1989

1989-1990 Graduate Catalog

University of Alabama in Huntsville

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Class Periods

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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 1989-90

Fall Term
Labor Day Holiday .......................................................... September 1, 4, 5, 1989
Registration ................................................................. September 14, 15
First Saturday Class ......................................................... September 16
Classes Start ................................................................. September 18
Thanksgiving Holidays ...................................................... November 23, 24
Last Class ................................................................. November 28
Study Day ................................................................. November 29
Exams ................................................................. November 30 and December 1, 4, 5
Commencement, Sunday ..................................................... December 10
Christmas Holidays .......................................................... December 22, 25, 26, 27, 28, 29

Winter Term, 1989-90
New Year’s Day Holiday .................................................. January 1, 1990
Registration ................................................................. January 3
Classes Start ................................................................. January 4
Last Class ................................................................. March 14
Study Day ................................................................. March 15
Exams ................................................................. March 16, 17, 19, 20

Spring Term
Registration ................................................................. March 23, 1990
First Saturday Class ......................................................... March 24
Classes Start ................................................................. March 26
Memorial Day Holiday ..................................................... May 28
Last Class Day .............................................................. June 1
Exams ................................................................. June 2, 4, 5, 6
Commencement, Sunday ..................................................... June 10
Summer Term 1990

8 Week Term

Registration .............................................. June 15, 1990
Classes Start ............................................. June 18
Independence Day Holiday .............................. July 4
Last Class Day ............................................ August 13
Study Day ................................................... August 14
Exams ......................................................... August 15, 16, 17

10 Week Term

Registration .............................................. June 15, 1990
Classes Start ............................................. June 18
Independence Day Holiday .............................. July 4
Last Class Day ............................................ August 27
Study Day ................................................... August 28
Exams ......................................................... August 29, 30, 31
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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 post-baccalaureate 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.

Computing Facilities

The University utilizes the State's Supercomputer (a CRAY X-MP/24 with a 32M word Solid State Device) located in Huntsville and operated by the State of Alabama to foster research and graduate education.

The University also operates a UNIVAC 1100/73 three-processor mainframe with 24M bytes of memory. This basic computing capability is augmented by:

- DEC VAX 11/785
- DEC VAX 8250
- Intergraph Graphic System:
  - VAX 11/750 with 8 Interpro-32 graphic workstations
- TI Explorer Lisp Machines
- Symbolics 3670 Lisp Machines
- Sperry 7000/40 with UNIX
- HP 9000
- SUN 4 Graphics System
- IRIS 4D Graphics System

General purpose graphics terminals are available for support of instructional and research efforts and a research-quality general purpose graphics laboratory is accessible to researchers, faculty and 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 occupies facilities in a new 93,000 sq. foot hotel and conference training center 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, materials 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 and Materials 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 also has 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 spectrometry 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 ionosphere, and physics of solar flares, solarinterplanetary dynamics, critical ionization phenomena, direct measurements of electric currents in space, electrostatic charging of spacecraft, and optical meas-
urements 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 $20. 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
3. 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 undergraduate GPA) + 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 at UAH 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 readmitted 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, Room 124, University Center, to apply for a change in residency status.

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.

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 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 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, Room 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.

Credit earned under unclassified status may be applied toward a graduate degree program following admission to the graduate degree program and approval of courses by the major department.

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, Room 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 (Co-op) 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- | 4
B- | 3
C- | 2
D- | 1
F | 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.)

S-Satisfactory work.
Applicable to noncredit courses and to some specified credit courses, and will not be counted in the GPA.

U-Unsatisfactory work.
Applicable to noncredit courses and to some specified credit courses, and will not be counted in the GPA.

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. 17 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
Inquiries or complaints concerning the application to these federal requirements and this policy should be directed to one of the following persons:

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

Ms. Gerry Moore  
Staff EEO Officer  
135 Madison Hall  
The University of Alabama in Huntsville  
Huntsville, AL 35899 (205-895-6545)

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 birth, 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:

- Assistant Vice President for Enrollment Management
- Director, Student Records
- Director, Academic Advisement and Information Center
- Director, Cooperative Education
- Assistant Dean, Administrative Science
- Associate Dean, Engineering, Lower Division
- Appropriate Engineering Department Chairman, Upper Division and Graduate
- Director, Nursing, Undergraduate Program
- Director, Nursing, Graduate Program
- Director, Nursing, RN Education
- Director, Continuing Education
- Vice-President, Student Affairs
- Director, Medical Student Affairs
- Director, Financial Aid

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.

2. 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.

3. 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.

4. 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.
Financial Information

Graduate Tuition

<table>
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<th>HOURS</th>
<th>REGISTRATION FEE</th>
<th>TUITION</th>
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<td></td>
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<td>IN-STATE</td>
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<tr>
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</table>

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 timetable of classes) a schedule of courses, and a tuition bill. Tuition charges should 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 may 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**

<table>
<thead>
<tr>
<th>Description</th>
<th>Fee</th>
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</thead>
<tbody>
<tr>
<td>Application (non-refundable)</td>
<td>$20.00</td>
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<tr>
<td>International student deposit</td>
<td>$1,500.00</td>
</tr>
<tr>
<td>Change of schedule (non-refundable)</td>
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</tr>
<tr>
<td>- Drop/add/change to audit/reinstatement</td>
<td>$20.00</td>
</tr>
<tr>
<td>Late registration (non-refundable)</td>
<td>$20.00</td>
</tr>
<tr>
<td>Credit by examination or validation, per semester hour</td>
<td>$10.00</td>
</tr>
</tbody>
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**Laboratory and Special Fees**

<table>
<thead>
<tr>
<th>Level</th>
<th>Fee</th>
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</thead>
<tbody>
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<td>12</td>
<td>110.00</td>
</tr>
<tr>
<td>13</td>
<td>120.00</td>
</tr>
</tbody>
</table>

| Replacement of I.D. card                                       | $10.00    |
| Transcript                                                     | No Charge |
| Duplicate Diploma                                              | $7.50     |
| Thesis binding (4 copies)                                      | $17.50    |
| each additional copy                                           | $6.00     |

| Vehicle registration regulations concerning traffic and parking are available at the Campus Safety Office | $15.00 |

**College of Nursing**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Liability Insurance (per year)</td>
<td>approximately $60.00</td>
</tr>
<tr>
<td>College of Nursing Pin (graduation)</td>
<td>$35.00 - $100.00</td>
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<tr>
<td>Annual health examinations</td>
<td>variable</td>
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</tbody>
</table>

**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 $20.00
During first two weeks: registration fee $20.00
plus.......................................................... withdrawal fee $20.00
After first two weeks of class ...................................... 100% of fees
plus withdrawal fee of 20.00

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.

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 in private industry or government. Students accepted for Graduate Co-op normally work six months, return as a full-time student for 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. Admissions to the School of Graduate Studies as a degree candidate.
2. A minimum of a 3.0 grade point average of all graduate course work. If the student’s field of study is significantly different from his/her undergraduate major, the student may need to complete nine hours of graduate work at UAH.
3. Formal application to the UAH Co-op Office. The mailing address is Cooperative Education Office, Room 212, University Center, The University of Alabama in Huntsville, Huntsville, AL 35899. The telephone number is (205) 895-6741.

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 Perkins 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 Stafford 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; for currently enrolled students 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 SIGI PLUS 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 fall and spring.

A credentials file which includes a resume, an authorization form, and a candidate registration form 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 person 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 Office, Room 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.

U 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 a study lounge 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 may 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, The University of Alabama in Huntsville, Huntsville,
Alabama 35899 telephone (205) 895-6108. Individual and group tours of the apartments
may be arranged by appointment through the housing office.

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 University Center houses the Division of Student Affairs, the Office of Admissions
and Records, the Academic Advisement and Information Center, Career Planning and Place­
ment 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: Samuel P. McManus, Professor of Chemistry.

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

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*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.
2. Any time a student's overall grade average on graduate courses drops below a B, the student will be placed on probation.
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.
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 six or more of thesis credit hours, 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 Graduate School’s Theses Manual available in the University Bookstore.

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 if 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: A 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: A 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: A 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.

Students must also register for a minimum total of 18 semester hours of dissertation research.

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 after the student has completed the Program of Study and the language requirement.

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 Graduate School’s Theses Manual available in the University Bookstore.

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: A 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.

**Between UAH and The University of Alabama at Birmingham (UAB)** A cooperative program in Engineering was initiated between UAH and UAB for the pursuit of doctoral degrees. A student at UAB may earn the doctoral degree at UAH with a major in electrical engineering, computer engineering, or mechanical engineering; while a UAH student may pursue the master or the doctoral degree with a major in biomedical engineering at UAB. An interested student must first be admitted at the principal institution i.e. the one offering the degree, but may take courses and satisfy the residency requirements at either campus. All degree requirements must be satisfied at the principal institution. More details are available through the participating departments.
College of Administrative Science

Master of Science
Doctor of Philosophy

Degrees: Master of Science in Management
Ph.D. 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: Rudolph S. Lindbeck,
Professor of Accounting
Chair, Department of Accounting and Business Legal Studies: Grover L. Porter, Professor of Accounting
Chair, Department of Economics and Finance: Niles C. Schoening, Associate Professor of Economics
Chair, Department of Management and Marketing: J. Daniel Sherman, Associate Professor of Management
Chair, Department of Management Information Systems and Management Science: Robert R. Zant, Professor of Management Information Systems.

Professors:
Billings, C.D.; government financial management, systems analysis, investments.
Bond, M.S.; Comparative Systems - Economics.
Choudry, Amar; Management Science.
Lindbeck, R.S.; taxation, not-for-profit accounting, financial accounting.
McCollum, J.K.; labor relations, organizational theory.
Porter, G.L.; managerial accounting, accounting information systems.
Schroer, B.J.; project management, management science, manufacturing.
Zant; R.F.; Management Information Systems

Associate Professors:
Bryson, R.E. Jr.; financial accounting, auditing
Paul, C.W., II; managerial economics.
Schoening, N.C.; urban & regional economics
Sherman, J.D.; organizational behavior, organizational theory.
Stafford, E.F., Jr.; production/operations management.

Assistant Professors:
Batchelder, W.I.; accounting information systems, financial and managerial accounting.
Burger, K.J.; marketing research, marketing management.
Floyd, S. A.; decision support systems, management science.
Forbes, S.M.; financial economics
Ford, D.R.; artificial intelligence, management information systems.
Sundaraiyer, V.H.; management science.
Tan, K.J.; corporate finance, investments.
Tseng, F.T.; management information systems.
Tyagi, R.B.; management information systems.

Lecturer:
Ballenger, J.P.; management information systems.
The College of Administrative Science is a professional school with the mission to disseminate and develop knowledge which contributes to the education of competent, creative, and socially responsible managers for careers in private and public sectors with specific emphasis on the management of technology.

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.

In fulfilling this mission, the college seeks to accomplish three major objectives in instruction, research and service.

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 produce research which furthers the accumulated knowledge and/or contributes to the practice of the respective disciplines represented in the College;
3. To render public service to business and government in the region and to conduct productive applied research which serves the technology industry and public sector organizations in the region. In addition, faculty involvement in professional societies is emphasized.

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 $6,000 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.
Master of Science in Management

Purpose of the MSM

The Master of Science in Management (MSM) degree is a unique specialized management program, especially designed for the management of technology including the special needs of the Huntsville community. It provides 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 both external challenges such as rapid technological change, and increasing environmental complexities, and internal issues such as changing employee expectations, and methods of increasing productivity. 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, laboratories and computer-assisted instruction.

The total hours required of students and the level at which they begin participation in the MSM program depends on their academic preparation. Generally, the program extends for two and one-half years for full-time students with a nonbusiness administration background, and one and one-half year for full-time students with a business administration background. The total number of hours required for completion of an MSM may range from 33 to 63.

All of the 600 level courses are offered in the evening.

Goals of the MSM 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
- Project Management

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 MSM 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 MSM 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, The 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 will be considered for unconditional admission if they obtain a total of at least 950 based on the formula: 200 times the overall undergraduate grade point average (based on a 4.0 scale) 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 Coordinator. 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 College’s Graduate Coordinator.

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 six-nine 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 MSM 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 MSM program may consist of as few as 33 hours for students 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 Science in Management degree must meet the conditions of one of the following two plans to be eligible for graduation:

Plan I—MSM 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 six 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—MSM 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>Semester Hours</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 301</td>
<td>Principles of Management</td>
<td>3</td>
</tr>
<tr>
<td>MIS 301</td>
<td>Information Systems in Organizations</td>
<td>3</td>
</tr>
<tr>
<td>MSC 325</td>
<td>Quantitative Methods in Business</td>
<td>3</td>
</tr>
<tr>
<td>ACC 601</td>
<td>Introduction to Accounting</td>
<td>3</td>
</tr>
<tr>
<td>BLS 211</td>
<td>Environment of Business</td>
<td>3</td>
</tr>
<tr>
<td>ECN 239</td>
<td>Principles of Economics</td>
<td>3</td>
</tr>
<tr>
<td>MKT 301</td>
<td>Principles of Marketing</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>International Business</td>
<td>3</td>
</tr>
</tbody>
</table>

(one of ACC 550, MGT 550, FIN 554, MKT 515)
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>Semester Hours</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 MSM 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, management, management information systems, or project management.

