software Engineering
CS 750  Advanced Software Engineering

Artificial Intelligence

Artificial intelligence allows the building of computer-based systems that require minimal human interaction with operational details; are easy to use through enhanced communication and understanding abilities; are autonomous in significant roles of their operation; can adapt to environmental variations; and can describe their own operations and justify their solutions, decisions and advice. These applications are numerous in areas such as: perception (computer vision, speech understanding, and tactile sensation); robotics; natural language processing; and expert systems. The courses listed below cover the fundamentals of artificial intelligence:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 535</td>
<td>Symbolic and Logic Programming</td>
</tr>
<tr>
<td>CS 630</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>CS 635</td>
<td>Computational Models of Cognition</td>
</tr>
<tr>
<td>CS 730</td>
<td>Expert Systems and Heuristic Programming</td>
</tr>
<tr>
<td>CS 760</td>
<td>Pattern Directed Inference Systems</td>
</tr>
</tbody>
</table>

**Image Processing and Vision Systems**

For more than a decade research in artificial intelligence has focused on the problem of duplicating human intelligence in machines so that the machines can perceive and understand the environment through visual and other patterns, and then respond with appropriate actions. Such systems have many industrial, military and space applications. The following course sequence covers theory, computational algorithms and architecture for the design and development of pattern recognition and vision systems.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 640</td>
<td>Automatic Pattern Recognition</td>
</tr>
<tr>
<td>CS 642</td>
<td>Computer Processing of Digital Images</td>
</tr>
<tr>
<td>CS 735</td>
<td>Computer Vision</td>
</tr>
<tr>
<td>CS 742</td>
<td>Image Processing Algorithms and Architectures</td>
</tr>
</tbody>
</table>

**Computer Architecture**

The courses offered in the area of Computer Architecture cover the organization, architecture and design of digital computer systems from high level conceptual design to gate level implementation. The area is interdisciplinary with augmenting courses from the Electrical and Computer Engineering Department. The main concentration areas are: logic design and digital computer hardware design; advanced computer architectures; distributed processing; and microprocessors and bit slice devices. Suggested courses in this area:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 586</td>
<td>Microprocessor Architectures</td>
</tr>
<tr>
<td>CS 613</td>
<td>Computer Architectures</td>
</tr>
<tr>
<td>CS 670</td>
<td>Computer Networks</td>
</tr>
<tr>
<td>CS 686</td>
<td>Bit Slice Microcomputer Systems</td>
</tr>
<tr>
<td>CS 713</td>
<td>Distributed Processing Systems</td>
</tr>
<tr>
<td>CS 780</td>
<td>Computer System Reliability</td>
</tr>
</tbody>
</table>

**Supercomputer Applications**

The application of advanced high speed processors to problems is having revolutionary impact on the way solutions must be structured. This area provides instruction in the applications of high speed (class VI or greater) machines to the solution of complex problems. Areas include vectorization, parallel algorithm development, advanced computing architectures, numerical analysis and specific solution applications. Courses in this specialty will be interdisciplinary including: mathematics, physics and engineering in addition to a computer science core. Specific course content can be tailored to student needs and will be planned individually with the student's advisor.
Master of Science

Admission Requirements

Requirements for admission to the Computer Science degree program are in addition to those of the School of Graduate Studies. A minimum score of 500 on the quantitative portion of the aptitude test of the GRE is required for unconditional admission. The advanced portion of the GRE is not required. Request for admission will be evaluated according to the following guidelines.

Unconditional Admission

1. Meets all of the requirements of the School of Graduate Studies for unconditional admission and
2. Has all the following prerequisites required to pursue the M.S. degree. a) Mathematics: MA 153, MA 154, MA 233, MA 244, MA 385 and b) Computer Science: CS 108, CS 208, CS 214 or MA 440, CS 424, CS 490, CS 513 or CS 309 and CS 415, and CS 517 or CS 314 and CS 317.

Conditional Admission

1. Meets all of the requirements of the School of Graduate Studies for admission but needs one or more prerequisite courses in order to begin graduate program.

Students lacking sufficiently large numbers of courses in order to qualify for the program will be asked to complete the prerequisites and then reapply for admission.

Degree Requirements

The Master of Science degree is conferred under Plan I or Plan II. All students must take the following four core courses: CS 613 (Advanced Computer Architecture), CS 617 (Design and Analysis of Algorithms), CS 624 (Programming Languages), and CS 690 (Operating Systems). A minor area of six hours is also required. Typical minors are in Administrative Science, Computer Engineering, Engineering Management, Mathematics and Operations Research. Other minors may be approved by the chairman of the department.

Plan I. A minimum of 24 semester hours of coursework and the writing of an acceptable thesis. Coursework includes: (a) 18 semester hours of graduate credit in core and major elective computer science courses, and (b) six hours of courses in an approved minor area. In addition, six hours of thesis credit must be earned. Students must pass a comprehensive oral final examination covering the thesis and coursework.

Plan II. A minimum of 33 semester hours, including: (a) 27 semester hours of graduate credit courses in core and computer science electives, and (b) 6 semester hours of courses in an approved minor area. Students must pass a written examination on the core courses, and an oral examination on the other coursework.

The following departmental policies also apply:

1. Courses numbered between 535 and 599 (inclusive) may be taken for graduate credit with prior approval of the student’s advisor. To receive credit toward a master’s degree, students must attain a minimum grade of B in all core
courses and in each CS course numbered less than 600. In addition, students must attain a minimum of B average in all CS graduate courses.

2. A program of study must be planned before completing 12 semester hours of study in consultation with a member of the computer science faculty assigned by the department chairman as temporary advisor. The program of study is approved by the Chair of the Computer Science Department and the Dean of the School of Graduate Studies. Students following Plan I will have a supervisory committee appointed following selection of a thesis topic. For Plan II students a committee will be appointed shortly before the oral examination.

Minor in Computer Science

Graduate students wishing to have a minor in computer science should select from the 600 level core courses observing the prerequisites.

Doctor of Philosophy

Admission Requirements

The admission policies for the Ph.D. program in Computer Science follow the policies of the School of Graduate Studies. The possession of a M.S. degree does not guarantee admission to the program. Applicants program will be reviewed in light of their coursework and expectation of completing the degree. Students requiring a large amount of remedial coursework will not be admitted to the program until the courses have been successfully completed. Requests for admission will be evaluated according to the following guidelines.

Unconditional Admission

1. Meets all of the requirements of the School of Graduate Studies for unconditional admission and
2. Has completed the M.S. core courses as well as CS 603 and CS 630.

Conditional Admission

1. Meets all of the requirements of the School of Graduate Studies but needs coursework to complete the courses in 2 above.

Degree Requirements

The general requirements for the Ph.D. degree comply with those of the School of Graduate Studies. In addition, the following departmental regulations must be fulfilled:

Preliminary Examination

Students will be required to take a preliminary examination over the following courses: CS 603, CS 613, CS 617, CS 624, CS 630 and CS 690. The examination should be taken at the earliest opportunity upon completion of the coursework. Students completing the Masters Degree at UAH who have successfully passed a written examination on the core courses may satisfy all or part of the preliminary examination requirements. Successful completion of the examination will provide evidence of the students ability to continue to pursue the Ph.D. degree.