Strategic Management Requirement

While the entire MSM 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 MSM 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. 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</th>
<th>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 Legal Studies courses</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>15</td>
</tr>
</tbody>
</table>

* The student must meet all course prerequisites in order to enroll.
2. Management Option

This option furnishes advanced study in leadership and motivation, personnel activities, labor law, and communication patterns in organizations. Primary emphasis is placed on managing human resources within an organization.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Semester Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGT 631</td>
<td>Personnel Administration in Organizations</td>
<td>3</td>
</tr>
<tr>
<td>CM 636</td>
<td>Seminar in Organization Communication</td>
<td>3</td>
</tr>
<tr>
<td>MGT 625</td>
<td>Labor Relations and the External Environment</td>
<td></td>
</tr>
<tr>
<td>MGT 629</td>
<td>Leadership and Motivation</td>
<td></td>
</tr>
<tr>
<td>MGT 635</td>
<td>Administrative Science Internship</td>
<td></td>
</tr>
<tr>
<td>MGT 650</td>
<td>Selected Research Topics</td>
<td></td>
</tr>
<tr>
<td>SOC 630</td>
<td>Industrial Sociology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Six hours from the following</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Three hours from 500 or 600 level College of Administrative Science courses</td>
<td>3</td>
</tr>
</tbody>
</table>

Total 15

3. 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 Hours</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></td>
<td>MIS 634 Seminar in Management Information Systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MIS 660 Seminar in Telecommunications and Distributed Processing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MIS 672 Seminar in Systems Design Process</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MIS 645 Applications of Artificial Intelligence</td>
<td></td>
</tr>
</tbody>
</table>

Total 15

4. Project Management

This option examines the process whereby a single manager is responsible for planning, organizing, coordinating, directing, and controlling the combined effort of contractors and participating organizations in accomplishing program/project objectives. This process is employed throughout the acquisition life cycle to ensure that efforts of functional activities of the organizations are consistent with program objectives and that participating organizations act with full awareness of their respective functions and responsibilities. It includes major systems as well as small systems, subsystems, and equipment. The primary differences between major acquisitions and small projects are related to systems integration, degree of complexity, procedures, and the levels of review and approval.
### Semester Hours

- **MGT 640** Principles of Project Management .................................................. 3
- **MSC 641** Project Management Planning and Control ............................................. 3
- **MSC 642** Management Science for Project Management ....................................... 3
- **MSC 643** Systems Modeling and Simulation ....................................................... 3
- Three hours from the following ................................................................................ 3
- **MSC 648** Management of Computer Integrated Manufacturing
- **MSC 645** Applications of Artificial Intelligence

**Total** 15

### Suggested Schedule of Core and Option Courses for Full-time Master of Science in Management Students who first begin Master level Courses in the Fall Quarter.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Hours</th>
<th>Winter</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
<th>Summer</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MGT 622</td>
<td>3</td>
<td>MGT 623</td>
<td>3</td>
<td>MGT 624</td>
<td>3</td>
<td>FIN 601</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
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<td></td>
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<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>MGT 698</td>
<td>3</td>
<td>Option Course</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
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<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

### Suggested Schedule of Core and Option Courses for Full-Time Master of Science in Management Students who first begin Master Level Courses in the Spring Quarter.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Hours</th>
<th>Winter</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
<th>Summer</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MGT 622</td>
<td>3</td>
<td>MGT 623</td>
<td>3</td>
<td>MGT 624</td>
<td>3</td>
<td>FIN 601</td>
<td>3</td>
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<tr>
<td></td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
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<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
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<td>6</td>
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</tr>
</tbody>
</table>

### Suggested Schedule of Core and Option Courses for Part-time Master of Science in Management Students who first begin Master Level Courses in the Fall Quarter.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Hours</th>
<th>Winter</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
<th>Summer</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MGT 622</td>
<td>3</td>
<td>MGT 623</td>
<td>3</td>
<td>MGT 624</td>
<td>3</td>
<td>FIN 601</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
<td>3</td>
<td>NONE</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
<td>3</td>
<td>Option Course</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>6</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
Suggested Schedule of Core and Option Courses for Part-time Master of Science in Management Students who first begin Master Level Courses in the Spring Quarter.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall Hours</th>
<th>Winter Course</th>
<th>Spring Hours</th>
<th>Summer Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MGT 622 3</td>
<td>Option Course</td>
<td>MGT 623 3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>MGT 624 3</td>
<td>Option Course</td>
<td>MSC 651 3</td>
<td>FIN 601 3</td>
</tr>
<tr>
<td>3</td>
<td>Option Course</td>
<td>Option Course</td>
<td>MGT 698 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Option Course</td>
<td>Course</td>
<td>Course 3</td>
<td></td>
</tr>
</tbody>
</table>

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. 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.

The 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 chairman and a majority of committee members are from the University of Alabama in Tuscaloosa campus. The program 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.

Offerings. The following abbreviations indicate the term of the calendar the course normally will be offered: SU-Summer Term, F-Fall Term, W-Winter Term, and SP-Spring Term. Course offerings by term are subject to change dependent upon availability of faculty resources and to accommodate the needs of students.

Accounting (ACC)

507 Accounting Information Systems 3 hrs.
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 4. (Same as MIS 507.)

513 Income Tax Accounting II 3 hrs.
Tax accounting for partnerships, corporations, Sub chapter S corporations, estates, and trusts. Tax administration and research are emphasized. Prerequisite: ACC 313. Lab Fee: Level 3.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Lab Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>515</td>
<td>Advanced Financial Accounting</td>
<td>3 hrs.</td>
<td>Analysis of issues and alternatives in advanced problem areas including partnerships, business combinations, and not-for-profit organizations. Prerequisite: ACC 312. Lab Fee: Level 3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>532</td>
<td>Advanced Auditing</td>
<td>3 hrs.</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. Lab Fee: Level 3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>550</td>
<td>Seminar in International Accounting</td>
<td>3 hrs.</td>
<td>Seminar on current topics in international accounting. Prerequisite: ACC 312.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>570</td>
<td>Seminar in Contemporary Accounting Issues</td>
<td>3 hrs.</td>
<td>Seminar on current topics in professional accounting. Prerequisite: ACC 431 and graduate standing.</td>
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<td></td>
</tr>
<tr>
<td>601</td>
<td>Foundations in Accounting for Management</td>
<td>3 hrs.</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>
<tr>
<td>602</td>
<td>Managerial Accounting</td>
<td>3 hrs.</td>
<td>The course examines the managerial uses of accounting information but is primarily non-technical. The focus of the course is on the MSM 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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>607</td>
<td>Advanced Accounting Information Systems</td>
<td>3 hrs.</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. Lab Fee: Level 4.</td>
<td></td>
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</tr>
<tr>
<td>614</td>
<td>Advanced Managerial Accounting</td>
<td>3 hrs.</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. Lab Fee: Level 3.</td>
<td></td>
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</tr>
<tr>
<td>642</td>
<td>Advanced Internal and Operational Auditing</td>
<td>3 hrs.</td>
<td>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. Lab Fee: Level 3.</td>
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**Business Legal Studies (BLS)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Prerequisites</th>
<th>Lab Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>511</td>
<td>Business Law for Accountants</td>
<td>3 hrs.</td>
<td>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.</td>
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</tbody>
</table>
### Finance (FIN)

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>554</td>
<td>International Finance</td>
<td>3 hrs.</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, graduate standing and approval of AS Graduate Coordinator.</td>
</tr>
<tr>
<td>601</td>
<td>Introduction to Managerial Finance</td>
<td>3 hrs.</td>
<td>Corporate financial planning and decision making. Financial analysis, working capital management, capital budgeting, cost of capital, and long-term financial decisions. Prerequisites: ACC 601 and graduate standing. SU.</td>
</tr>
<tr>
<td>650</td>
<td>Selected Research Topics in Finance</td>
<td>3 hrs.</td>
<td>Research in a particular topic in finance relevant to administrative science by one student or a group of students. The research paper must be an original contribution showing a research design and results that meet the highest standards of social science research. Prerequisite: Completion of 15 hours of the students’ curriculum and approval of the Graduate Program Advisory Committee.</td>
</tr>
<tr>
<td>670</td>
<td>Advanced Managerial Finance</td>
<td>3 hrs.</td>
<td>Study of working capital management including cash management, credit policy, and inventory policy. Prerequisite: FIN 601.</td>
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</tbody>
</table>

### Management (MGT)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>505</td>
<td>Small Business Management</td>
<td>3 hrs.</td>
<td>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: Graduate standing and approval of the college’s Graduate Advisor.</td>
</tr>
<tr>
<td>540</td>
<td>Small Business Counseling</td>
<td>3 hrs.</td>
<td>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.</td>
</tr>
<tr>
<td>550</td>
<td>International Management</td>
<td>3 hrs.</td>
<td>Management of the multinational business enterprise in interaction with its political, economic, social, cultural, and legal environments. Prerequisite: MGT 301 and graduate standing. Lab Fee: Level 2.</td>
</tr>
<tr>
<td>570</td>
<td>Seminar in Management</td>
<td>3 hrs.</td>
<td>Selected Topics in management. Prerequisite: Approval of college’s Graduate Coordinator. Lab Fee: Level 2.</td>
</tr>
</tbody>
</table>
595 Internship in Management 3 hrs.
Active involvement in a project in a business enterprise, professional organization or in a government agency that has particular interest and relevance to the student. Prerequisites: Senior standing, approval of department chairman, and subject to college’s guidelines on internships.

605 Advanced Entrepreneurship 3 hrs.
This course will explore advance subjects such as leveraged buyouts, R & D in small high tech firms, limited partnerships, private placements of stock, the role of the entrepreneur in economic development, marketing strategy for smaller businesses, and strategic planning during early growth stages. The student will also learn to prepare a business plan. Prerequisite: MGT. 405/505 or consent of instructor. F.

622 Human Behavior in Organizations 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 301. Lab Fee: Level 1. F, Sp.

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 301. Lab Fee: Level 2. W, Su.

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. Lab Fee: Level 3. F, Sp.

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. Lab Fee: Level 2. Sp.

629 Leadership and Motivation 3 hrs.
Authority and leadership styles and their effectiveness in different types and levels of organization. Theories of personnel motivation and their practicability and effectiveness. The critical role of effective communication in leadership and motivation. Prerequisite: MGT 622. Lab Fee: Level 2. W.

631 Personnel Administration in Organizations 3 hrs.
Traditional and contemporary theories of purposes, functions, and processes of personnel administration needs of large complex organizations in both the private and public sector. Elements of a comprehensive personnel program in relation to the total management. Lab Fee: Level 2. F.
634 Seminar in Management 3 hrs.
Social and behavioral concepts applicable to leadership, motivation, morale, decision making, and communication. Student's individual research projects based on their own investigation. Integration and application of acquired knowledge. Prerequisite: Graduate students in management with 27 credit hours toward the degree including 15 credit hours of core courses.

635 Management Internship 1-3 hrs.
Management internships will provide the opportunity to observe and participate in local industries and organizations. Students will be required to keep a log of activities and submit a final report. Prerequisite: minimum of 12 hours completed in MSM Program.

640 Principles of Project Management 3 hrs.
The conceptual foundation and organization of project management. The project life cycle, planning, control, and financial management.

650 Selected Research Topics 3 hrs.
Research in a particular topic relevant to administrative science by one student or a group of students. The research paper must be an original contribution showing a research design and results that meet the highest standards of social science research. Prerequisite: completion of 15 hours of student's curriculum and approval of the College's Graduate Program Advisory Committee.

698 Strategic Management 3 hrs.
Administrative decision making with emphasis on analyzing a complex business situation, evaluating historical trends, current operational conditions, and environmental settings, in order to establish: a unifying strategy; implementation of integrated functional policies; and a plan of action to achieve established objectives. Prerequisites: Completion of all management core. Lab Fee: Level 2. F, Su.

699 Masters Thesis 3 hrs.
Required each term the student is working and receiving direction on his/her masters' thesis. Maximum of six hours credit may be applied toward the degree. Prerequisites: Completion of core and major option.

Management Information Systems (MIS)

507 Accounting Information Systems 3 hrs.
Design, operation, 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 4. (Same as ACC 507).

575 Information Resource Management 3 hrs.
Overview of the management of the information systems resources of the firm. Permission of Department Chair. Lab Fee: Level 4. F,W.

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 MSM Graduate Coordinator. Lab Fee: Level 5. Sp.
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. Lab Fee:
Level 3. F.

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 5.

645 Applications of Artificial Intelligence and Decision Making 3 hrs.
Basic concepts of the application of artificial intelligence to the decision making
process. Prerequisites: MIS 301. Lab Fee: Level 5. W.

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 301. Lab Fee:
Level 3.

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 3. W.

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. Prerequisites: CS 113, MSC 325, MSC 386, or approval of AS
Graduate Coordinator. Lab Fee: Level 3.

641 Project Management Planning and Control 3 hrs.
Modeling and analysis of projects and other systems problems using PERT, CPM,
and other network techniques. Managerial aspects of modeling techniques.
Prerequisite: MSC 325. Lab Fee: Level 3. W.

642 Management Science for Project Management 3 hrs.
Concepts, and applications of deterministic and stochastic management tools. Topics
include linear programming, sensitivity analysis, transportation and assignment
problems, queueing theory. Application of these techniques in project management.
Prerequisites: MA 151 or equivalent; MSC 325. Lab Fee: Level 3. F.
643 Systems Modeling and Simulation 3 hrs.
Modeling and analyzing systems using simulation. Programming systems models using an appropriate simulation language. Verification and validation of models using appropriate statistical analysis. Prerequisites: MA 151 or equivalent; MSC 325; MSC 642. Lab Fee: Level 4. Sp.

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 301. (Same as MIS 645). Lab Fee: Level 5. W.

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. Lab Fee: Level 3. W.

650 Selected Research Topics 3 hrs.
Research in a particular topic relevant to management science 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 325, 12 additional credit hours of graduate courses; and approval of the AS Graduate Coordinator. Lab Fee: Level 3.

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 325. Lab Fee: Level 3. Sp, Su.

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. Prerequisite: Common body of knowledge as defined in graduate catalog and completion of ADSC core courses.

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: MKT 301 and graduate standing. Lab Fee: Level 2.

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. Lab Fee: Level 2.
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 approval of Graduate Coordinator. Lab Fee: Level 2.

Strategic Marketing Management 3 hrs.
Comprehensive review of the nature and application of strategic marketing management decision making. Includes particular emphasis on the start to finish sequence of decisions necessary in new product development. Prerequisites: Graduate standing and MKT 301. W.

Procurement Management (PRM)

Acquisition Management I 3 hrs.
The budgeting and major systems acquisition policies and procedures of the Department of Defense, Federal Acquisition Regulations (FARS), requirements determination, and cost estimating techniques and methodologies. (Same as ISE 671) Prerequisite: ISE 690

Acquisition Management II
Department of Defense Contract Administration and organization, source evaluation and selection, types of contracts, solicitations, negotiations, subcontracts, legislative requirements and impacts, contract termination and litigation. (Same as ISE 672) Prerequisite: PRM 671.
College of Engineering

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

Dean: L.D. Russell, Professor of Mechanical Engineering
Associate Dean: K. O. Thompson, Associate Professor of Engineering, Emeritus.

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:

- Atmospheric Dynamics
- Applied Mechanics
- Communications and Information Theory
- Manufacturing Systems Engineering
- Control Sciences
- Materials Engineering
- Computational Fluid Dynamics
- Operations Research
- Digital and Neural Computer Architecture
- System Engineering
- Electromagnetic, Microwaves and Antennas
- Product Assurance
- Network Theory
- Energy/Power
- Electro-optics and Optical Engineering
- Environmental Engineering
- Radar Systems
- Solar Terrestrial Environment
- Software Engineering
- Combustion Propulsion
- Solid State Electronics
- Thermodynamics, Heat & Mass Transfer
- Engineering Management
- Process Dynamics
- Human Factors Engineering
- Structural Engineering
- Computer Engineering
- Reaction Engineering
- Composites

In addition to the above, the College of Engineering participates in a Ph.D level Material Science Program which is awarded jointly by The University of Alabama (Tuscaloosa), The University of Alabama at Birmingham, and The University of Alabama in Huntsville. That program is described elsewhere in this catalog.
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 non-degree post graduates 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 six hours in an approved engineering area of specialization, (c) second minor of six 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 nine 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—one 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.

Cooperative Programs with the University of Alabama at Birmingham (UAB)
A cooperative program in engineering was initiated between UAH and UAB for the pursuit of doctoral degrees. A student at UAB may earn the doctoral degree at UAH with a major in electrical engineering, computer engineering, or mechanical engineering; while at UAH a student may pursue the master or the doctoral degree with a major in biomedical engineering at UAB. An interested student must first be admitted at the principal institution, i.e., the one offering the degree, but may take courses and satisfy the residency requirements at either campus. All degree requirements must be satisfied at the principal institution. More details are available through the participating departments.
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.; antennas, electromagnetics and fiber optics.
Biggs, A.W.; microwaves, antennas, remote sensing.
Halijak, C.A.; analog and digital computers, network synthesis and controls.
Jarem, J. M.; antenna and microwave theory, electromagnetics
Padulo, L., systems
Polge, R. J.; communications, radar, computer engineering, digital and optical systems
Singh, N.; electromagnetics, plasmas, antennas.

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

Associate Professors:
Ho, F.D.; solid state and electronics, VLSI design and modeling, digital hardware.
Stensby, J.; communications, signal analysis
Stern, H., (Adjunct); communications and controls.

Assistant Professors:
Abushagur, M.; electro-optics, electromagnetics, optical computers.
Adhami, R.; digital systems, signal processing.
Chandra, V., radars, atmospheric sciences
Hofmann, M.A.; artificial intelligence, controls, software engineering.
Katsinis, C.; computer systems, image processing, pattern recognition.
McCullough, C.L.; stochastic systems, central theory, robotics.
Mirsalehi, M.; electro-optics, optical computers, electromagnetics.

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>Credits</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>
<tr>
<td>414</td>
<td>Passive Electrical Networks</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>416</td>
<td>Electronics II</td>
<td>3 hrs.</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.

500 Random Signals and Noise 3 hrs.
Random variables and probabilistic description of signals. Introduction to random processes: autocorrelations, cross correlations, power spectral density. Noise analysis: thermal, shot, white, colored. Response of electrical systems to random inputs. Prerequisite: EE 382 (Same as EE 420).

501 Electric Machines 3 hrs.
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.

502 Advanced Logic Circuits 3 hrs.
Boolean algebra; the n-cube, star array, Karnaugh arrays; one-toone transformations, partial transformations, DON'T-CARES; symmetric switching function synthesis and reduction with applications to multiple input adders; generator theory of flipflops and stability condition; serial arithmetic and the binary comparator. Prerequisite: EE 202.

504 Instrumentation 3 hrs.
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.

505 Introduction to Control and Robotic Systems 3 hrs.
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.)

506 Communication Theory 3 hrs.
Transmission of information including effects of networks, modulation systems, noise, and use of statistics in analysis of information transmission. Prerequisite: EE 382.

509 Microcomputers 3 hrs.
The microcomputer as a component in digital design. Laboratory experience in interfacing and design projects. Prerequisites: EE 202 and 315; EE 516 recommended. Lab Fee: Level 5.

510 Selected Topics in Electrical Engineering Credit to be arranged

512 Advanced Senior Design Project in Electrical Engineering 3 hrs.
Individual design project under the direction of an EE faculty member. Prerequisite: Senior standing. Lab Fee: Level 3.
513 Computer Simulation of Dynamic Systems
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.)

516 Digital Electronics

519 Digital Electronics Laboratory
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 6. Must parallel EE 516.

532 Optical Systems Design
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
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
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
A course on the development of general purpose stand-alone microprocessor systems using a microprocessor development system. Prerequisites: EE 509, 402. Lab Fee. Level 6.

600 Bit-Slice Design
Theoretical and practical aspects of computer hardware design using AMD 2900 family bit-slice components. Prerequisite: EE 509. Lab Fee: Level 5.

601 Linear Systems
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
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>603</td>
<td>Computer Methods in Power Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
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</tr>
<tr>
<td>604</td>
<td>Digital Image Processing</td>
<td>3 hrs.</td>
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<tr>
<td>605</td>
<td>Control System Design</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Control system synthesis by means of feedback, feedforward, minor loop, and cascade techniques. System designs by analog simulation. Laboratory sessions. Prerequisite: EE 505. Lab Fee: Level 5.</td>
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</tr>
<tr>
<td>606</td>
<td>Statistical Communications Theory</td>
<td>3 hrs.</td>
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<tr>
<td>607</td>
<td>Robotic Systems Control</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>608</td>
<td>Electromagnetic Field Theory I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>609</td>
<td>Electromagnetic Field Theory II</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Continuation of EE 608. Prerequisite: EE 608.</td>
<td></td>
</tr>
<tr>
<td>610</td>
<td>Selected Topics in Electrical Engineering</td>
<td>Credit to be arranged.</td>
</tr>
<tr>
<td>611</td>
<td>Signal Analysis</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Advanced analysis methods for continuous and discrete signals and systems, properties of band-limited and time-limited signals, theory and use of generalized Fourier series using prolate spheroidal functions, ambiguity functions and Hilbert, Mellin and Z transforms. Prerequisites: EE 425/505 and EE 426/506.</td>
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</tr>
<tr>
<td>612</td>
<td>Graduate Design Project</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Graduate design project in support of an MSE program. Prerequisite: approval by MSE committee. Lab Fee: Level 5.</td>
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</tr>
<tr>
<td>613</td>
<td>Laser Electronics</td>
<td>3 hrs.</td>
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<tr>
<td>Course</td>
<td>Title</td>
<td>Credit Hours</td>
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<tr>
<td>615</td>
<td>Active Networks Synthesis</td>
<td>3 hrs.</td>
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<tr>
<td>617</td>
<td>Very Large Scale Integration Devices</td>
<td>3 hrs.</td>
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<tr>
<td>618</td>
<td>Very Large Scale Integrated (VLSI) Circuits</td>
<td>3 hrs.</td>
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<tr>
<td>619</td>
<td>Introduction to Radar Systems</td>
<td>3 hrs.</td>
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<tr>
<td>623</td>
<td>Design of Knowledge Based Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>631</td>
<td>Detection of Optical and Infrared Radiation</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>
632 Coherent Optical Systems and Holography 3 hrs.
Introducing the optical system as an invariant linear system, Sommerfield’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 7.

633 Electro-Optical Engineering 3 hrs.
Propagation of optical beams in homogeneous and guiding media, optical resonators, and spectrum analyzers, theory of laser oscillation, some specific laser systems, parametric oscillators, electro-optical and acousto-optical modulators. Prerequisite: EE 541 or equivalent.

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 7.

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 7.

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 7.

645 Modulation and Phase Locked Techniques in Communication 3 hrs.

649 Neural Networks and Their Applications 3 hrs.
Elements of threshold logic and discriminant functions, patterns classification and general mappings with feedforward networks, training algorithms and self-organization, Hopfield model and Boltzman machine Computations by energy minimization. Selected Topics. Prerequisites: EE 604 or equivalent.

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 nine 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
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
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
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
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
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
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
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
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
Antennas and antenna arrays. Radiation patterns and impedance characteristics. Spheres, cylinders, horns, slots, microwave lenses, traveling-wave, and frequency independent antennas. Prerequisite: EE 608.
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.

Device Modeling for Integrated Circuit Design 3 hrs.

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.

Microwave Techniques 3 hrs.

Advanced Electromagnetic Field Theory 3 hrs.

Computer-Aided Design of Control Systems 3 hrs.
Application of computer-sided design techniques to problems of analysis and control design for single-input and multi-input dynamic systems. Canonical decompositions, eigen structure assignment out put feedback design, Kalman filters, full and reduced-order observer design, LQR and DAC design. Prerequisite: EE 701.

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

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 7.

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 7.

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. Prerequisites: EE 506 and 608 or equivalent. Lab Fee: Level 7.

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 7.

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 7.

799 Doctoral Dissertation 3-6 hrs.
Computer Engineering (CPE)

629 Advanced Microcomputer Techniques 3 hrs.
Advanced hardware interfacing techniques, complex interfaces (disks), direct memory access, memory design and management, cache memory, fault tolerance issues, parallel processing, with emphasis on hardware issues, neural networks. Prerequisites: EE 429/509. Lab fee: Level 3.
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, experimental design.

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

Associate Professors:
Dorsett, M. (adjunct); operations research, statistics.
Lovett, J.N.; operations research, work design, manufacturing processes.
Safie, F. (adjunct); reliability statistics.
Tytula, T.P.; systems engineering, reliability, product assurance, and risk analysis
Walker, J.R.; engineering management, engineering economy, applied statistics.
Yarbrough, L.S. (adjunct); simulation, statistics, operations research, quality control, computer applications.

Assistant Professor:
Lawler, P. (adjunct); engineering economy, quality control.
Lulu, M.; quality assurance, manufacturing systems
Riggs, J.L.; reliability modeling, cost modeling, applied statistics, systems engineering.

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, Quality Assurance 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) six 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, and either 629 or 547; (b) six hours of courses in approved minor area; (c) six 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 Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>321</td>
<td>Engineering Economy</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>326</td>
<td>Production and Operation Systems I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>327</td>
<td>Production and Operation Systems II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>378</td>
<td>Materials and Manufacturing Processes (Same as ME 378)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>390</td>
<td>Probability and Engineering Statistics I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>421</td>
<td>Measurement and Instrumentation in Industrial Processes (Same as ISE 521)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>422</td>
<td>Logistics Planning and Control (Same as ISE 522)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>423</td>
<td>Statistical Quality Control (Same as ISE 523)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>424</td>
<td>Introduction to Ergonomics: Work Development (Same as ISE 524)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>425</td>
<td>Metal Processing and Metrology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>426</td>
<td>Design and Analysis of Experiments (Same as ISE 526)</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>427</td>
<td>Management Systems Analysis</td>
<td>3 hrs.</td>
</tr>
<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>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------</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, Credit to be arranged</td>
<td>3 hrs.</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</td>
<td></td>
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<td></td>
<td>information from industrial processes. Laboratory work includes the use of</td>
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<tr>
<td></td>
<td>currently available transducers. Prerequisites: EE 301, 311. (Same as ISE</td>
<td></td>
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<tr>
<td></td>
<td>421) Lab Fee: Level 9.</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</td>
<td></td>
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<tr>
<td></td>
<td>their interaction, the logical network for project-planning and control, and</td>
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<tr>
<td></td>
<td>the physical distribution network. Charting, milestone method, lines of balance,</td>
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<tr>
<td></td>
<td>PERT-CPM, resource allocation and leveling, and maximum flow and minimum cost</td>
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<tr>
<td></td>
<td>algorithms. Prerequisite: ISE 390. (Same as ISE 422) Lab Fee: Level 4.</td>
<td></td>
</tr>
<tr>
<td>523</td>
<td>Statistical Quality Control</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Statistical theory and techniques to control quality of manufactured products.</td>
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<tr>
<td></td>
<td>Prerequisite: ISE 390. (Same as ISE 423)</td>
<td></td>
</tr>
<tr>
<td>524</td>
<td>Introduction to Ergonomics: Work Development</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Philosophy, methodology, and techniques related to providing optimal match</td>
<td></td>
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<tr>
<td></td>
<td>between job requirements and worker skills. Intensive use of actual industrial</td>
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<tr>
<td></td>
<td>requirements and experience in practical applications. Prerequisites: ISE 390;</td>
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<tr>
<td></td>
<td>ISE 327 or graduate standing. (Same as ISE 424) Lab Fee: Level 5.</td>
<td></td>
</tr>
<tr>
<td>526</td>
<td>Design and Analysis of Experiments</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Advanced topics in statistical experiments with emphasis on design aspect.</td>
<td></td>
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<tr>
<td></td>
<td>Confounding, fractional replication, factorial and nested design. Prerequisite:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ISE 490. (Same as ISE 426)</td>
<td></td>
</tr>
<tr>
<td>530</td>
<td>Modern Manufacturing/Production Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Overview of modern manufacturing and production systems, including principles,</td>
<td></td>
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<tr>
<td></td>
<td>theory and practical applications of integrated manufacturing systems with</td>
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<td>and without robotics and automated materials handling. Includes review of</td>
<td></td>
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<tr>
<td></td>
<td>classical systems, Japanese production systems, and group technology. Prerequisite: Senior standing. (Same as ISE 430) Lab Fee: Level 4.</td>
<td></td>
</tr>
</tbody>
</table>
531 Microprocessor Applications in Manufacturing 3 hrs.
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. Prerequisite: ISE 521. (Same as ISE 431) Lab Fee: Level 9.

539 Selected Topics in Industrial Engineering Credit to be arranged

541 Quality Assurance 3 hrs.
Philosophy and design techniques for achieving a stable quality assurance program; role of quality assurance in test and development; roles of management and labor in a total quality assurance system. Prerequisites: ISE 390 or ISE 690, ISE 523.

547 Introduction to Digital Simulation 3 hrs.
Philosophy and elements of digital simulation. Review of queuing models and stochastic process models. Discrete-event simulation with emphasis on analysis of systems and models. Prerequisites: EE 197, ISE 390 or equivalent. (Same as ISE 447) Lab Fee: Level 7.

571 System Simulation Laboratory I GPSS 2 hrs.
Modeling and Digital Simulation of Systems using GPSS. Prerequisite: EE 197. (Same as ISE 471)

572 System Simulation Laboratory II SIMAN 2 hrs.
Modeling and Digital Simulation of Systems using SIMAN. Prerequisite: EE 197. (Same as ISE 472)

573 Systems Simulation Laboratory III 2 hrs.
Modeling and Simulation of Dynamic Feedback Systems using DYNAMO. Prerequisite: EE 197. (Same as ISE 473)

620 Engineering Management I 3 hrs.
Principles of executive process in technical organizations. Basic management functions, scientific management, planning, directing, controlling, and decision making as they relate to management of technical organizations and design and implementation of management systems. Prerequisite: Graduate standing.

622 R & D Management 3 hrs.
Research unique to the management of organizations engaged in R&D activities. Management control systems for R&D projects, motivation of technical personnel, problems of managing the creative person, means of increasing creativity, and management of change. Prerequisite: ISE 620.

623 Engineering Economic Analysis 3 hrs.
Mathematical models for expenditure analysis under uncertainty. Relationship between investment decision criteria and microeconomic theory. Capital planning and budgeting. Decisions involving expansion, acquisitions, replacement, and disinvestment. Prerequisite: ISE 490 or ISE 690.

624 Advanced Ergonomics: Man-Machine Interfaces 3 hrs.
Psychological, physiological, and anthropometric requirements of human beings and their relationship to design specifications for machines in man-machine interfaces. Prerequisite: ISE 524. Lab Fee: Level 4.
626  Introduction to Operations Research 3 hrs.
Philosophy and methodology of operations research. Prerequisite: EE 197 or CS 113, ISE 390 or 690, MA 251. Lab Fee: Level 5.

627  Introduction to Systems Engineering 3 hrs.
Overview of engineering analytic methods applied to design of operational, procedural, and hardware systems. Concepts of the system life cycle, and cost-benefit and tradeoff analysis. Use of engineering models of components, logic, signals, and organization in systems analysis. Prerequisites: ISE 390 or EE 505 or EE 506 or ISE 690.

628  Engineering Management II 3 hrs.
Organization and human relations of technical management. Formal and informal organizations, job satisfaction, motivation of employees, manager-employee relations, social behavior in work situation, and executive management functions as they influence design and implementation of management systems. Prerequisite: ISE 620.

Classical optimization theory with introduction to search techniques, the Jacobian, and Lagrangian methods. Kuhn-Tucker conditions, quadratic programming, geometric and dynamic programming, and several search procedures. Prerequisites: ISE 626, 390 or 690. Lab Fee: Level 7.

630  Automation: Numeric Control to Computer-Aided Manufacturing 3 hrs.
Numerical Control, CNC, DNC, FMS, unmanned cellular manufacturing systems, robotics, autonomation and other aspects of programmable automation systems found in CAM. Includes introduction to adaptive control, NC and robot programming. Prerequisite: ISE 530. Lab Fee: Level 7.

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 non-Markov processes. Prerequisite: ISE 490 or 690. Lab Fee: Level 4.

633  Industrial Forecasting and Analysis I 3 hrs.
Industrial forecasting methods. Simple forecasting models, multivariate regression, correlation, and spectral analysis, exponential smoothing, and Box-Jenkins forecasting. Prerequisite: ISE 490 or ISE 690. Lab Fee: Level 5.