Major/Minor Subjects

A minimum of 60 hours of graduate course credit plus 18 dissertation credit
hours are required for the Ph.D. in Computer Science. The program of study will consist of 36 hours in the major, 24 hours in a minor and must be approved by the students supervisory committee.

The major must include CS 603, CS 613, CS 617, CS 624, CS 630 and CS 690 as a core. In addition, a minimum of 15 additional semester hours must be selected to form a coherent area of emphasis, of which at least 6 semester hours must be at the 700 level. At least 9 semester hours of graduate level mathematics must also be included in the program, with 3 hours at the 600 level.

**Admission to Candidacy**

To be admitted to candidacy for the Ph.D. degree, students must first pass the qualifying examination and have an approved research proposal. Prior to taking the qualifying examination, applicants must be considered adequately prepared in the major and minor fields by the supervisory committee. The qualifying examination may be taken no more than twice; it is designed to test students' fitness for pursuing a research project in their chosen areas and to test their general knowledge of computer science. Additionally, the following requirements must be satisfied:

(a) Completion of 6 or more graduate hours per term for three consecutive terms, at UAH, (the Summer term may be ignored, if desired, in establishing three consecutive terms);

(b) Completion of the language requirements as outlined by the School of Graduate Studies. Any of the described methods of meeting the requirements are acceptable.

**Dissertation**

A significant portion of the dissertation must be submitted for publication in an approved journal with international circulation.

**Undergraduate Courses (CS)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>415</td>
<td>Introduction to Digital Computer Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>424</td>
<td>Introduction to Programming Languages</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>430</td>
<td>Introduction to Artificial Intelligence</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>445</td>
<td>Introduction to Computer Graphics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>470</td>
<td>Computer Applications in Economics and Business II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>490</td>
<td>Systems Software</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>499</td>
<td>Senior Project</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

**Special Courses (CS)**

The following courses serve as prerequisites for students entering the Computer Science graduate program. They are not open to Computer Science undergraduates and can not be taken for credit by Computer Science undergraduate and graduate majors.
513 Introduction to Computer Architecture 3 hrs.
Review of combinational and sequential logic design, register transfer concept, logic design of memory, arithmetic unit, control unit, and I/O system of simple computer. Architectural trade-offs; representative computer architectures including a micro- mini-, and large-scale computer system. Lab fee: Level 4. Prerequisites: CS 490.

517 Data Structures 3 hrs.
Basic concept of data, Linear lists, sublists, strings, arrays, queues, stacks, trees and graphs. Storage systems and structures and storage allocation and collection. Efficient algorithms for creating, sorting, merging, searching structured data. Formal specification of data structures, data structures in programming languages, and generalized data-management systems. Lab fee: Level 3. Prerequisite: CS 490.

Graduate Courses (CS)

535 Symbolic and Logic Programming 3 hrs.
Use of the LISP Language. Computing with symbolic expressions rather than numbers, eg. algebraic expressions, logical expressions, patterns, graphs, and computer programs themselves. Building and controlling abstractions. Object oriented programming; prototyping. Introduction to PROLOG. Lab fee: Level 3, Prerequisites: CS 317 or 517.

550 Software Design and Development Using Ada 3 hrs.
Introduction to syntax and semantics of Ada, comparison to Pascal language, data encapsulation, data abstraction, recursive data structures, parallel tasks, Ada program design languages. Introduction to Ada Program Support Environments and concepts of correct software system design and development using Ada. Lab fee: Level 3, Prerequisites: CS 317, 424.

555 Theory of Program Development 3 hrs.
Propositional and predicate calculi, reasoning about programs, weakest precondition, program development, developing invariants, efficiency consideration, and program documentation. Lab fee: Level 3, Prerequisites: CS 424.

586 Microprocessor Architecture 3 hrs.

590 Programming Environments with UNIX 3 hrs.
Advanced strategies for the design and development of systems and programs in the Unix environment. Emphasis on automated tool and system development using Unix tools. Parallel and Supercomputer issues as treated by UNIX and C. Advanced Shell concepts and programming including control flow and interrupt handling. Process and interprocess communications. Lab fee: Level 3. Prerequisites: CS 390 or two years experience in Unix.

603 Formal Languages and Automata Theory 3 hrs.
Formal definition of programming languages. Definition of formal grammars: regular, context-free, context sensitive, and phrase-structure. Definition of automata: finite-state, pushdown, linear-bounded automata, Turing Machines. Relationship between formal languages and automata. Lab fee: Level 3. Prerequisite: CS 214 and 624 or approval of instructor.

612 Compiler Design 3 hrs.
Compilation of expressions and statements; organization of a compiler including compile-time and run-time symbol tables, lexical analysis, syntax analysis, optimization, object-code generation and error diagnostics. Compiler writing tools: Lab fee: Level 3. Prerequisite: CS 624.

613 Computer Architectures 3 hrs.
Associative, parallel, and pipeline architectures; multiple processor systems, and concepts

158
of high-order language architectures. Computer networks, performance evaluation, selected architectures including micro-, min-, and large-scale computer systems. Lab fee: Level 3. Prerequisite: CS 415 or CS 513.

617 Design and Analysis of Algorithms 3 hrs.
Strategies of algorithm synthesis and analysis. Design methodologies of classical algorithm categories such as: divide-and-conquer, greedy method, dynamic programming, search and traversal, back-tracking, and branch-and-bound. Computational complexity and important theoretical results from lower- and upper-bound studies, NP-hard and NP-complete problems. Lab fee: Level 3. Prerequisite: CS 317 or CS 517.

624 Programming Languages 3 hrs.
Definition and classification of programming languages. Concepts, designs, and use of languages, such as block-structured, string-processing, and list-processing languages. Unified approach to general-purpose languages, comparative analysis of languages. Recent developments; syntax, and semantics. Lab fee: Level 3. Prerequisite: CS 424 and CS 317 or CS 517.

630 Artificial Intelligence 3 hrs.
A rigorous treatment of the issues and ideas of Artificial Intelligence. Topics include knowledge representation, automated deduction, search control, machine learning, and meta-level architectures. Current topics and reading, in AI. Lab fee: Level 3, Prerequisites: CS 535, 617, 624.

635 Computational Models of Cognition 3 hrs.
Computational models of information processing covering topics of current interest to both Artificial Intelligence and Cognitive Psychology. Use of computer simulations to test psychological theories. Application of psychological research to building AI systems. Lab fee: Level 3, Prerequisites: CS 630.

640 Automatic Pattern Recognition 3 hrs.
Discriminant analysis, maximum likelihood decisions, deterministic and non-deterministic approaches for trainable classifiers, preprocessing and feature extraction, clustering, syntactic pattern recognition. Pattern recognition in image analysis. Lab fee: Level 3. Prerequisites: MA 244, 385.

Introduction to image processing systems; sensing, sampling and quantization; image transforms; image enhancement and restoration; image segmentation, and description; image correlation; image sequence analysis; practical applications of image processing. Lab fee: Level 3. Prerequisites: MA 244, MA 385.