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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>635</td>
<td>Linear Programming</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Application of linear programming to complex allocation problems. Methods for determining 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. Prerequisite: ISE 626. Lab Fee: Level 6.</td>
<td></td>
</tr>
<tr>
<td>636</td>
<td>Systems Modeling</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Philosophy and methodology for modeling probabilistic systems. Team project required. Prerequisites: ISE 390 or 690, ISE 626 or 627. Lab Fee: Level 6.</td>
<td></td>
</tr>
<tr>
<td>638</td>
<td>Engineering Reliability</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>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.</td>
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</tr>
<tr>
<td>639</td>
<td>Selected Topics in Industrial and Systems Engineering</td>
<td>Credit to be arranged</td>
</tr>
<tr>
<td>641</td>
<td>Product Assurance</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Application and control of the product assurance process during design and production; systems engineering approach to providing product assurance, including but not limited to reliability growth projections, criticality analysis and failure mode analysis. Prerequisite: ISE 541.</td>
<td></td>
</tr>
<tr>
<td>647</td>
<td>System Simulation</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>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. Prerequisite: ISE 547. Lab Fee: Level 7.</td>
<td></td>
</tr>
<tr>
<td>648</td>
<td>Reliability, Availability, and Maintainability</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>In-depth application of decision theory and MIL-HDBK-217, and maintenance engineering techniques in order to achieve targeted reliability, availability and maintainability design goals. Prerequisite: ISE 638.</td>
<td></td>
</tr>
<tr>
<td>671</td>
<td>Acquisition Management I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>The budgeting and major systems acquisition policies and procedures of the Department of Defense, Federal Acquisition Regulations (FARS), requirements determination, and cost estimating techniques and methodologies. Prerequisite: ISE 690. (Same as PRM 671)</td>
<td></td>
</tr>
<tr>
<td>672</td>
<td>Acquisition Management II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Department of Defense contract administration and organization, source evaluation and selection, types of contracts, solicitations, negotiations, subcontracts, legislative requirements and impacts, contract termination and litigation. Prerequisite: ISE 671. (Same as PRM 672)</td>
<td></td>
</tr>
<tr>
<td>690</td>
<td>Statistical Methods for Engineers</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>
### 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 six hours required for M.S.E. students. A maximum of nine hours of credit is awarded upon successful completion of master's thesis.

### 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. Prerequisite: ISE 629. Lab Fee: Level 7.

### 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.

### Industrial Forecasting and Analysis II

3 hrs.
Industrial forecasting methods. Box-Jenkins model diagnostic checking, seasonal models, and transfer function modeling. Prerequisite: ISE 633. Lab Fee: Level 5.

### 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. Prerequisite: ISE 635. Lab Fee: Level 6.

### Selected Topics in Industrial and Systems Engineering

Credit to be arranged

### Advanced Simulation Design and Analysis

3 hrs.

### Advanced Statistical Applications

3 hrs.
Continuation of ISE 690 with extension to nonparametric methods, multivariate analysis and clustering techniques. Prerequisite: ISE 690. Lab Fee: Level 5.

### Doctoral Dissertation

3-6 hrs.
Materials Science

A Ph.D. degree, awarded jointly by The University of Alabama-Tuscaloosa (UA), The University of Alabama at Birmingham (UAB), and The University of Alabama in Huntsville (UAH) is available in Material Science. All requirements can be completed on the UAH campus. The participating faculty from the UAH campus are in the departments of Biological Science, Chemistry, Electrical Engineering, Mechanical Engineering (including the Chemical Engineering and Civil Engineering programs), and Physics. The program faculty have a major interest in production of new materials, in the application of materials to the needs of technology, and in materials processing. These interests currently fall into the following general curricular areas which are designated as options for specialization:

1. Materials structure and properties
2. Macromolecular materials
3. Electronic, optical, and magnetic materials
4. Materials processing
5. Biomaterials
6. Mechanical behavior of materials

Students entering the program are expected to have strong, but diverse undergraduate training. They will typically have bachelors’ degrees in chemistry, chemical engineering, materials science, materials engineering, mechanical engineering, or physics. Students with interest in materials science and engineering are encouraged to refer to the complete description of the Materials Sciences doctoral program contained in the Interdisciplinary Section of this catalog.
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.
Cost, T.L.; finite element applications, structural dynamics, composite materials.
Gilbert, J.A.; solid mechanics, experimental stress analysis, and applied optics.
Harwell, K.E., propulsion, aerospace.
Hung, R.J.; ionospheric research, remote sensing, robotics, numerical computation.
Liu, F.C.; dynamics and control, orbital mechanics, and vibrations.
Russell, L.D., thermodynamics, heat transfer.
Shih, C.C.; high energy lasers and fluid-thermal aspects of chemical lasers.
Wallace, D.B., solar energy, photovoltaic cells, CAEDM, and robotics.
Wessling, F.; 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.

Assistant Professors:
Bower, M.; nonmetallic materials, fluid mechanics, and CAEDM.
Chen, C.P.; computational fluid mechanics, chemical processes.
Crull, M.M., structural engineering, finite element analysis
Musielak, Z.E., solar phenomena.
Schonberg, W.P.; impact dynamics, elasticity theory, and large space structures.
Thomas, D.L.; electrochemical mathematical modeling, and convective transport.
Toghiani, R.K., equilibrium and transport properties of gases.
Uber, J.G., waste water treatment, nonlinear optimization.

Assistant Research Professors:
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, aero­
dynamics, thermodynamics, transport phenomena, propulsion, chemical processes, environ­
mental engineering 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 re­
search 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>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>480</td>
<td>Aircraft Stability and Control</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>485</td>
<td>Numerical Methods and Computation II</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>
Numerical Engineering Analysis 3 hrs.
Analysis of Engineering Systems 3 hrs.
Computer-Aided Engineering 3 hrs.

Graduate ME Courses

531 Introduction to Plasma dynamics 3 hrs.

540 Physical Properties of Fluids 3 hrs.
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.

542 Internal Combustion Engines 3 hrs.
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.

545 Heat Distribution System Design 3 hrs.
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.

546 Solar Energy Systems 3 hrs.
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 454 recommended.

547 Energy Conversion and Power Generation I 3 hrs.
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.

548 Energy Conversion and Power Generation II 3 hrs.
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.
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.

556 Turbomachinery 3 hrs.
The application of the principles of fluid mechanics and thermodynamics to the analysis and design of dynamic fluid machines classified as turbomachines, including axial and centrifugal flow pumps and fans, compressors, and hydro-and gas-turbines. Prerequisites: ME 342, 454.

557 Fundamentals of Aerodynamics 3 hrs.
The application of the principles of fluid mechanics and thermodynamics to the prediction of aerodynamic performance of aircraft, missiles and other flight vehicles. Topics include lift and drag, thrust and power, and the influence of wing loading, power loading, zero-list drag, wing geometry, high lift devices Mach number, etc., on the performance and design trades of flight vehicles. Prerequisites: ME 342, 454.

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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>577</td>
<td>Fundamentals of Experimental Mechanics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>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. Prerequisites: ME 370 and junior standing. (Same as ME 477.) Lab Fee: Level 7.</td>
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</tr>
<tr>
<td>578</td>
<td>Matrix Methods in Structural Mechanics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>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.)</td>
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</tr>
<tr>
<td>580</td>
<td>Aircraft Stability and Control</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>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. Prerequisites: ME 454, 488. (Same as ME 480.) Lab Fee: Level 7.</td>
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<tr>
<td>581</td>
<td>Atmospheric Thermodynamics</td>
<td>3 hrs.</td>
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<td></td>
<td>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.)</td>
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<tr>
<td>585</td>
<td>Numerical Methods and Computation II</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>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. Prerequisite: ME 396. (Same as ME 485). Lab Fee: Level 7.</td>
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<tr>
<td>586</td>
<td>Numerical Engineering Analysis</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>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)</td>
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</tr>
<tr>
<td>589</td>
<td>Computer-Aided Engineering</td>
<td>4 hrs.</td>
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<tr>
<td></td>
<td>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.)</td>
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</tr>
<tr>
<td>601</td>
<td>Physical Metallurgy</td>
<td>3 hrs.</td>
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<tr>
<td>641</td>
<td>Advanced Thermodynamics</td>
<td>3 hrs.</td>
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<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>
</tbody>
</table>
Radiative Sources and Detectors 3 hrs.
Optical and thermal radiative sources and detectors. Sources of detector noise and its influence on performance. Instrumentation using radiative detectors. Prerequisite: Graduate Standing. Lab Fee: Level 7.

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. Prerequisite: ME 442. Lab Fee: Level 7.

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 nonlinear inversion methods. Application to remote sensing from space. Prerequisite: Permission 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. Prerequisite: ME 454. Lab Fee: Level 7.

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. Prerequisites: ME 454, ME 442.

Computational Fluid Dynamics I 3 hrs.
Finite difference and finite element formulations of incompressible and compressible flows. Explicit and implicit methods, operator splitting, artificial damping, ADI methods, flux-corrected transport. Prerequisite: ME 651. Lab Fee: Level 5.

Computational Fluid Dynamics II 3 hrs.
Grid generation techniques, applications of multigrid adaptive methods in incompressible and compressible flows. Vectorization and parallel processing as applied to computational fluid dynamics, applications to practical geometries. Prerequisite: ME 653. Lab Fee: Level 5.

Computational Fluid Dynamics III 3 hrs.
Applications to computational methods in aerodynamics problems, treatment of shocks, Kutta conditions, nonvanishing enthalpy and entropy gradients. Prerequisite: ME 653. Lab Fee: Level 5.
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. Prerequisite: ME 454. Lab Fee: Level 7.

Selected Topics in Mechanical Engineering Credit to be arranged

Structural Dynamics 3 hrs.

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.

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.

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.

Theory of Elasticity 3 hrs.

Plasticity 3 hrs.

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.

Viscoelasticity 3 hrs.
677 Experimental Stress Analysis
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. Prerequisite: ME 577. Lab Fee: Level 7.

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

683 Graduate Seminar
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
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
Fourier series, Fourier integrals, Laplace transformations, partial differential equations, boundary-value problems, and special functions. Prerequisites: MA 352, ME 692.

699 Master's Thesis
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 nine hours of credit is awarded upon successful completion of master's thesis.

741 Statistical Thermodynamics

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

745 Combustion Theory
Development of theory of chemical reactions in fluid flow, Shrub-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. Prerequisite: ME 651. Lab Fee: Level 7.

746 Convective Heat Transfer
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. Prerequisite: ME 643. Lab fee: Level 7.
Radiative Transfer 3 hrs.
Physics and modeling of radiative transfer. Scattering, remote sensing, and absorption in participating media. Infrared through optical wavelengths. Computational methods in radiative transfer. Prerequisite: Permission of instructor. Lab Fee: Level 7.

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. Prerequisites: ME 643, 651. Lab fee: Level 7. (Same as CHE 749).

Computational Fluid Dynamics IV 3 hrs.
Advanced topics in computational methods in heat transfer, turbulence, acoustics, and reacting flows, special techniques for nonlinear and stiff equations, length and time scales. Prerequisite: ME 653. Lab Fee: Level 5.

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. Prerequisite: ME 653. Lab fee: Level 7.

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. Prerequisite: ME 651. Lab fee: Level 7.

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. Prerequisite: ME 754. Lab fee: Level 7.

Numerical Simulations of Magnetohydrodynamics 3 hrs.
Finite difference methods for simulation of MHD flows will be discussed. These methods include explicit scheme, FICE methods, LBL, ADI, artificial damping and projected characteristics for multidimensional time-dependent flow. Prerequisite: ME 753. Lab fee: Level 3.
758  Turbulence 3 hrs.
Turbulence in gases and liquids; boundary layers, atmospheric phenomena. Prerequisite: ME 656. Lab Fee: Level 5.

759  Selected Topics in Mechanical Engineering  Credit to be arranged

760  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.

762  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.

765  Random Vibration of Elastic Systems 3 hrs.

768  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 gyrostate. Prerequisite: ME 660 or 661.

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. Illustration of theories by selected problems. Prerequisite: ME 671.

774  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.

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.

780  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. Prerequisite: ME 671. Lab Fee: Level 5.
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</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>403</td>
<td>Reinforced Concrete Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>404</td>
<td>Structural Design</td>
<td>3 hrs.</td>
</tr>
<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>459</td>
<td>Selected Topics in Civil Engineering</td>
<td>Credit to be arranged</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>Water Quality Control Processes</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>
<td>Credit to be arranged</td>
</tr>
<tr>
<td>480</td>
<td>Civil Engineering Design Project</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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<th>Course</th>
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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>
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</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>Credit to be arranged</td>
</tr>
<tr>
<td>577</td>
<td>Fundamentals of Experimental Mechanics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>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. Prerequisites: ME 370 and junior standing. (Same as ME 577).</td>
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<tr>
<td>Course Number</td>
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<td>Credits</td>
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<tr>
<td>581</td>
<td>Advanced Soil Mechanics</td>
<td>3 hrs.</td>
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<tr>
<td>582</td>
<td>Soil Dynamics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>585</td>
<td>Foundation Engineering</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>652</td>
<td>Introduction to Air Pollution</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>659</td>
<td>Selected Topics in Civil Engineering</td>
<td>Credit to be arranged</td>
</tr>
<tr>
<td>675</td>
<td>Rock Mechanics</td>
<td>4 hrs.</td>
</tr>
</tbody>
</table>
Mechanics of Composite Materials
Introduction to composite materials, microand macromechanical behavior of laminae; bending, buckling and vibration of laminated plates. Prerequisites: ME 671, 672.

Selected Topics in Civil Engineering Credit to be arranged

Random Vibration of Elastic Systems
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).

Theory of Structural Stability

Theory of Shells
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.

Fracture Mechanics
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

Unit Operations Laboratory 3 hrs.
Chemical Kinetics & Reactor Design 3 hrs.
Mass Transfer Operations 3 hrs.
Chemical Process Control 3 hrs.
Chemical Engineering Design I 3 hrs.
Chemical Engineering Design II 3 hrs.

Graduate CHE Courses

Physical Properties of Fluids 3 hrs.
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.
541 Chemical Kinetics and Reaction Design 3 hrs.
Fundamental principles of chemical kinetics and chemical reactor engineering along
with the design of both thermal and catalytic reactors. Prerequisites: CHE 344,
443.

549 Introduction to Environmental Engineering 3 hrs.
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.

550 Environmental Control 3 hrs.
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.)

559 Selected topics in CHE Credit to be arranged

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

644 Introduction to Electrochemical Systems 3 hrs.
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. Prerequisites:
CHE 443 or equivalent. Lab Fee: Level 4.

646 Thermodynamics of Materials 3 hrs.
Treatment of thermodynamic topics as they apply to behaviors observed in metallic
and non-metallic materials. Prerequisites: Ch 341 or equivalent. (Same as CH 646).
Lab fee: Level 7.

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

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 CE 652.)

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
Lab fee: Level 7

699 Master's Thesis
Lab fee: Level 7

749 Mass Transport
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 7. Prerequisite: ME 643 and 651. (Same as ME 749.)
College of Liberal Arts

Degrees: Master of Arts

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 a program of study leading to the Master of Arts.

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.; (Emeritus); developmental learning, 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.; (Emeritus); marriage and family sociology, counseling and children's literature.

Assistant Professors:
Allen, D.A.; reading, secondary and elementary education.
Piersma, M.P.; reading elementary education.

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). Certain individual courses are also offered, on demand, for in-service training of personnel. The programs in Secondary Education 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. 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)

(a) Middle School (traditional)
   - ED 604, ED 606, ED 626 (required) 9 sem. hrs.
   - ED 510 or 610 3 sem. hrs.
   - ED 601 or ED 603 or ED 608 (select one) 3 sem. hrs.
   - Teaching Field 24 sem. hrs.
   - Special Education Requirement* (3 sem. hrs.)