645 Interactive Computer Graphics 3 hrs.
Interaction graphics application program fundamentals. User friendly interactive dialogue design, hardware and software concepts-windowing, clipping, and logical interaction handling; data structures and geometric transformation useful for modeling objects especially in hierarchical form; device independent algorithms as well as shading, texturing and models for representing color in realistic synthetic photographs. Evolution of display processor architecture with respect to functional distribution. Lab fee: Level 4. Prerequisites: CS 513, CS 517, MA 244 or equivalent.

650 Software Engineering 3 hrs.
Life-cycle stages of a software system, including requirements, design, implementation, testing, and maintenance. Project management issues. Software design, structured programming, and program testing techniques in software system development. Projects to illustrate software engineering advancements. Lab fee: Level 3. Prerequisite: CS 624.

670 Computer Networks 3 hrs.
Computer network structures and architectures, network topology, the ISO reference model: layers, protocols, and interfaces, local area networks, descriptions of ARPANET, SNA and DECNET. Lab fee: Level 3, Prerequisites: CS 613.
686 Bit Slice Microcomputer Systems 3 hrs.
Digital design methods: Microprogramming and microprogrammed control units; ALU/
Register slices; Microprogram sequencers; Bit slice support chips: program control unit,
priority interrupt controller, status and shift control unit, etc.; Programmable logic; PLA,
PAL; Firmware design. Lab fee: Level 3. Prerequisites: CS 586.

687 Data Base Systems 3 hrs.
Basic concepts of data base systems. Relational data bases, normal forms of relation data
bases; relational calculus and relational algebra, data sublanguages. Hierarchical data bases
and IMS model. Network data bases and DBTG model. Security and integrity issues. Lab
fee: Level 3. Prerequisites: CS 624 and 690.

690 Operating Systems 3 hrs.
Techniques of constructing operating system control programs including management of
system, jobs, and data; multiprogramming, multiprocessing, and timesharing systems. Lab
fee: Level 3. Prerequisite: CS 617.

695-698 Selected Topics in Computer Science 3 hrs.
Courses in special topics requested by students. Prerequisites: approval of instructor.

699 Master's Thesis
Required each term student is working and receiving direction on master’s thesis. Minimum
of two terms is required. Maximum of 9 hours of credit upon successful completion of
master’s thesis.

703 Theory of Programming Languages 3 hrs.
Syntactic analysis and semantic interpretation of programming languages based on research
and results in formal languages and associated compiler techniques. Identification of
research directions and potential research projects in programming languages. Lab fee:
Level 3. Prerequisite: CS 603.

713 Distributed Processing systems 3 hrs.
Computer network configurations, communication protocols, and architectural tradeoffs;
distributed data bases; operating systems and software issues. Reconfiguration, recovery,
and reliability, specification and design of distributed systems: case studies. Prerequisites:
CS 613 and 690.

717 Advanced Algorithm Design and Analysis 3 hrs.
Parallel algorithms, combinatorial algorithms, approximation algorithms for NP-complete
problems, Computational complexity. Distribution of algorithms across complex architec­
tures. Lab fee: Level 3, Prerequisites: CS 617.

730 Expert Systems and Heuristic Programming 3 hrs.
Expert system concepts and their architectures. Languages and tools for knowledge
engineering. Heuristic versus algorithmic methods, treatment of heuristics as used in expert
systems, an heuristic programming techniques. Class and individual projects to illustrate
concepts. Lab fee: Level 3, Prerequisites: CS 624, 630.

735 Computer Vision 3 hrs.
The construction of explicit, meaningful descriptions of physical objects from images.
Generalized and segmented images and image-like entities, geometric structures expressed
as quantitative models of images. Relational structures using knowledge bases and symbolic
descriptions and understanding via matching, inference and goal achievement. Lab fee:
Level 4. Prerequisites: CS 530, CS 640, CS 642.

742 Image Processing Algorithms and Architectures 3 hrs.
Algorithms and data structures for image enhancement, segmentation, object recognition
and image sequence analysis; real-time versus non real-time image processing; computer
architectures for fast image processing; cellular logic array processors, distributed array
processors, systolic array processors; binary array processors, etc. Lab fee: Level 4.
Prerequisites: CS 642, CS 613.
Advanced Software Engineering  3 hrs.
Experimental framework of software engineering. Design of experiments to evaluate
different methods and techniques in software development, operation, and maintenance.
Quality and productivity issues. Review of current literature. Student-design software
engineering experiments as course project. Lab fee: Level 3. Prerequisite: CS 650.

Pattern-Directed Inference Systems  3 hrs.
Studies of concept information, language understanding, problem solving, inferential
reasoning, and memory organization as applied to pattern-directed inference systems.
Theory as well as design and implementation issues in pattern-directed inference systems.
Lab fee: Level 4. Prerequisites: CS 730.

Computer System Reliability  3 hrs.
Overview of reliability theory; hardware fault diagnosis, and fault tolerance; notion of
software reliability, techniques for program specification and program validation; system
reliability. Lab fee: Level 3. Prerequisites: MA 585, CS 613.

Advanced Database Systems  3 hrs.
Advanced topics in data bases. Introduction to distributed data bases and current research in
expert data bases. Query processing, concurrency control, security and recovery issues in
both centralized and distributed data bases. Lab fee: Level 3, Prerequisites: CS 687.

Advanced Operating Systems  3 hrs.
Time-sharing and distribution queuing models, models of program behavior, concurrency,
multilevel memory allocation and paging, algorithms, analysis of file structures and I/O
scheduling. Measurement techniques and analysis. Lab fee: Level 4. Prerequisite: CS 690.

Advanced Selected Topics  3 hrs.
Courses in special topics requested by students. Prerequisite: approval of instructor.

Doctoral Dissertation
Required each term student is enrolled and receiving direction on doctoral dissertation.
Maximum of 18 hours credit.
Mathematics and Statistics

Degrees: Master of Arts
    Master of Science
Doctor of Philosophy in cooperation with The University of Alabama, Tuscaloosa.

Chair: P. M. Gibson, Professor; linear algebra, combinatorics.

Professors:
Chang, M.H.; probability, optimal control theory, stochastic processes.
Doss, D.C.; statistics.
Hoomani, J.; combinatorics, statistics.
Lehnigk, S.H. (Adjunct); differential equations, special functions.
Slater, P.J.; graph theory, combinatorics, computer graphics.

Associate Professors:
Cook, E.L.; mathematical modeling, differential equations, orthogonal polynomials.
Forte, A.; geometry, group theory, number theory.
Howell, K.B.; elasticity theory, partial differential equations.
Morales, C.H.; functional analysis, operator theory.
Siegrist, K.T.; probability, stochastic processes, reliability theory.

Assistant Professors:
Dow, S.J.; combinatorics, geometry.
Fehribach, J.D.; partial differential equations, mathematical modeling.
McNider, R.T.; numerical modeling, boundary layer dynamics.
Miller, T.L. (Adjunct); fluid dynamics, numerical modeling.

The graduate program in the Department of Mathematics and Statistics fosters advanced mathematical education through closely integrated instruction and research. The program's options and concentration areas lead students to examine in greater depth those concepts and techniques introduced at the undergraduate level and further expose them to more sophisticated concepts and techniques. Because the faculty considers that mathematics majors should effectively apply their training to today's technological problems, special emphasis is given to applied mathematics.

Admission Requirements

In addition to fulfilling School of Graduate Studies admission requirements, all applicants for graduate study in mathematics should have completed the equivalent of a complete calculus sequence, a linear algebra course, MA 440, MA 502, and 6 additional hours in upper-division mathematics courses. Students deficient in more than two undergraduate courses in mathematics must remove these deficiencies before admission to the mathematics program. Such students should consult the graduate program director of the department on how best to remove these deficiencies.
For unconditional admission, applicants must satisfy requirements of the School of Graduate Studies. Only the aptitude portion of the Graduate Record Examination (GRE) is required by the department. The Miller Analogies Test, administered regularly on campus, is accepted by the department in lieu of the GRE for conditional admission.

Degree Requirements

The graduate faculty offers courses in mathematics (MA) and statistics (ST) to satisfy the requirements for M.A. and M.S. degrees in mathematics and to satisfy individual needs for courses to supplement other areas of study. Entering graduate students will have a variety of mathematical backgrounds and goals. Consequently, programs of study leading to the M.A. or M.S. degree can vary considerably. For the M.S. degree, a program of study must include a minor area in the College of Science or the College of Engineering. For the M.A. degree, a minor area is not required. All minors must be outside of mathematics and must include at least six hours of approved graduate coursework.

New graduate students should meet with the graduate program director of the department at their earliest convenience for initial guidance. Later an advisor will be assigned to work closely with each student in designing an individualized program of study to meet the student’s needs according to the School of Graduate Studies requirements. Master’s programs that include a thesis (Plan I) require at least 24 hours of coursework. Programs without a thesis (Plan II) require at least 33 hours of coursework. Students should explore with their advisor which plan is better for their particular objectives.

Four main groups of graduate students have been identified:

(a) Those who plan to work in industry or government and will need considerable depth in areas of probability and statistics. A non-thesis Master’s program might be MA 544, 570, 585, 653, 656, 685, ST 687, MA 686 or ST 787, and three approved graduate courses, including at least one course numbered 600 or above.

(b) Those who plan to work in industry or government and will need depth, breadth, or both in other applicable areas. For a student desiring a broad general background, a non-thesis Master’s program might be MA 526, 542, 544, 585, 615, 625, 640, 656, and three approved graduate courses, including at least two courses numbered 600 or above. For a student who wishes to concentrate in numerical analysis, a non-thesis program might be MA 515, 526, 544, 570, 614, 615, 626, 670 and three approved graduate courses, including at least two courses numbered 600 or above. Other concentration areas could be differential equations, optimization, or combinatorics and graph theory.

(c) Those who plan to concentrate their studies in mathematical areas that may not directly relate to problems in industry or government. A non-thesis program might be MA 542, 570, 653, 656, 671, three of MA 643, 644, 670, 754, 756, and three approved graduate courses.

(d) Those teachers who hold the Class B Middle/Junior High or Secondary School Teacher’s Certificate and who wish to earn the Class A Teacher’s Certificate. A non-thesis program might be MA 542, 544, 570, 585, 614, 633, ST 687, nine hours of appropriate graduate education courses, and one approved MA or ST course numbered 600 or above.
A sample thesis program for a student in group (a), (b), or (c) would contain some of the courses listed above and a thesis. A thesis would be included instead of the additional coursework required in a non-thesis program.

Master's students who are interested in obtaining Class A Secondary Teacher's Certification but have not completed more than twelve semester hours in teacher education (graduate or undergraduate) courses, should consider the Non-Traditional Fifth Year Program. The MA and ST courses listed in (d) would be appropriate for such a program. Students should contact the Education Department for preliminary advisement on admission and general program requirements. More details on the Non-Traditional Fifth Year Program are given in the Education Department section.

The Ph.D. in Mathematics can be earned through a cooperative program with the Tuscaloosa campus. In that program, all but two semesters of coursework can be taken at UAH. The dissertation advisor can be a member of the UAH faculty. Students interested in the cooperative Ph.D. program should contact the graduate program director of the Mathematics and Statistics Department for details.

**Undergraduate Mathematics Courses (MA)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>415</td>
<td>Introduction to Numerical Methods</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>425</td>
<td>Introduction to Mathematical Modeling</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>440</td>
<td>Algebraic Structures with Applications</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>452</td>
<td>Introduction to Real Analysis (See MA 502)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>490</td>
<td>Selected Topics in Undergraduate Mathematics</td>
<td>1-3 hrs.</td>
</tr>
</tbody>
</table>

**Graduate Mathematics Courses (MA)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>502</td>
<td>Introduction to Real Analysis</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Sequences, limits, continuity, differentiation of</td>
<td></td>
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<tr>
<td></td>
<td>functions of one real variable, Riemann</td>
<td></td>
</tr>
<tr>
<td></td>
<td>integration, uniform convergence, sequences and</td>
<td></td>
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<tr>
<td></td>
<td>series of functions, power series, and Taylor</td>
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<tr>
<td></td>
<td>series. Prerequisite: MA 352 or 440 or approval</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of instructor.</td>
<td></td>
</tr>
<tr>
<td>515</td>
<td>Introduction to Numerical Analysis</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Numerical solution of ordinary differential</td>
<td></td>
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<tr>
<td></td>
<td>equations, solution of linear and nonlinear</td>
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<tr>
<td></td>
<td>algebraic systems, iterative methods in matrix</td>
<td></td>
</tr>
<tr>
<td></td>
<td>algebra, error analysis, and convergence</td>
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<tr>
<td></td>
<td>properties of selected methods. Lab fee: Level 3.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prerequisites: MA 244, 352, CS 108 or equivalent.</td>
<td></td>
</tr>
<tr>
<td>521</td>
<td>Introduction to Complex Analysis</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Complex algebra, analytic functions, Cauchy-Riem</td>
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<td></td>
<td>ann equations, exponential, trigonometric, and</td>
<td></td>
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<tr>
<td></td>
<td>logarithmic functions, integration, Cauchy</td>
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<td></td>
<td>integral theorem, Morera's theorem, Liouville's</td>
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<td></td>
<td>theorem, maximum modulus theorem, residue theory,</td>
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<td></td>
<td>Taylor and Laurent series, and applications.</td>
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<td>Prerequisite: MA 502 or approval of instructor.</td>
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<tr>
<td>525</td>
<td>Intermediate Differential Equations</td>
<td>3 hrs.</td>
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<td>Systems of linear ordinary differential equations,</td>
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<td>first order systems with constant coefficients,</td>
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<td>plane autonomous systems, stability, and selected</td>
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<td>topics related to properties and characterization</td>
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<td>of solutions. Prerequisite: MA 352 or approval</td>
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<td>of instructor.</td>
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<tr>
<td>526</td>
<td>Partial Differential Equations I</td>
<td>3 hrs.</td>
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<td></td>
<td>Systems of first order ordinary differential</td>
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<td>equations, first order quasilinear partial</td>
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<td>differential equations, general first order</td>
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<td>partial differential equation by Cauchy's method</td>
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<td>of characteristics, higher-order equations,</td>
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<td>canonical forms, separation of variables, Fourier</td>
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<td>series, wave equation, heat equation, and</td>
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<td>potential equation. Prerequisite: MA 352.</td>
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164
527 Vector Analysis 3 hrs.
Brief review of vector algebra and calculus of vector-related functions, representation of
vector operators in curvilinear coordinates, line and surface integrals, theorems of Gauss,
Green, and Stokes, Jacobian, and changes of variables in multiple integrals. Prerequisite:
MA 352 or approval of instructor.