(b) High School (traditional)
   - ED 604, ED 606, ED 630 (required) 9 sem. hrs.
   - ED 510 or 610 3 sem. hrs.
   - ED 601 or ED 603 or ED 608 (select one) 3 sem. hrs.
   - Teaching Field 24 sem. hrs.
   - Special Education Requirement* (3 sem. hrs.)

(c) Middle School (Strengthened Subject Matter)
   - ED 604, ED 610, ED 626 (required) 9 sem. hrs.
   - Teaching Field 24 sem. hrs.
   - Special Education Requirement* (3 sem. hrs.)

(d) High School (Strengthened Subject Matter)
   - ED 604, ED 610, ED 630 (required) 9 sem. hrs.
   - Teaching Field 24 sem. hrs.
   - Special Education Requirement* (3 sem. hrs.)

*Special Education Requirement: A survey course in special education is required (ED 593) is required 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, or 610, ED 593, ED 604, ED 608, ED 630 (Req.) 15 sem. hrs.
   - ED 698 (Req.) 6 sem. hrs.
   - Teaching Field 24 sem. hrs.
This is a 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) A major, or the equivalent, at the undergraduate level in the field where certification is sought.
(c) Sixty semester hours in general studies at the undergraduate level, with some work in each of four areas: humanities, social studies, science, and mathematics.
(d) Admissibility to the graduate school, and to subject field programs.
(e) An accumulation of no more than 12 semester hours of coursework, on any level, in professional education.
(f) A passing score on the Alabama State English Language Proficiency Exam.
(g) Submission of proper application forms with documentation of items a - f above to the Registrar's office. Note: student may be conditionally admitted and may take up to 12 semester hours while meeting the stated prerequisites.

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.

522 Space Orientation for Teachers: 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.

532 Space Orientation for Teachers: Secondary 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.

549 Audiovisual Instruction 3 hrs.
Audiovisual media in teaching and the selection, use, and maintenance of audiovisual materials in educational programs.
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>593</td>
<td>Education of Exceptional Children and Youth</td>
<td>3 hrs.</td>
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<td></td>
<td>Introduction to the field of exceptional children and youth, including observations. This course, or equivalent, is a prerequisite to certification. (Same as DL 593)</td>
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<tr>
<td>600</td>
<td>Special Problems in Education</td>
<td>1-3 hrs.</td>
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<td></td>
<td>Independent study, special projects, and in-service programs.</td>
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<td>601</td>
<td>Public School Organization and Administration</td>
<td>3 hrs.</td>
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<td></td>
<td>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.</td>
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<tr>
<td>602</td>
<td>The Principal as Educational Leader</td>
<td>3 hrs.</td>
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<td></td>
<td>Role of principal as supervisor, organizer, and administrator of schools, programs of study, teaching staff, pupil personnel, plant and equipment, and community relationships.</td>
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<td>603</td>
<td>Sources of American Educational Thought</td>
<td>3 hrs.</td>
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<td></td>
<td>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.</td>
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<td>604</td>
<td>Contributions of Psychology to Education</td>
<td>3 hrs.</td>
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<td></td>
<td>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.</td>
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<tr>
<td>606</td>
<td>Principles of Curriculum Development</td>
<td>3 hrs.</td>
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<td></td>
<td>Principles of curriculum construction that underlie the reorganization of the programs of study for elementary and secondary schools. Origin and background of the curriculum, methods of organization, curriculum planning and development, and pertinent applications.</td>
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<tr>
<td>607</td>
<td>The Educational Leader as Evaluator</td>
<td>3 hrs.</td>
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<td>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.</td>
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<tr>
<td>608</td>
<td>Reading in the Content Areas</td>
<td>3 hrs.</td>
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<td></td>
<td>Instruction in developing reading skills, methods and materials. 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).</td>
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<td>610</td>
<td>Foundations of Educational Evaluation</td>
<td>3 hrs.</td>
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<td></td>
<td>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. Prerequisite: ED 604</td>
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<td>Course Code</td>
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<td>611</td>
<td>Principles of Guidance</td>
<td>3 hrs.</td>
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<td>Sociological, psychological, and educational</td>
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<td>foundations of guidance; history and growth of</td>
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<td>the guidance movement; functions, scope,</td>
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<td>organization, and administration of guidance.</td>
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<td>622</td>
<td>Space Orientation for Teachers: Elementary</td>
<td>3 hrs.</td>
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<td>The curriculum for this program will build on</td>
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<td>conducted at UAH, by providing experiences</td>
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<td>available in Washington, D.C. These will occur</td>
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<td>at the National Air and Space Museum, Goddard</td>
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<td>Space Flight Center, Owens Science Center</td>
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<td>U.S. Naval Observatory, Space Telescope</td>
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<td>Science Institute at John Hopkins, National</td>
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<td>Oceanic and Atmospheric Administration, and the</td>
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<td>Office of Technology Assessment.</td>
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<td>Prequisites: ED 532, ES 532, SS 532, or ED 522.</td>
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<td>626</td>
<td>Modern Middle School Programs</td>
<td>3 hrs.</td>
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<td>Survey of important viewpoints and issues,</td>
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<td>reorganization trends, typical research findings</td>
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<td>curriculum proposals at the national, state, and</td>
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<td>local levels.</td>
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<td>630</td>
<td>Modern Secondary School Programs</td>
<td>3 hrs.</td>
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<td>Important viewpoints and issues, reorganization</td>
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<td>trends, typical research findings by subject</td>
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<td>fields. Analysis of current curriculum</td>
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<td>proposals at the national, state, and local</td>
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<td>632</td>
<td>Space Orientation for Teachers: Secondary</td>
<td>3 hrs.</td>
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<td>Office of Technology Assessment.</td>
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<td>Prequisites: ED 532, ES 532, SS 532, or ED 522.</td>
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<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</td>
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<td>continued professional development of individuals</td>
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<td>and groups who are responsible for establishing</td>
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<td>learning environments. The course is designed</td>
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<td>for those in instructional leadership positions</td>
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<td>who are responsible for the development (in-</td>
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<td>service) programs including conferences,</td>
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<td>workshops, single sessions, and comprehensive</td>
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<td>647, 648,</td>
<td>Field Experience Practicum</td>
<td>1 hr.</td>
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<td>649</td>
<td>Student demonstration of performance</td>
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<td>competencies in school administration through</td>
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<td>field practicum. Students with committee</td>
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<td>approval may register for 647-648-649</td>
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<td>individually or jointly. Course approval based</td>
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<td>upon committee’s evaluation of student’s</td>
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<td>readiness for field practicum. Courses</td>
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<td>individually scheduled to fit concurrently with</td>
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<td>student’s regular employment assignment.</td>
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<td>661</td>
<td>Major Issues and Trends in Instructional</td>
<td>3 hrs.</td>
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<td>Leadership</td>
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<td>This course is designed to: stimulate student</td>
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<td>participation in the analytic process of</td>
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<td>examining issues and trends in the broad field</td>
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<td>of instructional leadership; serve as a vehicle</td>
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<td>for increasing proficiency in writing skills;</td>
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<td>refine participants abilities to analyze,</td>
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<td>synthesize, and formulate a position relative to</td>
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<td>controversial educational issues and areas.</td>
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</table>
662 Instructional Leadership 3 hrs.
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.

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.
English

Degree: Master of Arts
Chair: Richard S. Moore, American Literature

Professors:
Martin, C. W.; American Literature
Wilson, J.L.; Linguistics

Associate Professors:
Mebane, J.S.; Renaissance
Moore, R.S.; American Literature
Munson, W.F.; Medieval Literature
Neff, D.S.; Romantic Period, Criticism

Assistant Professors:
Johnson, P.E.; Victorian Literature
Norman, R.; Technical Writing
Schenker, D.; Modern British Literature
Szilagyi, S.; Augustan and Eighteenth-Century 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 nine hours in English courses at UAH numbered 600 or above (exclusive of thesis credit hours).
4. Master's thesis with at least two terms (six hours) of English 699. Upon petition to and approval by the Graduate Committee, a student may substitute nine 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 nine 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:

8. 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.

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

8. 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. A fee is required. Any 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 three semester hours of English 507 (English Linguistics) or English 508 (History of the English Language) or a designated course of a similar nature is required. 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 nine hours of graduate courses in Education. These hours replace the thesis requirement; thus, of the 33 semester hours required, 24 are in English and nine 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 15 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 an appropriate masters degree and the following five courses: EH 505, 507, 508, 609, and 610. Students who wish to apply EH 505, 507 and 508 towards completion of the certificate must take these courses at the graduate level. EH 505, 507 and 508 may apply to requirements for both the M.A. degree in English and the certificate. EH 609 and 610 may only be counted towards completion of the certificate. Students who already possess an appropriate masters degree may earn the certificate by taking the five required courses; no more than six 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.

500 Literary Criticism and Theory 3 hrs.
Major texts and approaches from Plato to the present.

501 Special Topics in Writing 3 hrs.
Analysis and research on a topic to be announced in advance.

505 Survey of General Linguistics 3 hrs.
A survey of the field of linguistics, including language typology, distribution of major languages of the world, cognition, topics in socio and psycholinguistics, theories of grammar, and an introduction to writing mini-grammars. Course draws on comparative examples of English with other world languages.

506 Introduction to Old English 3 hrs.
Introduction to the phonology, morphology, and syntax of Old English; intensive reading of Old English prose and verse text which characterize the Anglo-Saxons.

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.

508 History of the English Language 3 hrs.
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.

530 Special Studies in American Literature 3 hrs.
Topics announced in advance.

532 Southern Literature 3 hrs.
Selected figures and movements from colonization to the present.

533 William Faulkner 3 hrs.
Biography, background, and critical study of the major novels.

540 Special Studies in English Literature 3 hrs.
Topics announced in advance.

551 Middle English Literature 3 hrs.
The literature of later medieval England, excluding Chaucer, chosen from the Gawain poet, Malory, romance and dream vision, the drama, and the short poem.

571 Renaissance Drama 3 hrs.
Major plays of the sixteenth and early seventeenth centuries, including Marlowe, Jonson, and others. Excludes Shakespeare.

Major novelists: their depiction of reality in response to the post-Darwinian world.
609 Applied English Linguistics II: Strategies for Research and Teaching in TESOL 3 hrs.
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.

610 Applied English Linguistics III: Practicum in TESOL 3 hrs.
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.

620 Studies in Modern Poetry 3 hrs.
Selected British and American poets studied in detail.

630 Studies in American Literature to 1865 3 hrs.
Major movements from Colonial times to 1865; selected major figures or special problems.

631 Studies in American Literature since 1865 3 hrs.
Major movements since 1865; selected major figures or special problems.

649 Special Studies 3 hrs.
Study of one or more writers, genres, groups, or movements; announced in advance.

650 Chaucer 3 hrs.
The Canterbury Tales, Troilus and Criseide, and other works studied in relation to relevant literary and religious traditions.

660 Shakespeare 3 hrs.
Selected Shakespearean plays, with special attention to the major criticism, problems of interpretation, and current issues in Shakespearean study.

665 Renaissance Poetry and Prose 3 hrs.
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.

667 Milton 3 hrs.
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 Paradise Lost.

680 Eighteenth-Century Studies 3 hrs.
Extensive and intensive study of important themes in the poetry, drama, fiction, and non-fictional prose of major eighteenth-century writers.

690 Studies in English Romanticism 3 hrs.
Selected poetry and critical prose with attention to aesthetic theory and philosophical and psychological backgrounds.

691 Studies in the Victorian Period 3 hrs.
Representative writing, both poetry and prose with emphasis on social and cultural changes that inform the literature.
Master's Thesis

3 hrs.

Required each term during which a student is working and receiving direction on his master's thesis. No more than 6 hours' credit may be applied toward the degree.
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.
Boucher, P.P.; early modern Europe, European expansion.
Shields, J.N.; U.S. South, nineteenth-century U.S.
White, C.W.; Britain, modern Europe, historiography.

Associate Professors:
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.

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 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, six of which may be transfer credit approved by the Graduate Committee. Equal course distribution of U.S. and European history is expected.

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 nine 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 six hours. Upon petition to and approval by the department Graduate Committee, a student may substitute nine 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 12 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, six to 12 course hours at the 400 level (senior undergraduate) may be required. Courses listed below carry three 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.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>413</td>
<td>The Old South</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>414</td>
<td>The New South</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>424</td>
<td>The Atlantic World</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>426</td>
<td>Colonial America</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>427</td>
<td>The Age of the American Revolution</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>
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.

537 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.
538 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.

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

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

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

575 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.

576 The Ancien Regime 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.

577 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.

578 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.

579 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.

590 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.

605 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.

614 Studies in Southern History 3 hrs.
Research, writing, and critical examination of selected topics in nineteenth and twentieth century southern history.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>618</td>
<td>Studies in Early American History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>650</td>
<td>Research Methods in History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>655</td>
<td>Studies in British History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>656</td>
<td>Studies in French History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>657</td>
<td>Studies in Russian and Soviet History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>670</td>
<td>Studies in Medieval History</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>680</td>
<td>Studies in Early Modern Europe</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>690</td>
<td>Studies in Modern Europe</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>699</td>
<td>Master's Thesis</td>
<td>1-3 hrs.</td>
</tr>
</tbody>
</table>

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.
Political Science

Degree: Master of Arts 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
Gitz, B.R.; Communist Systems, Soviet Foreign Policy
Pottenger, J.R.; Ethics and Public Policy

The Master of Arts 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 Master of Arts in Public Affairs requires 37 hours of approved graduate work from the following courses:

Plan I Thesis Option:
1. Ten hours required of all students: AHS 600, PSC 660, PSC 661.
2. Twelve hours from the following: MGT 622, 623 and 624, PSC 618, 650, 652, 655, 657, 680, 685.
3. Nine hours from the following: PSC 620, 646, 667, 668, 678, 689, and 695.
4. Six hours of Master's thesis.
5. Oral comprehensive examination on courses and thesis.

Plan II Non thesis option:
1. Ten hours required of all students: AHS 600, PSC 660, PSC 661.
2. Fifteen hours from the following: MGT 622, 623 and 624, PSC 618, 650, 652, 655, 657, 680 and 685.
3. Twelve hours from the following: PSC 620, 646, 667, 668, 678, 689 and 695.
4. Successful completion of written and oral examination to be taken at the end of 37 hours of coursework in the Program.

Graduate Courses
AHS 600 Graduate Statistical Analysis 4 hrs.
An introduction and exploration of issues in multiple regression, analysis of variance, and analysis of covariance. Emphasis will be placed on the appropriate application of these procedures in the analysis of both health and social science data. Prerequisite: AHS 300. Lab Fee; Level 4.
MGT 622 Human Behavior in Organization
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
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.

MGT 624 Organizational Problems
Organizational and group interface problems and processes and principles bearing on their solutions by simulations, case analysis, and structure interactions.

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

PSC 618 Public Values and Public Policy
A critical examination of the normative aspect of public policy-making. This course focuses on the value assumptions of social theoretical paradigms that influence the design of public policy and on the ethical and moral implications of those designs. Major themes include ideological biases of empirical analyses and evaluations in the policy sciences, ethics of social policy formation, and moral problems of economic distribution, and redistribution.

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

PSC 646 Seminar in International Politics
Examination of critical factors affecting the conduct of international relations. Course will emphasize causes of war and peace and factors influencing changes in the world state system.

PSC 650 Public Management Profession: Theory and Practice
Introduction to public management as a field of study and practice. Review of basic literature. Emphasis on ethics in public service.

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

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

PSC 657 Complex Organization in Industrial Society
This course will expose students to mainstream and critical sociological theories for understanding complex organization in industrial societies. Specific areas to be covered include: historical development, structure and processes, contradictions and conflict, and alternative forms. (Same as SOC 657.)
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.

PSC 661 Public Policy Evaluation
3 hrs.
Survey of Evaluation Research Methods including experimental, quasi-experimental, and non-experimental research designs and statistical analysis. In addition, the problems and issues of presentation, implementation and utilization of results will be examined. Prerequisite: AHS 600.

PSC 667 Soviet Foreign Policy
3 hrs.
A graduate seminar devoted to both the substance of Soviet foreign policy and the assumptions; theoretical frameworks; and methodologies employed by Western students of Soviet policy.

PSC 668 National Security Policy
3 hrs.
An examination of the evolution of U.S. security policy in the post-1945 era, with a special focus upon the theory and practice of deterrence; the nature of Soviet military doctrine; and the problems associated with disarmament and arms control. Undergraduate course in I.R. recommended.

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 or 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 six 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.

PSC 699 Master's Thesis
1-3 hrs.
A student must enroll for one to three thesis hours every term that he or she is writing and receiving direction on a master's thesis. A minimum of two terms and six thesis hours is required for the thesis option. No more than six hours credit may be applied toward the degree.
Psychology

Degree: Master of Arts
Chair: S.W. Kirkpatrick, Associate Professor; developmental theory and research, research methodology.

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

Associate Professors:
Hays, D.G.; social psychology, symbol processing.
James, R.E.; learning theory, nonverbal communication, experimental aesthetics.

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. The course work in the program covers core fields and issues in psychology as well as research and statistical methods. Students may pursue specialized study in a variety of areas related to current faculty expertise and interests.

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 grade point 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 six hours of thesis. A maximum of six hours may be transfer courses approved by the graduate committee of the department.
2. The following four courses are required of all students; PY 602, PY 604, PY 611 and PY 613 or AHS 600. Three of these four courses must be completed before taking PY 641.
3. Following the completion of at least three of the four required courses listed above, each student must complete at least six 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 the advice of the student’s advisor from graduate level courses in Psychology, and may, with approval of the graduate committee of the department, include up to 6 hours of graduate courses from related departments.
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 cannot be transferred or used for credit toward a Master of Arts degree.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>401</td>
<td>Personality</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>410</td>
<td>Issues in Developmental Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>411</td>
<td>Issues in Motivation and Emotion</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>412</td>
<td>Issues in Personality</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>413</td>
<td>Issues in Applied Social Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>414</td>
<td>Issues in Learning</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>420</td>
<td>Seminar in Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>422</td>
<td>Individual Research</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>426</td>
<td>History and Systems in Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>433</td>
<td>Abnormal and Health Psychology for the Human Service Professions</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>436</td>
<td>Physiological Psychology</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

## Graduate Courses in Psychology (PY)

The 500 level courses listed below are offered at the senior/graduate level.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>Human Research I</td>
<td>2 hrs.</td>
</tr>
<tr>
<td></td>
<td>The study of human behavior by observation and/or experimentation. Students will design a study dependent upon the content of a previously completed Issues course, will engage in data collection and analysis, and will report their findings in a research paper. (Offered Winter term of each year.) Includes laboratory. Lab fee: Level 3. Prerequisites: PY 302, and one Issues course (PY 410, 414).</td>
<td></td>
</tr>
<tr>
<td>501</td>
<td>Human Research II</td>
<td>2 hrs.</td>
</tr>
<tr>
<td></td>
<td>A required continuation of PY 500. (Offered Spring term of every year.) Includes laboratory. Lab fee: Level 3. Prerequisite PY 500.</td>
<td></td>
</tr>
<tr>
<td>502</td>
<td>Industrial and Organizational Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Application of basic principles of learning, motivation, and perception to typical industrial and organizational problems.</td>
<td></td>
</tr>
<tr>
<td>503</td>
<td>Advanced General Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Survey. Various major areas of psychology. Open only to senior psychology majors and graduate students. Prerequisite: 24 hours PY and senior standing.</td>
<td></td>
</tr>
<tr>
<td>513</td>
<td>Psychometrics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>History and development of psychological testing with special emphasis given to both theory and process of effective evaluation. Prerequisites: AHS 300.</td>
<td></td>
</tr>
<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>
<td></td>
</tr>
<tr>
<td>601</td>
<td>Advanced Developmental Psychology</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>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>------------</td>
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</tr>
<tr>
<td>602</td>
<td>Proseminar: Cognitive</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Critical examination of the cognitive approach to areas of study within Psychology. Students will be responsible for library research, writings, and presentation of selected topics. (Offered once each year.) Prerequisite: Graduate standing in Psychology.</td>
<td></td>
</tr>
<tr>
<td>604</td>
<td>Proseminar: Experimental</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Critical examination of the experimental approach to areas of study within Psychology. Students will be responsible for library research, writings, and presentation of selected topics. (Offered once each year.) Prerequisite: Graduate standing in Psychology.</td>
<td></td>
</tr>
<tr>
<td>606</td>
<td>Language Development</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Stages and processes of the development of language and communication skills.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Experimental design and appropriate statistical techniques for psychological research. Includes laboratory for statistical applications. Fee: Level 6. Prerequisites: AHS 300 and PY 302 or equivalents as approved by instructor.</td>
<td></td>
</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: AHS 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>
<td></td>
</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 three of the following: PY 602, 604, 611, 613/AHS 600; and permission of instructor. (In exceptional individual instances some of these prerequisites may be waived by the graduate committee of the department.)</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 641 and permission of advisor.</td>
<td></td>
</tr>
</tbody>
</table>
Symbolic Processes
Psychology of processing symbolic material.

Master's Thesis
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 six hours is allowed, for the thesis. Credit awarded upon successful completion of the thesis. Prerequisites: PY 643.
College of Nursing

Degree: Master of Science in Nursing

Interim Dean:
R.L. Henze, Associate Professor

Director:
Burge, J.M., Professor; curriculum and instruction.

Professors:
Hincker, E.A.; professional practice issues.

Associate Professors:
Henze, R.L.; adult health nursing.
Williamson, J.W.; adult health nursing.

Assistant Professors:
Benedict, S.C.; research.
Cholewinski, J.T.; community health nursing.
Holder, P.G.; adult health nursing.
Williams, R.D.; community health nursing.

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. Part-time study is available and encouraged.

Clinical experiences in the graduate program use the total family as the primary unit of care. Opportunities for student learning are individualized while developing advanced skills and knowledge in three clinical majors: Adult Acute Care Nursing, Home Health Care Nursing or Family Nurse Practitioners. The Adult Acute Care track has the functional options of teaching, supervision or home health care administration. The Family Nurse Practitioner and Home Health Care tracks have the functional component of Practice. All graduates, upon completion of the program, are eligible to sit for national certification in selected areas.

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 serve as a clinical site for students in the College of Nursing. In addition, there are multiple home health care facilities available.

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. Other hospitals, clinics, and physicians' offices are used 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 or on the last 60 semester hours in nursing.
3. Evidence of a current license to practice as a registered nurse in Alabama. On the last 60 semester hours in nursing.
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 outpatient 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, and a minimum of 51 semester hours for those enrolled in the Home Health Care 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; and a minimum of 55 semester hours for the Home Health Care 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 College 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**

<table>
<thead>
<tr>
<th>Core Requirements:</th>
<th>Semester Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of Nursing Theory (NUR 601)</td>
<td>3</td>
</tr>
<tr>
<td>Graduate Statistical Analysis (NUR 605)</td>
<td>4</td>
</tr>
<tr>
<td>Seminar in Research (NUR 602)</td>
<td>3</td>
</tr>
<tr>
<td>Use of Computers in Nursing (NUR 604)</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>Family Nursing (NUR 627)</td>
<td>5</td>
</tr>
<tr>
<td>Professional Practice Issues (NUR 641)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>

### Adult Acute Care Track

In addition to the above 27 semester hours of required core courses, student selects one of the three 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 637) ............................................................... 3

**Total** ........................................................................................................... 17

**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

**Total** ........................................................................................................... 17

**OR**

#### Option III: Adult Care with Home Health Administration Functional Area

- Acute Care Nursing (NUR 631, 632) ............................................................. 8
- Home Health Support Courses (NUR 607, 608) .......................................... 6
- Home Health Practicum (NUR 644) ............................................................. 4

**Total** ........................................................................................................... 18

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

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

Home Health Care Track
In addition to the above 27 semester hours of required core courses, student completes
the following 24-28 semester hours of course work if enrolled in the home health care track:
- Home Health Care Nursing (NUR 642, 643, 644) .................................. 12
- Home Health Care Support Courses (NUR 607, 608) ............................ 6

The remaining 6-10 hours required are selected on the basis of a thesis (Plan I) for a
minimum of six semester hours, or a professional paper (Plan II) for a minimum of 4 semester
hours plus six semester hours of electives. A minimum of 51 semester hours is required in
the program preparing students with a clinical major in Home Health Care Nursing.

Graduate Nursing Courses (NUR)

500 Special Topics 2-4 hrs.
Advanced study of underlying sciences and personal experiences in application of
skills in selected area of interest in nursing. Elective. Prerequisite: approval of
instructor.

601 Development of Nursing Theory 3 hrs.
Seminar. Theory and theory building as explored and practiced in clinical setting.
Theory building for nursing practice and its application to research in nursing. Lab
Fee: Level 2.

602 Seminar in Research 3 hrs.
Identification, exploration, and critique of current nursing theory and research to
courage student to think critically. Use of theory and scientific methodology to
formulate a proposal for investigation or research. Lab Fee: Level 2.

603 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 602, 604, 605, 627.

604 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 6.
Graduate Statistical Analysis 4 hrs.
Theory and application of statistical tests of association, relationship and differences including descriptive statistics and regression analysis. Use of personal computers and SYSTAT statistical software will be required. Prerequisite: NUR 602, 604. Lab Fee: Level 5.

Advanced Health Assessment 3 hrs.
Theory and laboratory practice to develop skills for comprehensive health assessment of individuals and families. Lab fee: Level 7. Fall.

Home Health Theory and Issues 3 hrs.
Overview of current and emerging issues in home health care. Emphasis will be given to the social, economic, legislative and technological forces influencing changes in health and home care delivery systems. Lab Fee: Level 2. Spring.

Case Management in Home Health Nursing 3 hrs.
Extensive analysis of home health care delivery systems with emphasis on planning, implementing, coordinating and evaluating care of clients in the home environment. The course will include an introduction to the use of computer software for fiscal and personnel management. Prerequisites: NUR 607; NUR 631 or 642. Lab Fee: Level 2. Summer.

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. Lab Fee: Level 1. Winter.

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. Lab Fee: Level 1. Spring.

Family Nursing 5 hrs.

Family Nursing in Community I 4 hrs.

Family Nursing in Community II 4 hrs.

Family Nursing in Community III 7 hrs.
Seminar and clinical practicum utilizing innovative nursing management for families with complex problems. Lab fee: Level 8. Prerequisite: NUR 629. Fall.

Family Nursing in Acute Care I 4 hrs.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Description</th>
<th>Prerequisites/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>633</td>
<td>Management Theory for Advanced Nursing Practice</td>
<td>3 hrs.</td>
<td>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. Lab Fee: Level 1. Summer.</td>
<td></td>
</tr>
<tr>
<td>634</td>
<td>Curriculum Development in Nursing</td>
<td>3 hrs.</td>
<td>Theories and concepts of contemporary curriculum development and program evaluation in associate and baccalaureate nursing programs. Lab Fee: Level 1. Spring.</td>
<td></td>
</tr>
<tr>
<td>635</td>
<td>Teaching and Evaluation in Nursing</td>
<td>3 hrs.</td>
<td>Teaching strategies applicable to basic nursing education including process of formative and summative evaluation. Prerequisite: NUR 634. Lab Fee: Level 1. Summer.</td>
<td></td>
</tr>
<tr>
<td>636</td>
<td>Practicum in Supervision</td>
<td>3 hrs.</td>
<td>Practicum in planning, directing and evaluating activities of nursing personnel in selected health care settings. Lab fee: Level 7. Prerequisites: NUR 633. Fall.</td>
<td></td>
</tr>
<tr>
<td>637</td>
<td>Practicum in Teaching</td>
<td>3 hrs.</td>
<td>Practicum in planning and teaching nursing to selected student groups at the associate and baccalaureate degree levels. Lab fee: Level 7. Prerequisite: NUR 635. Fall.</td>
<td></td>
</tr>
<tr>
<td>640</td>
<td>Concepts of Role Socialization</td>
<td>2 hrs.</td>
<td>Seminar in leadership skills and role socialization to enhance effectiveness of master’s prepared family nurse practitioner students. Lab Fee: Level 1. Summer.</td>
<td></td>
</tr>
<tr>
<td>641</td>
<td>Issues in Professional Practice</td>
<td>2 hrs.</td>
<td>Exploration of professional nursing’s development and related social, political, and technological forces. Strategies for management and change are identified and evaluated. Prerequisite: NUR 629, 632, or 643. Lab Fee: Level 1. Fall.</td>
<td></td>
</tr>
<tr>
<td>643</td>
<td>Home Health Care Nursing II</td>
<td>4 hrs.</td>
<td>Clinical course providing students with initial experience in home health care agencies. Students will be introduced to overall coordination activities related to case management. Lab fee: Level 8. Prerequisites: NUR 607, 642. Summer.</td>
<td></td>
</tr>
<tr>
<td>644</td>
<td>Home Healthy Care Administrative Practicum</td>
<td>4 hrs.</td>
<td>Practicum providing students with opportunity to practice leadership and administrative skill within the context of home health and under the direct preceptorship of home health nursing administrators. Lab fee: Level 8. Prerequisites: NUR 608; NUR 632 or 643. Fall.</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Hours</td>
<td></td>
<td></td>
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<tr>
<td>-------------</td>
<td>------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>650</td>
<td>Independent Study</td>
<td>2-4 hrs.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>The planning, implementation, and evaluation of related phenomena of special interest observed in nursing practice. Prerequisite: Dean's approval.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>699</td>
<td>Thesis</td>
<td>6 hrs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Independent research investigation related to practice of nursing under faculty guidance. Minimum of six hours required. Prerequisites: NUR 602, 604, 627.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
College of Science

Degrees:  Applied Mathematics  Ph.D.
Atmospheric and Environmental Science  Certificate
Biological Sciences  M.S.
Chemistry  M.S., Ph.D.*
Computer Science  M.S., Ph.D.
Materials Science  Ph.D.
Mathematics  M.A., M.S.
Physics  M.S., Ph.D.

*Doctor of Philosophy in cooperation with The University of Alabama, Tuscaloosa

Dean: Harold J. Wilson, Professor of Biological Sciences
Associate Dean: F.L. Cook, Associate Professor of Mathematics

The College of Science includes the departments of Biological Sciences, Chemistry, Computer Science, Mathematical Sciences, 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 Applied Mathematics, Computer Science, Materials Science, and Physics. A proposal to offer the Ph.D. degree in Atmospheric Science is presently being reviewed by the Alabama Commission on Higher Education for implementation in the fall of 1989. A Ph.D. degree is also offered in chemistry through a cooperative program with other campuses in the University of Alabama system. All departments in the College offer programs leading to the M.S. degree. A program for the M.A. degree is offered in the Department of Mathematical Sciences.