530 Introduction to Fourier Analysis 3 hrs.
Fourier series and Fourier transforms with emphasis on the one- and two-dimensional
transforms. Topics include the basic properties of the Fourier transform, the computation
and analysis of the transforms of various functions and generalized functionals, Green’s
functions, convolution, correlations, sampling, the discrete transform, and applications.
Prerequisites: MA 244, 352.

534 Introduction to Integral Equations 3 hrs.
Volterra equations, convolution equations, the resolvent, Fredholm equations, Green’s
functions, the Fredholm alternative, and approximate methods of solution. Prerequisites:
MA 244.

540 Combinatorial Enumeration 3 hrs.
Counting, pigeonhole principle, permutations and combinations, generating functions,
principle of inclusion and exclusion, Polya’s theory of counting. Prerequisite: MA 440 or
approval of instructor.

542 Algebra 3 hrs.
Topics from group theory and ring theory: subgroups, normal subgroups, quotient groups,
homomorphisms, isomorphism theorems, ideals, principal ideal domains, Euclidean do-

544 Linear Algebra 3 hrs.
Vector spaces, bases, linear transformations, matrices, determinants, eigenvalues, similarity,
Jordan canonical forms, dual spaces, bilinear forms, quadratic forms, orthogonal and
unitary transformations. Prerequisites: MA 244 and at least one MA course at 300 level or
above.

551 Functions of Several Variables 3 hrs.
Topology of En, limits, continuity, and differentiation of functions of several real variables,
Jacobians, implicit function and inverse function theorems, Riemann integration of func-
tions of several real variables, and change of variables theorem for multiple integrals.
Prerequisite: MA 502.

570 Metric Spaces with Applications 3 hrs.
Basic metric spaces, continuous functions, compactness, connectedness, completeness,
Arzela-Ascoli theorem, Stone-Weierstrass theorem, contraction mappings, applications to
existence and uniqueness of solutions of differential and integral equations. Prerequisite: MA 551 or approval of instructor.

585 Probability 3 hrs.
Probability theory and its applications. Independent trials, discrete and continuous random
variables, law of large numbers, basic distributions, sums of independent random variables,
sequences of random variables, central limit theorem, and convergence in distribution.
Prerequisites: MA 251 and one of MA 385, EG 390, ST 281, or approval of instructor.

590 Selected Topics in Mathematics 3 hrs.
Courses in requested selected topics. Prerequisite: Approval of instructor.

614 Numerical Methods for Linear Algebra 3 hrs.
Norms and vector spaces, matrix factorizations and direct solution methods, least squares
methods, stability and conditioning, iterative refinement and updating decompositions,
algebraic eigenvalue problems, and Q R algorithms. Lab fee: Level 4. Prerequisites: MA
415 or 515, MA 544, CS 108 or equivalent.
615 Numerical Methods for Partial Differential Equations 3 hrs.
Finite difference methods for parabolic, elliptic, and hyperbolic partial differential equations, error analysis, stability, and convergence of finite difference methods. Lab fee: Level 4. Prerequisites: MA 415 or 515, MA 526, CS 108 or equivalent.

621 Special Functions 3 hrs.
Gamma and beta functions, probability integral and applications, orthogonal polynomials, Bessel functions and their applications, spherical harmonics and their applications, hypergeometric functions. Prerequisite: MA 521.

625 Calculus of Variations 3 hrs.
Problems in calculus of variations, necessary and sufficient conditions for extrema of a definite integral in both parametric and nonparametric representations in the plane, Bolza problem. Prerequisite: MA 502 or approval of instructor.

626 Partial Differential Equations II 3 hrs.
Higher dimensional equations, potential theory, eigenfunction expansions for solutions to homogeneous and non-homogeneous equations, Green’s functions, and other special topics in the theory and application of partial differential equations. Prerequisite: MA 526.

633 Geometry 3 hrs.
Axioms of incidence and order, affine structure of the plane, metric properties, isometrics, similarity transformations, the group of angles, orientation. Prerequisites: MA 440, 544 or approval of instructor.

640 Graph Theory 3 hrs.
Graphs, subgraphs, trees, connectivity, Euler tours, Hamilton cycles, matchings, edge colorings, independent sets, vertex colorings, planar graphs, Kuratowski’s theorem, four-color theorem, directed graphs, networks, cycle and bond spaces. Prerequisite: MA 540 or 542.

643 Group Theory 3 hrs.
Isomorphism theorems, permutation groups, basis theorem and fundamental theorem for finite abelian groups, the Remak-Krull-Schmidt theorem, Sylow theorems, normal series, solvable groups, extensions, and selected topics in representation theory. Prerequisite: MA 542.

644 Matrix Theory 3 hrs.
Functions of matrices, invariant polynomials, elementary divisors, similarity of matrices, normal forms of a matrix, matrix equations, generalized inverses, non-negative matrices, localization of eigenvalues. Prerequisite: MA 544.

645 Combinatorial Design 3 hrs.
Systems of distinct representatives, difference sets, coding theory, block designs, finite geometries, orthogonal latin squares, and Hadamard matrices. Prerequisites: MA 540, 544.

646 Combinatorial Algorithms 3 hrs.
Linear, polynomial and exponential graph theoretic algorithms, generating combinatorial objects, and NP-completeness. Prerequisite: MA 540.

652 Advanced Differential Equations 3 hrs.
Approximate methods, oscillations and periodic solutions, stability and Liapunov theory, delay equations, and selected topics. Prerequisites: MA 502, 525.

653 Real Analysis I 3 hrs.
Countable sets, characterization of open and closed sets, Heine-Borel theorem, Riemann integral, Lebesgue measure and outer measure, measurable functions, Lebesgue integral, Fatou’s lemma, and Lebesgue-dominated convergence theorem. Prerequisites: MA 551 and one MA course at the 540 level or above.
656 Complex Analysis I 3 hrs.
Topology of the complex plane, analytic functions of one complex variable, elementary functions and their mapping properties, power series, complex integration, Cauchy's theorem and its consequences, isolated singularities, Laurent series, residue theory. Prerequisite: MA 551 or approval of instructor.