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

Acting Coordinator: McNider, R. T.; Associate Professor, Mathematical Sciences; 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, Mathematical Sciences, 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, Mathematical Sciences, and Engineering. A proposal to offer the Ph.D. degree in Atmospheric Science is presently being reviewed by the Alabama Commission on Higher Education for implementation in the fall of 1989. 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)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>512</td>
<td>Environmental Transport</td>
<td>3 hrs</td>
</tr>
<tr>
<td>521</td>
<td>Environmental Data Management and Analysis</td>
<td>3 hrs</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>525</td>
<td>Environmental Chemistry</td>
<td>3 hrs</td>
</tr>
<tr>
<td></td>
<td>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. Prerequisites: CH 521 or 123; EG 311, 342. (Same as CH 525).</td>
<td></td>
</tr>
</tbody>
</table>
532 Space Orientation for Teachers: Science 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 developments 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. (Same as ED 532.)

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 551.)

553 Atmospheric Radiation 3 hrs.
An introduction to solar and terrestrial radiation. Absorption and emission of radiation in the atmosphere. Transfer of radiation in a plane stratified atmosphere. Experimental determinations of flux emissivity. Divergence of net radiation. Prerequisites: MA 352, PH 112. (Same as ME 553.)

581 Atmospheric Thermodynamics 3 hrs.
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.)

593 Directed Studies in Atmospheric and Environmental Science 1-4 hrs.
Supervised compilation, summarization, and discussions of special topics in atmospheric and environmental science. Prerequisite: permission of instructor.

632 Space Orientation for Teachers: Science 3 hrs.
The curriculum for this program will build on that already attained by those educators who have participated in the generic program conducted at UAH, by providing educational experiences available in Washington, D.C. These will occur at the National Air and Space Museum, Goddard Space Flight Center, Owens Science Center (Challenger Center), Maryland Science Center, U.S. Naval Observatory, Space Telescope Science Institute at Johns Hopkins, National Oceanic and Atmospheric Administration, and the Office of Technology Assessment. Prerequisite: ES 532. (Same as ED 632.)

643 Atmospheric Boundary Layers 3 hrs.
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.
653 Atmospheric Optics 3 hrs.
Operational characteristics of optical or other radiative devices depend 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.

663 Advanced Topics in Atmospheric Science 1-3 hrs.
To include Satellite and Radar Meteorology and Numerical Atmospheric Modeling.

681 Numerical Atmospheric Modeling 3 hrs.
Introduction to numerical methods applied to simulation of the atmosphere. Filtering radiative parameterization, thermodynamics, turbulent parameterization, initialization, coordinate transformation. Prerequisite: MA 415, ES 551.
Biological Sciences

Degree: Master of Science

Interim Chair:
R. F. Modlin; Associate Professor; biology of crustacea, ecology of marine and freshwater ecosystems.

Professors:
Campbell, P. S.; reproductive physiology, sex steroid hormone action.
Dimopoullos, G. T.; pathogenesis of infectious diseases, detection of vibrio species.
Wilson, H. J.; subcellular movement in plant and animal cells.
Young, R. B.; gene expression in skeletal muscle, recombinant DNA.

Associate Professors:
Eley, M. H.; chemical and biological conversions of biomass.
Garstka, W. R.; reproduction and chemical communication in vertebrates.
Lawton, R. O.; structure and composition of forest communities.
Meehan, E. J.; (Adjunct); biomolecule structure, X-ray crystallography.

Assistant Professors:
Johnson, A. D.; Nutritional physiology
Moriarity, D. M.; Regulation of eucaryotic gene expression.
Zahorchak, R. J.; mechanisms of bacterial pathogenesis, especially Yersinia

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 accommodate.

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; minimum of six hours BYS 699 required.
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 nine 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 12 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 hr.</td>
</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>
</tbody>
</table>
490 Special Topics in Biological Sciences 1-4 hrs.
492 Undergraduate Research 2-4 hrs.
496, 497, 498, 499 Seminar 1 hr. each

Graduate Biological Sciences Courses (BYS)

519 Gene Structure and Function 3 hrs.
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.

521 Medical Mycology (UAH) 4 hrs.
Basic and applied studies of the various classes of fungi pathogenic to humans; reproduction, morphology, classification, classification of disease states, pathogenesis, laboratory diagnosis and chemotherapy. Two 2-hour labs per week. Lab fee: Level 5. Prerequisite: BYS 421; BYS 430 is recommended.

524 Mycology (UAH and A&MU) 4 hrs.
Lines of phycomycetes using representative species; various series of actinomycetes; representative pathogenic (crop and vegetative pathogens) and nonpathogenic heterobasidiomycetidae organisms; orders and families of homobasidiomycetidae. Ontogenetics, cellular, and structural study applied to all divisions, classes, series, orders and families. Lab fee: Level 5.

525 Medical Parasitology (UAH) 5 hrs.
Basic and applied studies of the various classes of parasites pathogeneic to humans and their laboratory identification. Arthropods and their relationship as vectors of parasites. Immunology and chemotherapy of parasitism. Two 2 hour labs per week. Lab fee: Level 4. Prerequisite: BYS 221 or equivalent.

531 Plant Physiology (UAH) 4 hrs.
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 4. Prerequisites: BYS 113, 371, or 372, CH 113 or 331.

532 Animal Physiology (UAH) 4 hrs.
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 emphasis on regulation. One laboratory session a week illustrating physiological principles discussed in lecture. Lab fee: Level 5. 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).
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>544</td>
<td>Cellular and Developmental Biology (UAH)</td>
<td>3 hrs.</td>
<td>Continuation of BYS 543 and selected morphogenesis of germ-layer derivatives.</td>
<td>Prerequisite: BYS 543</td>
</tr>
<tr>
<td>547</td>
<td>Biochemistry I (UAH)</td>
<td>3 hrs.</td>
<td>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.)</td>
<td></td>
</tr>
<tr>
<td>548</td>
<td>Biochemistry II (UAH)</td>
<td>3 hrs.</td>
<td>Metabolism, biosynthesis of macromolecular precursors, storage, transmission, expression of genetic information, and molecular physiology. Prerequisite: CH 561 or BYS 547. (Same as CH 562.)</td>
<td></td>
</tr>
<tr>
<td>561</td>
<td>Physiological Ecology (UAH)</td>
<td>4 hrs.</td>
<td>Physiological and behavioral responses of organisms to natural changes in their chemical and physical environment. One 3-hour lab a week. Lab fee: Level 4. Prerequisite: BYS 312 or approval of instructor. BYS 361 or 532 recommended.</td>
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</tr>
<tr>
<td>562</td>
<td>Community Ecology (UAH)</td>
<td>4 hrs.</td>
<td>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 4. Field trips required. Prerequisites: BYS 312 and taxonomy.</td>
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</tr>
<tr>
<td>564</td>
<td>Limnology (UAH)</td>
<td>4 hrs.</td>
<td>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 5. Prerequisites: BYS 312 and 315, 371 or 378.</td>
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<tr>
<td>571</td>
<td>Plant Anatomy (UAH and A&amp;MU)</td>
<td>4 hrs.</td>
<td>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 5. Prerequisite: BYS 372 or approval of instructor.</td>
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<tr>
<td>578</td>
<td>Aquatic Arthropod Biology</td>
<td>4 hrs.</td>
<td>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 5. Prerequisite: BYS 378.</td>
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<tr>
<td>Course Code</td>
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<td>Credits</td>
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<tr>
<td>621</td>
<td>Pathogenic Bacteriology (UAH)</td>
<td>4 hrs.</td>
<td>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 5. Prerequisites: BYS 361, 421, 430, or equivalents, or approval of instructor.</td>
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<tr>
<td>624</td>
<td>Immunology (UAH)</td>
<td>4 hrs.</td>
<td>Theoretical and practical aspects of immunology. Current areas of immunology that are controversial. One 4-hour lab a week. Lab fee: Level 5. Prerequisites: BYS 361 and BYS 430 or approval of instructor.</td>
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<tr>
<td>633</td>
<td>Endocrinology (UAH)</td>
<td>3 hrs.</td>
<td>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.</td>
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<tr>
<td>641</td>
<td>Advanced Cell Biology (UAH and A&amp;MU)</td>
<td>4 hrs.</td>
<td>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 5. Prerequisite: Cellular and Developmental Biology or approval of instructor.</td>
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<tr>
<td>643</td>
<td>Microscopy (UAH)</td>
<td>4 hrs.</td>
<td>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 7. Prerequisites: graduate standing and approval of instructor.</td>
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<tr>
<td>644</td>
<td>Topics in Cell and Developmental Biology and Biological Fine Structure (UAH)</td>
<td>2 hrs.</td>
<td>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. Prerequisite: BYS 543 or 643 or approval of instructor.</td>
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<tr>
<td>646</td>
<td>Molecular Genetics (UAH and A&amp;MU)</td>
<td>3 hrs.</td>
<td>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 replication; genetic recombination; RNA transcription; translation and genetic code; regulation of gene function; evolution at molecular level. Prerequisites: BYS 319 and BYS-CH 361.</td>
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<tr>
<td>647</td>
<td>Enzymology (UAH)</td>
<td>4 hrs.</td>
<td>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.</td>
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</table>
653  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 4. Prerequisite: BYS 455 or approval of instructor.

660  Ecosystem dynamics (UAH)  3 hrs.  
An analytical approach (including simulation and modeling) to the interactions of organisms in terrestrial, aquatic, and marine ecosystems. Prerequisites: BYS 564 and 562.

661  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 4. 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 3 for 2 hours; Level 4 for 3 hours; Level 5 for 4 hours; Level 5 for 5 or 4 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 six hours required for MS students. Maximum of nine 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. Prerequisites: 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 they 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:
Clunie, J.C. (Adjunct); solution thermodynamics, diffusion.
Fredericks, W.J. (Research); light scattering.
Gregory, J.C.; cosmic ray astronomy, interaction of atomic oxygen with surfaces.
Harris, J.M.; polymers, organic reaction mechanisms, crystal growth in microgravity.
Loo, B.H.; surface enhanced Raman spectroscopy, electrochemistry, superconductivity.
Gregory, J.C.; cosmic ray astronomy, interaction of atomic oxygen with surfaces.
Harris, J.M.; polymers, organic reaction mechanisms, crystal growth in microgravity.
Clunie, J.C. (Adjunct); solution thermodynamics, diffusion.
Fredericks, W.J. (Research); light scattering.

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 6000 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, Auger electron spectrometer, GC/MS, fluorescence spectrometer, X-ray photoelectron spectrometer, molecular beam scattering machine, Perkin-Elmer spectrometer, Jarrell-Ash 2 meter spectrometer, Varian Dris-90 ultraviolet-visible spectrometer with kinetics apparatus, Beckman DB-G visible-ultraviolet spectrometers, Raman spectrometer with laserexcitor,Picker x-ray diffractometer and sev-
eral atomic absorption spectrometers, polarography system, Waters binary gradient liquid chromatography system, Perkin-Elmer high pressure liquid chromatograph, gas chromatographs and various CW and pulsed lasers. The University has an upgraded UNIVAC 1100/70 computer, and has access to a Cray-XMP supercomputer at the Alabama Supercomputer Center, which is in Huntsville. The Chemistry Department has 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, 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, 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</th>
<th>Credits</th>
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<tr>
<td>331 Organic Chemistry</td>
<td>3 hrs.</td>
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<tr>
<td>332 Organic Chemistry</td>
<td>2 hrs.</td>
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<td>333 Organic Chemistry</td>
<td>2 hrs.</td>
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<tr>
<td>335 Organic Chemistry Laboratory I</td>
<td>1 hr.</td>
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<tr>
<td>336 Organic Chemistry Laboratory II</td>
<td>1 hr.</td>
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<tr>
<td>337 Organic Chemistry Laboratory III</td>
<td>2 hrs.</td>
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<tr>
<td>341 Chemical Thermodynamics</td>
<td>3 hrs.</td>
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<tr>
<td>342 Chemical Dynamics</td>
<td>2 hrs.</td>
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<tr>
<td>343 Introduction to Quantum Chemistry</td>
<td>2 hrs.</td>
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<tr>
<td>345 Experimental Physical Chemistry I</td>
<td>1 hr.</td>
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<tr>
<td>346 Experimental Physical Chemistry II</td>
<td>1 hr.</td>
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<tr>
<td>347 Biophysical Chemistry I</td>
<td>3 hrs.</td>
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<tr>
<td>348 Biophysical Chemistry II</td>
<td>3 hrs.</td>
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<tr>
<td>361 General Biochemistry I</td>
<td>3 hrs.</td>
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<tr>
<td>362 General Biochemistry Laboratory I</td>
<td>1 hr.</td>
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</tbody>
</table>
363 General Biochemistry II 3 hrs.
364 General Biochemistry Laboratory II 1 hr.
401 Inorganic Chemistry 3 hrs.
402 Inorganic Chemistry Laboratory 1 hr.
421 Instrumental Analysis 4 hrs.

Graduate Chemistry Courses (CH)

521 Chemical Instrumentation 4 hrs.
Use of basic instrumentation in electrochemical, chromatographic, and spectrophotometric analysis. Laboratory work emphasizes utility of operational amplifiers in making chemical measurements. Introduction to digital logic. Lab fee: Level 6. Prerequisite: CH 346.

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. Prerequisites: CH 521 or 123; EG 311, 342. (Same as ES 525.)

531 Theoretical Organic Chemistry 4 hrs.
Molecular orbital theory and bonding, molecular structure, frontier molecular orbitals, pericyclic reactions, and reactive intermediates. Extensive computational laboratory work included. Lab fee: Level 5. Prerequisites: Ch 333, and 342 or 348 or approval of instructor.

540 High Polymer Chemistry 3 hrs.
Theory of polymer formation and structural dependence of polymer properties. Prerequisites: CH 337 and 342 or 348.

549 Spectroscopy and Molecular Structure 3 hrs.
Intermediate level treatment of principles of spectroscopy and their application to determination of molecular structure. Prerequisite: CH 343.