670 Introduction to Functional Analysis 3 hrs.
Normed and inner product spaces, finite dimensional spaces, product and quotient spaces, equivalent norms, Hahn-Banach theorem, principle of uniform boundedness, open-mapping theorem, Riesz representation theorem, complete orthonormal sets, Bessel's inequality, Parseval's identity, and conjugate spaces. Prerequisite: MA 570.

671 General Topology 3 hrs.
Set theory, logic, well-ordering principle, axiom of choice, topological spaces, product spaces, quotient spaces, continuous functions, connectedness, path connectedness, local connectedness, compactness, local compactness, countability and separation, generalized products, Tychonoff theorem. Prerequisite: MA 570.

685 Stochastic Processes with Applications I 3 hrs.
Discrete and continuous Markov chains, Poisson processes, counting and renewal processes, and applications. Prerequisites: MA 585, 244 or approval of instructor.

686 Stochastic Processes with Applications II 3 hrs.
Gaussian and Wiener processes, general Markov processes, special types of processes from queueing and risk theory, and selected advanced topics. Prerequisite: MA 685 or approval of instructor.

690 Special Topics in Mathematics 3 hrs.
Courses in requested special topics. Prerequisite: Approval of instructor.

699 Master's Thesis 3 hrs.
Required each term a student is working and receiving direction on his master's thesis. A minimum of two terms is required. Maximum of 9 hours credit awarded upon successful completion of the master's thesis.

754 Real Analysis II 3 hrs.
Differentiability of monotone functions, functions of bounded variation, absolute continuity, convex functions, Minkowski and Holder inequalities, $L_p$ spaces, Riesz-Fischer representation theorem, Fubini's theorem and selected topics. Prerequisite: MA 653.

756 Complex Analysis II 3 hrs.
Applications of residue theory, harmonic functions and their applications, Mittag-Leffler theorem, infinite products, Weierstrass product theorem, conformal mapping and Riemann mapping theorem, univalent functions, analytic continuation and Riemann surfaces, Picard's theorems, and selected topics. Prerequisite: MA 656 or approval of instructor.

785 Advanced Probability Theory 3 hrs.
Measure and integration, probability spaces, convergence concepts, law of large numbers, random series, characteristic functions, central limit theorem, random walks, conditioning, Markov properties, conditional expectations, and elements of martingale theory. Prerequisites: MA 585, 653.

790 Graduate Seminar 3 hrs.
Selected advanced topics. Prerequisite: Approval of instructor.

799 Doctoral Dissertation 3, 6, or 9 hrs.
Required each term a student is enrolled and receiving direction on his Ph.D. dissertation.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>687</td>
<td><strong>Theory of Statistics I</strong></td>
<td>3 hrs.</td>
<td>MA 244, 585</td>
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<td>Distribution of statistics based</td>
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<td>on ordered samples, asymptotic</td>
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<td>sampling distributions, maximum</td>
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<td>likelihood, least squares, and</td>
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<td>other methods of point estimation,</td>
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<td>Rao-Blackwell theorem and</td>
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<td>Cramer-Rao inequality, confidence</td>
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<td>intervals, regions, and their</td>
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<td>optimal properties. Neyman-Pearson</td>
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<td>formulation and tests of simple</td>
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<td>hypothesis against simple</td>
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<td>alternatives.</td>
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<td>690</td>
<td><strong>Special Topics in Statistics</strong></td>
<td>3 hrs.</td>
<td>Approval of Instructor</td>
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<td>Courses in requested special</td>
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<tr>
<td>787</td>
<td><strong>Theory of Statistics II</strong></td>
<td>3 hrs.</td>
<td>ST 687</td>
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<td>Continuation of hypothesis testing,</td>
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<td>likelihood ratio and unbiased</td>
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<td>tests, uniformly most</td>
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<td>powerful tests, power function,</td>
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<td>nonparametric tests, statistical</td>
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<td>decision theory, distribution</td>
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<td>and linear models.</td>
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<td>Prerequisite: ST 687.</td>
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Physics

Degrees
Master of Science
Doctor of Philosophy

Chair
Duthie, J.G., Professor; experimental optics and astrophysics.

Professors
Barr, T. A.; (Research) experimental physics, laser physics.
Bowden, C.M.; (Adjunct); theoretical quantum optics.
Caulfield, H.J.; (Adjunct); optical computing, holography, metrology.
Chan, C. H.; theoretical physics, quantum electronics.
Hendricks, J. B.; (Research) experimental physics, low temperature, superconductivity.
McKnight, W. B.; (Research) experimental physics, laser, quantum electrons.
Rosenberger, F.R.; chemical physics, fluid dynamics of materials processing.
Stuhlinger, E. (Adjunct); space physics
Smalley, L. L.; theoretical physics, general relativity.
Sung, C.C.; theoretical physics, solid state.
Tandberg-Hanssen, E. A.; (Adjunct); astrophysics, solarphysics.
Torr, D.G.; experimental physics, optics.
Wu, S. T.; (Adjunct); aerospace engineering, solar physics, plasma dynamics.

Associate Professors
Bartell, F. O.; Optics, Radiometry, Infrared.
Comfort, R. H.; (Research); Atmospheric and magnetospheric physics.
Davis, J. H.; Experimental physics, solid state.
Emslie, A. G.; Theoretical physics, solar physics.
Fennelly, A. J.; (Adjunct); Theoretical physics, optics gravitation physics.
Guenther, K.H.; (Adjunct); thin film physics, optical coatings, surface analysis.
Horwitz, J. L.; Atmospheric and magnetospheric physics.
Torbert, R.B.; experimental physics and optics.

Assistant Professors
Chipman, R.A.; (Adjunct); polarimetry, optical testing, optical design.
Paciesas, W. S.; (Research); X-ray and gamma-ray astronomy.
Stone, N. H.; (Adjunct); solar physics, magnetospheric physics.
Wu, M. K.; Solid state physics, superconductivity.

The undergraduate program provides a broad base in physical principles for a terminal, professional degree in physics while the graduate program provides a smooth transition to a more comprehensive and rigorous treatment of physical principles. The physics curriculum is broad-based through the master’s degree, thereupon narrowing into sub-fields and specializations for doctoral studies.

The Department of Physics recognizes three broad areas of emphasis in basic and applied research:
1. Space sciences including studies of magnetospheric physics, atmospheric physics, solar physics, solarterrestrial physics, astrophysics, low-temperature physics, relativity, plasma physics and zero g effects.
2. Solid state/materials including studies of critical phenomena, crystal growth, electromagnetic properties of matter, thermal properties of materials, electron spin resonance, and solid state theory.
3. Optics/quantum electronics including studies of laser physics, propagation, laser media and materials, optical properties of matter and electromagnetic scattering.

Degree Requirements

Besides meeting the requirements established by the School of Graduate Studies for advanced degrees, the Physics Department requires a) the advanced portion of the GRE for unconditional admission, and b) a departmental placement examination to be given during the first term of graduate study. Normally, students must take both, but under special circumstances the advanced portion of the GRE may be substituted for the placement exam. The placement examination is administered to help advisors and students determine the best course of study. It should be followed by the completion of a program of study.

Master of Science

Students must take PH 792 (Physics Seminar) for two terms. Two options are available for the Master of Science degree under Plan II.

A. Theoretical Physics Option: PH 601, 622, and 631 are required. PH 732, 751, 752 are also recommended. This option is designed for students who desire to complete course requirements early for an advanced degree program.

B. Applied Physics Option: PH 601, 622, and 631 are required and at least three additional courses which stress applications to various branches of physics. Since many of these topics involve current theory and research, advance topics normally occur under the heading Selected Topics. Frequently offered selected topics courses include Fourier optics, laser physics, electron-spin resonance, microwave properties of solids, physics of plasmas, superconductivity. These additional courses can best be arranged through consultation with the adviser.

Each candidate for the Master of Science degree must also pass the comprehensive examination, which is normally administered during spring term.

The physics faculty encourages students to carry out programs of study oriented toward applied physics. For this purpose, selected topics courses, PH 680-689 and PH 780-789 are offered frequently in areas such as laser physics, properties of materials, and phases of matter.

NON-TRADITIONAL FIFTH-YEAR PROGRAM leading to the M.S. in Physics plus a Class A Alabama High School Teachers Certificate.

Those who have a BA or BS degree with a major or its equivalent in Physics as determined by the department of Physics and have not taken more than twelve semester hours in teacher education (graduate or undergraduate), and who are interested in obtaining Class A (masters level) certification for secondary school teaching, should consider the Non-Traditional Fifth Year Program. Contact the Education department for preliminary advisement on admission and general program requirements. See the description in the Education section in the Graduate Catalog for more details.
Doctor of Philosophy

A statement of procedures for admission to the Ph.D. program in physics may be obtained from the Physics Department office.

Admission to the Ph.D. program in physics is dependent on performance on the Master of Science Comprehensive Examination. Students entering UAH with an M.S. degree or previous graduate training in physics must take the UAH Comprehensive Examination at their earliest opportunity.

A minimum of 48 hours of graduate course credit is required for the Ph.D. in physics. PH 601, 622, 631, 732, 751, 752 and a minimum of 12 credit hours in courses numbered 600 or above must be taken. Students in the Ph.D. program are required to take PH 792 (Physics Seminar) for three terms. Courses in addition to those enumerated above are selected in consultation with student’s advisory committee. Transfer of credit from other institutions requires approval of the graduate faculty in physics. Although a minor subject is not required, students are encouraged to develop an interdisciplinary program of study.

The Physics Department requires a score of 35th percentile or better in each language on the Graduate School Foreign Language Tests administered by the Educational Testing Service. To show in-depth knowledge of one language, students must score in the 65th percentile or better on the ETS examination.

After having earned 42 hours of graduate credit, students must then pass the departmental qualifying examination. However, the department may require the examination after two or more years of full-time graduate work or the equivalent in part-time work. This examination may be taken no more than twice. It tests students’ general fitness for pursuing a research project in their chosen area and their general knowledge of physics.

Finally, a significant portion of the dissertation must be submitted for publication in an approved journal with international circulation.

Physics (PH)

Prerequisites for physics courses listed may be waived by instructor or department chair for auditors or student with equivalent experience. In the case of courses listed for alternate years, “Even” or “Odd” refers to the calendar year. A partial listing of undergraduate courses appears below. (See general UAH Undergraduate Catalog for complete description).

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>301</td>
<td>Intermediate Mechanics I</td>
<td>3 hrs.</td>
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<tr>
<td>302</td>
<td>Intermediate Mechanics II</td>
<td>3 hrs.</td>
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<tr>
<td>321</td>
<td>Thermal and Statistical Physics</td>
<td>3 hrs.</td>
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<tr>
<td>337</td>
<td>Electronics</td>
<td>4 hrs.</td>
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<tr>
<td>342</td>
<td>Geometrical Optics II</td>
<td>3 hrs.</td>
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<td>343</td>
<td>Physical Optics I</td>
<td>3 hrs.</td>
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<td>351</td>
<td>Quantum Physics</td>
<td>3 hrs.</td>
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<tr>
<td>431</td>
<td>Intermediate Electricity and Magnetism I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>432</td>
<td>Intermediate Electricity and Magnetism II</td>
<td>3 hrs.</td>
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</table>

171
Graduate Courses

506 Introduction to Astrophysics of Stellar Systems 3 hrs.
Analysis of structure of main sequence stars; radiation theory, color-magnitude diagrams and their interpretation. Dynamics of simple and many-body systems - the restricted 3-body problem, Hamilton-Jacobi methods, Liouville’s and Jean’s theorems and their application to galactic structure. General relativity and application to cosmology. Prerequisites: PH 302, 321, 432, MA 352. Spring, odd years.

521 Thermal Physics 3 hrs.
Thermal phenomena on macroscopic and statistical basis and principles and laws governing them. Prerequisites: PH 321, 432. Summer.

531 Introduction to Plasma dynamics 3 hrs.

541 Optics I 3 hrs.
Review of basic optics; Electromagnetic waves; Huygen’s principle; Fresnel’s laws, geometrical optics, optical systems; polarization and optical fibers. Prerequisite: PH 432 or equivalent, Fall. (Same as EE 541)

542 Optics II 3 hrs.
Physical optics and Electrooptics. Interference, Michelson and Fabry-Perot interferometers; Fraunhofer and Fresnel diffraction; coherence theory; light sources, lasers, optical detection and modulation. Prerequisite: PH 541. (Same as EE 542)

544 Radiometry 3 hrs.
The theory and practice of radiometry. Nomenclature, Planck’s law, blackbodies and blackbody simulators, the propagation of radiant energy, detectors, normalization, source detector spectral mismatch, attenuation, very low signals and the avoidance of common errors. Prerequisite: PH 342. Spring.

545 Introduction to Lasers 3 hrs.
Basic physical concepts of spontaneous and stimulated radiation. Pumping processes, optical resonators, types of lasers and laser beam properties. Prerequisites: PH 343, 351, 442, Winter.

546 Electro Optics 3 hrs.
Planck’s law, blackbodies and blackbody simulators, propagation of radiant energy, detectors, noise, basic circuits for photoelectric detectors. Prerequisite: PH 342. Spring.

551 Introductory Quantum Mechanics I 3 hrs.
Background of quantum theory, wave-particle duality and uncertainty principle, basic postulates of quantum mechanics, angular momentum and spin; simple systems in one, two, and three dimensions. Perturbation theory, scattering theory, applications. Prerequisites: PH 351, 302, 432. Fall. (Same as CH 553).

552 Introductory Quantum Mechanics II 3 hrs.
Continuation of PH 551. Prerequisite: PH 551. Winter. (Same as CH 554).

560 Introduction to Solid State Physics I 3 hrs.

561 Introduction to Solid State Physics II 3 hrs.
Thermal properties of solids. Electronic properties, optical properties, electronic properties in a magnetic field, semiconductor devices, magnetism, superconductivity, defects and
alloys, dislocations and crystal growth, non-crystalline solids, surfaces and interfaces. Prerequisite PH 560. Spring

601 Classical Dynamics I 3 hrs.

607 Mathematical Methods I 3 hrs.

609 Mathematical Methods II 3 hrs.
Continuation of PH 607. Prerequisite: 607. Winter.

622 Kinetic Theory and Statistical Mechanics I 3 hrs.
Theomodynamics review, kinetic theory, classical statistical mechanics, canonical and grand canonical ensembles, quantum statistical mechanics, Bose and Fermi statistics, partition function. Prerequisites: PH 521, 552, MA 521. Fall.

631 Electromagnetic Theory I 3 hrs.

636 Introduction to Space Plasma Physics 3 hrs.
Charged particles in electric and magnetic fields, cosmic rays and trapped radiation; introduction to plasmas, including collisions and macroscopic effects. Prerequisites: PH 531, 631. Fall. Even years.

639 Experimental Plasma Physics and Instrumentation 3 hrs.

645 Infrared Science 3 hrs.
Theory and practice of infrared science. Foundations of infrared principles followed by study of infrared sources, atmospheric transmission, infrared detectors and system concepts. Prerequisite: PH 541. Fall. Odd years.

672 Optical Surface Characterization 3 hrs.

673 Fourier Optics 3 hrs.

684 Aeronomy I—Photochemistry 3 hrs.
Neutral atmospheric composition and thermal structure. Solar flux and absorption processes. Photochemistry of the mesosphere, thermosphere, ionosphere. Aurora and airglow. Prerequisite: PH 521, 551. Fall, even years.

687 Aeronomy 2—Dynamics and Energetics 3 hrs.

689 Selected Topics 3 hrs.
Offered upon demand. Previous topics: superconductivity, optical properties of solids in infrared, laser propagation, collision theory, quantum electronics, and microwave properties of solids.

699 Master’s Thesis 3 hrs.
Minimum of two terms required for M.S. students. Maximum of 9 hours credit awarded upon successful completion of master’s thesis.

702 Classical Dynamics II 3 hrs.
Continuation of PH 601. Review Lagrangian and Hamiltonian dynamics, canonical transformation, Hamilton-Jacobi theory, Lagrangian field theory, selected topics. Prerequisite: PH 601. Fall.

705 Relativity 3 hrs.

706 Solar Flare Physics 3 hrs.
Overview of the flare phenomenon; magnetic field structure and stability. Radiation mechanisms; energy transport by particles, hydrodynamic motions, and radiation, empirical and theoretical atmosphere models; energy release mechanisms; solar terrestrial effects. Prerequisite: PH 531, 631. Spring. Even years.

711 Problems in Physics I 3 hrs.
Application of theoretical principles of physics to an intensive analysis and solution of representative problems. Prerequisites: PH552, 601, 622, 631. Fall.

712 Problems in Physics II 3 hrs.
Continuation of PH 711. Prerequisite: PH 711. Winter.

713 Kinetic Theory and Statistical Mechanics II 3 hrs.
Continuation of PH 622. Advanced topics in kinetic theory and statistical mechanics. Prerequisite: PH 622. Winter.

731 Advanced Plasma Theory 3 hrs.

732 Electromagnetic Theory II 3 hrs.
Continuation of PH 631. Inhomogeneous wave equation and sources. Special relativity, radiation form accelerated charges, and Hamiltonian formulation of electrodynamics. Prerequisite: PH 631. Summer.

736 Magnetospheric Physics 3 hrs.

745 Quantum Electronics 3 hrs.
Non-Linear Optics 3 hrs.

Quantum Mechanics I 3 hrs.
Review of basic principles, general formulation in Hilbert space, angular momentum, steady-state perturbation theory, scattering theory and applications. Prerequisites: PH 552, 601, 609. Winter.

Quantum Mechanics II 3 hrs.
Continuation of PH 751. Identical particles, symmetry principles, time-dependent perturbation theory, variational principles, formal scattering theory. Prerequisite: PH751. Spring.

Quantum Mechanics III 3 hrs.
Continuation of PH 751 and 752. Relativistic wave equations, second quantization, interacting fields, Feynman techniques. Prerequisite: PH 752. Summer.

Quantum Theory of Solids I 3 hrs.
Semiclassical introduction, second quantization and the electron gas, Boson systems, one-electron theory and metals, electron-phonon interactions, superconductivity, dynamic electrons in a magnetic field, semiconductor crystals, energy bands, impurity states, semiconductor crystals II, optical absorption and excitations. Prerequisites: PH 552, 561, 631.

Fourier Optics II 3 hrs.

Selected Topics 3 hrs.
Offered upon demand. Previous topics: superconductivity, optical properties of solids in infrared, laser propagation, collision theory, quantum electronics, microwaves properties of solids, gravitational theories.

Physic Seminar No credit
Student reports on journal articles or individual research. Prerequisite: PH552. Two terms required for M.S. students. Fall, winter, spring.

Advanced Physics Project Laboratory 3 or 6 hrs.
Advanced laboratory research in one of the departmental research groups. Student works on an independent or group project. Prerequisite: approval of adviser.

Doctoral Dissertation 3, 6, 9 hrs.
Interdisciplinary Programs

The University of Alabama in Huntsville has formalized areas of study which cross the traditional departments. These interdisciplinary areas of study encompass science and engineering, and the centers where organized research exists. The formalized programs are optics, and atmospheric science. Other areas under development include robotics, materials science, and space plasma. Inquiries about these interdisciplinary programs should be addressed to the Dean of the School of Graduate Studies.

Optics

Research and specialization in optics at UAH date back to the early 1960's. The Center for Applied Optics was formally established in 1985. The Center has already been selected by the Strategic Defense Initiative Organization to be the lead center in the consortium to study innovative techniques for high speed optical computing. The Center houses many laboratories and also directly employs scientists and engineers to supplement teaching in the academic departments.

Interested faculty and students are encouraged to carry on research in various areas and are partially funded through the Center for Applied Optics. Students must first affiliate with one of the departments listed below to pursue a program leading to a Master of Science or Doctor of Philosophy degree.

- Chemistry
- Computer Science
- Electrical and Computer Engineering
- Industrial and Systems Engineering
- Mathematics and Statistics
- Mechanical Engineering
- Physics

Students choose specializations and research projects in specific areas of optics. In addition, students must satisfy departmental degree requirements.

Atmospheric Science

Research and instruction in the area of Atmospheric Science has been within the expertise of UAH for many years. This effort supports NASA's Marshall Space Flight Center programs in the use of space-borne sensors to observe the earth's atmosphere. Students, faculty, and research staff have successfully developed specializations in atmospheric remote sensing, wave propagation, cloud modeling, dynamic meteorology, geophysical fluid dynamics, storm physics, climatology, and mesoscale modeling. Research is on-going in cooperation with Marshall Space Flight Center, the Army Missile Command, the National Science Foundation, and the Tennessee Valley Authority.

Students interested in atmospheric science may pursue a Master of Science or the Doctor of Philosophy degree in graduate programs in the Departments of:
Industrial and Systems Engineering
Mechanical Engineering
Mathematics and Statistics
Physics

Students choose atmospheric specializations and research projects in specific areas of atmospheric science and engineering. In addition, students must meet departmental degree requirements.
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