553 Introductory Quantum Mechanics I 3 hrs.
Prerequisites: CH 343, PH 351, MA 244, 251, 352. (Same as PH 551.)

554 Introductory Quantum Mechanics II 3 hrs.
Prerequisite: CH 553. (Same as PH 552.)

560 X-Ray Structure Determination 4 hrs.
The course will examine both theoretical and practical aspects of molecular structure determination by x-ray diffraction methods. Topics include diffraction of x-rays, symmetry operations and space groups, methods of data collection, theory of structure factors and Fourier synthesis, least squares methods of structure refinement. Extensive laboratory and computer work included. Lab fee: Level 6. Prerequisites: senior standing in chemistry or physics and approval of the instructor.
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>561</td>
<td>Biochemistry I</td>
<td>3 hrs.</td>
<td>Structural chemistry and function of biomolecules, mechanisms of biochemical</td>
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<td>reactions, enzyme kinetics, and energy transfer. Prerequisite: CH 333 or CH 361.</td>
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<td>(Same as BYS 547.)</td>
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<tr>
<td>562</td>
<td>Biochemistry II</td>
<td>3 hrs.</td>
<td>Metabolism, biosynthesis of macromolecular precursors, storage, transmission,</td>
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<td>and expression of genetic information, and molecular physiology. Prerequisite:</td>
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<td>CH 561. (Same as BYS 548.)</td>
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<tr>
<td>565</td>
<td>Molecular Biochemistry Laboratory</td>
<td>2 hrs.</td>
<td>Practical experience in isolation and characterization of biomolecules. Lab fee:</td>
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<td>Level 6. Prerequisite: CH 562.</td>
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<tr>
<td>560</td>
<td>Advanced Inorganic Chemistry</td>
<td>3 hrs.</td>
<td>Survey with emphasis on structure and reactivity of inorganic compounds.</td>
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<td>Prerequisite: CH 401.</td>
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<tr>
<td>601</td>
<td>Structural Methods in Inorganic Chemistry</td>
<td>3 hrs.</td>
<td>Physical methods applied to determination of structure of inorganic compounds.</td>
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<td>Prerequisite: CH 600.</td>
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<tr>
<td>602</td>
<td>Chemistry of Coordination Compounds</td>
<td>3 hrs.</td>
<td>Modern bonding theory and stereochemistry of coordination compounds.</td>
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<td>Prerequisite: CH 600.</td>
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<tr>
<td>603</td>
<td>Chemistry of Nonmetal Compounds</td>
<td>3 hrs.</td>
<td>Chemistry of selected nonmetal compounds.</td>
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<td>Prerequisite: CH 601.</td>
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<tr>
<td>621</td>
<td>Methods of Chemical Analysis</td>
<td>3 hrs.</td>
<td>Literature, seminar course. Theory and methodology of various techniques of</td>
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<td>chemical analysis. Prerequisite: CH 521 or CH 421.</td>
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<td>photoelectron spectroscopy, scanning Auger microscopy, and Raman spectroscopy.</td>
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<td>Using commercial instruments, students will prepare samples and perform analyses</td>
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<td>of a variety of materials types (ceramics, metals and polymers). For each</td>
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<td>experiment, students will carry out the data analysis and prepare a report.</td>
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<td>One four-hour laboratory per week. Lab fee: Level 10. Prerequisite: CH 346 or 421.</td>
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<tr>
<td>631</td>
<td>Advanced Organic Chemistry I</td>
<td>3 hrs.</td>
<td>Organic synthetic reactions. Survey of certain reactions that enjoy widespread</td>
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<td>application to the synthesis of organic compounds. Prerequisites: CH 333, 342,</td>
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<td>or approval of instructor.</td>
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<td>relationships, reaction mechanisms and techniques used to determine them.</td>
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<td>Prerequisite: CH 531 or approval of instructor.</td>
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<tr>
<td>640</td>
<td>Advanced Chemical Thermodynamics</td>
<td>3 hrs.</td>
<td>First, second, and third laws of thermodynamics and applications. Brief</td>
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<td>introduction to statistical thermodynamics. Prerequisites: CH 343, MA 251, or</td>
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<td>approval of instructor.</td>
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155
641 Statistical Thermodynamics 3 hrs.
Principles leading to the development of Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics. Thermodynamic properties calculated from partition functions. Prerequisite: CH 343.

642 Advanced Chemical Dynamics 3 hrs.
Velocity of chemical reactions in homogeneous and heterogeneous systems. Absolute rate theory, collision theory, scattering, and concept of reaction cross sections. Prerequisite: CH 640.

643 Quantum Chemistry 3 hrs.
Application of quantum theory to the chemical bond. Prerequisite: CH 343.

644 Chemical Electrodynamics 3 hrs.
Electrodynamics problems encountered in Chemistry. Maxwell's equations, electrostatics. Onsager and Debye theory of dielectrics, molecular dipole moments, Beer's law, Landolt's rule, light scattering from macromolecules, quantum theory of radiation, magnetic susceptibility, introduction to NMR and ESR. Prerequisites: CH 342, MA 352.

646 Thermodynamics of Materials 3 hrs.
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.

647 Polymer Physical Chemistry 3 hrs.
Includes an introduction to structure, properties and processing of polymers. Topics included are structural types, structure-property relationships, thermodynamics and kinetics of polymerization and depolymerization, polymer characterization, thermodynamics of polymer solutions and blends, and mechanical evaluation of polymers. Prerequisite: CH 341 or equivalent.

661 Biological Macromolecules 3 hrs.
Detailed analysis of structures of proteins, nucleic acids, and complex polysaccharides. Prerequisite: CH 562.

699 Master's Thesis 3 or 6 hrs.
Required each term a student is enrolled and receiving direction on a master's thesis. Minimum of two terms required.

705 Selected Topics in Inorganic Chemistry 3 hrs.
Prerequisite: CH 600 and approval of instructor.

721 Selected Topics in Analytical Chemistry 3 hrs.
Prerequisite: CH 621 or equivalent and approval of instructor.

735 Selected Topics in Organic Chemistry 3 hrs.
Prerequisite: CH 632 and approval of instructor.

745 Selected Topics in Physical Chemistry 3 hrs.
Prerequisite: CH 643 and approval of instructor.
Solid State Chemistry 3 hrs.
Chemical properties of solids. Includes phase equilibria, chemical bonding in ionic and covalent crystals, thermodynamics of atomic defects, ionic conductivity in solids, corrosion, and introduction to surfaces and adsorption. Prerequisites: Ch 342, MA 352.

Selected Topics in Biochemistry 3 hrs.
Prerequisites: CH 661 and approval of instructor.

Chemistry Seminar 1 hr.
Required during each term of residence.

Doctoral Dissertation 3, 6, or 9 hrs.
Required each term student is enrolled and receiving direction on a doctoral dissertation.
Computer Science

Degrees: Master of Science
Doctor of Philosophy

Chair: C.G. Davis, Professor; software engineering, requirements definition, simulation and modeling, distributed computing.

Professors:
Hooper, J.W.; languages, simulation and prototyping, software engineering.
Johannes, J.D.; artificial intelligence, operating systems, text processing.
Shiva, S.G.; artificial intelligence, hardware/software design, methodologies, distributed processing.

Associate Professors:
Amin, A.T.; computer system reliability, distributed systems, 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.; algorithm design and analysis, symbolic programming.
Graves, S.J.; distributed computing, data, knowledge systems, and software engineering.
Meehan, J.M.; (Research); distributed processing, programming languages, real-time systems.
Moseley, C.W.; expert systems, software engineering, intelligent tutoring systems.
Reed, T.; software engineering, programming languages.
Ziebarth, J.P.; supercomputing applications, computational fluid dynamics.

Adjunct Faculty
Caufield, H.J.; Professor; optical computing, holography.
Choudry, A.; Professor, optical computing, distributed computing.
Dasarathy, B.V.; Associate Professor; pattern recognition, image processing.

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 7000/40 (UNIX) with terminals throughout the department, CRAY XMP/24, 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.

Emphasis Areas
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 managing, specifying, designing and testing large software systems are many resulting frequently in software being completed late, with many errors, and with cost overruns. The software engineering area is a study of the software development process and covers a wide variety of topics. An option in software engineering may be obtained by selecting from among the following course offerings. CS 650 must be included in the selection.

- CS 551  Object Oriented Software Development
- CS 555  Theory of Program Development
- CS 650  Software Engineering
- CS 651  Software Requirements and Design Methodologies
- CS 652  Software Testing and Reliability
- CS 653  Software Project Management and Quality Assurance
- 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.
### 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>
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<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>
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</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>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CS 586</td>
<td>Microprocessor Architectures</td>
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<tr>
<td>CS 613</td>
<td>Computer Architectures</td>
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<tr>
<td>CS 670</td>
<td>Computer Networks</td>
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<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>
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</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 and will include 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. Computer Science courses in this area include the following:

<table>
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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>CS 646</td>
<td>Computer Geometry Modeling</td>
</tr>
<tr>
<td>CS 647</td>
<td>Numerical Grid Generation</td>
</tr>
<tr>
<td>CS 660</td>
<td>Large Scale Scientific Computing</td>
</tr>
<tr>
<td>CS 770</td>
<td>Supercomputing Applications in Fluid Dynamics</td>
</tr>
</tbody>
</table>
Master of Science

Admission Requirements

Requirements for admission to the Computer Science graduate degree program are in addition to those of the School of Graduate Studies. A score of 650 is required on the quantitative portion of the GRE for unconditional admission. The advanced portion of the GRE is not required. The MAT or GMAT are not acceptable as substitutes for the GRE.

Prerequisites:

Prerequisites for the graduate program in computer science are the following:

Mathematics:
- MA 153 Calculus I
- MA 154 Calculus II
- MA 233 Calculus III
- MA 244 Introduction to Linear Algebra
- MA 385 Introduction to Probability

Computer Science:
- CS 108 Computer Science I with Pascal
- CS 208 Computer Science II-Data Structures with Pascal
- CS 214 Introduction to Discrete Structures
- or MA 440 Algebraic Structures with Applications
- CS 317 Introduction to Design and Analysis of Algorithms
- CS 424 Introduction to Programming Languages
- CS 490 stems Software
- CS 513 Introduction to Computer Architecture or
- CS 309 Switching Theory plus
- CS 415 Introduction to Digital Computer Design
- CS 517 Data Organization and Algorithm Analysis or
- CS 314 Data organization and file Processing plus
- CS 317 Introduction to Design and Analysis of Algorithms

Students applying for the Master program are expected to have an undergraduate background in Computer Science. Those students lacking sufficiently large numbers of courses in order to qualify for the program will be asked to complete the above prerequisites with a B average or better and minimum of C in any course and then reapply for admission.

Unconditional Admission

Students applying to the M.S. program will be given unconditional admission if they meet all the requirements of the School of Graduate Studies and of the Computer Science Department including prerequisite courses listed above.

Conditional Admission

Conditional admission may be given to students who in the judgment of the department have the potential for successfully completing graduate work but who do not meet all of the requirements 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 (Computer Architecture), CS 617 (Design and Analysis of Algorithms), CS 624 (Programming Languages), and CS 690 (Operating Systems). Six hours of course work in a minor area are also required. The minor may be within Computer Science or other areas such as Administrative Science, Electrical Engineering, Engineering Management, Mathematics, and Operations Research.

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) six semester in an approved minor area. Students must pass a written examination on the core courses, and an oral examination on the coursework. The written examination can be taken anytime after completion of 21 hours of graduate coursework.

A program of study must be planned before completing 12 semester hours of study. The plan must be made in consultation with a member of the computer science faculty assigned by the department chairman as an advisor. The program of study cannot contain more the three hours of special topics courses without approval of the department chairman. The program of study is approved by the Chair of the Computer Science Department, the Dean of the College of Science, and the Dean of the School of Graduate Studies. After approval of the program of study, students may not substitute courses without prior approval of an advisor.

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 and Computer Science Department as described above. An applicant's admission request will be reviewed in light of preparatory coursework, GRE scores, any supporting information, and general expectation of completing the degree. Students requiring a large amount of prerequisite coursework will not normally be admitted to the program until the courses have been completed. Graduate admission requests for the Ph.D. program will be reviewed once per term. This will normally be done two weeks following the application deadline. Applicants are encouraged to submit supporting recommendation letters and an indication of research interests. Requests for admission will be evaluated according to the following guidelines.

Unconditional Admission

Unconditional admission will be given to applicants who meet all of the requirements of the School of Graduate Studies and Computer Science Department for unconditional admission and have completed the M.S. core courses. Students showing exceptional promise who desire to pursue the Ph.D. full-time may be admitted to the program after completing a Bachelors Degree in Computer Science or Computer Engineering.
Conditional Admission

Conditional admission may be given to applicants who do not meet all of the requirements of the School of Graduate Studies and the Computer Science Department but who show high potential for completing the degree requirements.

Degree Requirements

The general requirements for the Ph.D. degree comply with those of the School of Graduate Studies. The requirements include among others, a preliminary examination over the core courses, completion of coursework, a qualifying examination, completion of significant research documented in a dissertation, and the final defense.

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 student's supervisory committee.

The program must include CS 603, CS 613, CS 617, CS 624, CS 630 and CS 690 as a core, and must have a coherent area of emphasis, of which at least six semester hours must be at the 700 level. At least nine semester hours of graduate level mathematics must also be included in the program.

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 Master's Degree at UAH who have successfully passed a written examination on the M.S. core courses may satisfy all or part of the preliminary examination requirements. Successful completion of the examination will provide evidence of the student's ability to continue to pursue the Ph.D. degree. The examination can be taken only twice.

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. The qualifying exam can cover any aspect of the student's program and is taken after completion of the student's coursework and upon recommendation of the student's 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. After completion of the qualifying exam the student will present a research proposal to the supervisory committee.

Residency Requirements

In order to meet the residency requirements, a student must have completed six 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. No more than six hours taken as part of the residency requirements may be dissertation credit.

Language Requirements

The language requirements, as outlined by the School of Graduate Studies, may be fulfilled by any of the four described methods. Any credit hours taken to fulfill the language requirements are in addition to the 60 hour coursework requirement.
Dissertation

A significant portion of the dissertation must be submitted for publication in an approved journal with international circulation prior to defense of the dissertation. A public defense of the dissertation is required.

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 cannot 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 5. Prerequisite: CS 490.

517 Data Organization and Algorithm Analysis 3 hrs.
Review of basic data structures such as stacks, queues, lists, B-Trees, and binary trees. Overview of file structures and access methods. Introduction to complexity analysis of algorithms. Basis algorithm design techniques such as divide & conquer, dynamic programming, and backtracking. Introduction to the classification of problems by class; i.e., tractable, NP, intractable, and unsolvable. Lab fee: Level 4. Prerequisite: CS 208.

Graduate Courses (CS)

Courses numbered between 530 and 599 (inclusive) may be taken for graduate credit with prior approval of the student's advisor. To receive credit toward an advanced degree, a student must attain a minimum grade of B in all core courses and in each computer science course numbered less than 600. In addition, students must maintain a minimum of B average in all CS graduate courses.

530 Introduction to Artificial Intelligence 3 hrs.
Basic introduction to AI concepts and methods for problem solving, heuristic search, planning hypothesis formation, modeling and knowledge representation, knowledge acquisition (learning), and AI's programming methodologies and tools. Applications of AI in areas of automatic programming, theorem proving, game playing, machine vision, natural language systems and robots. Lab fee: Level 4. Prerequisites: CS 317, CS 424.

537 Neural Networks 3 hrs.
The purpose of this course will be to learn the fundamentals of neural networks. Specific problems will be examined to contrast the connectionist approach to functionalism. The most common neural net models will be implemented and applied to various machine learning applications. Prerequisite: CS 530.

551 Object Oriented Software Development 3 hrs.
Object oriented methods and design concepts, languages and systems for object oriented development, object oriented programming environments, application of object oriented techniques. Lab fee: Level 4. Prerequisites: CS 208, CS 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 4. Prerequisite: CS 424.

586 Microprocessor Architecture 3 hrs.
Evolution of microprocessors. Software aspects: registers and register organization, instruction sets, addressing modes, assembler and assembler directives. Hardware aspects: redundant bus concepts, clock circuits, memory, parallel and serial input/output interfaces, programmed I/O, interrupt mode I/O, direct memory access. Survey of current microprocessor technology. Lab fee: Level 5. Prerequisites: CS 513, or CS 309 or CS 415.

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 4. Prerequisite: CS 390 or two years experience in Unix.

595 Selected Topics in Computer Science 3 hrs.

603 Formal Languages and Automata Theory 3 hrs.

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 4. Prerequisite: CS 624, 403 recommended.

613 Computer Architectures 3 hrs.
Associative, parallel, and pipeline architectures; multiple processor systems, and concepts of data flow and high-order language architectures. Performance evaluation, selected architectures including micro-, mini-, and large-scale computer systems. Lab fee: Level 4. Prerequisite: CS 415 or CS 513.

617 Design and Analysis of Algorithms 3 hrs.

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 4. Prerequisites: CS 424 and CS 317.
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 4. Prerequisite: CS 530.

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 4. Prerequisite: 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 4. 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 4. 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 transformations 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 5. Prerequisites: CS 513, CS 317, MA 244 or equivalent.

646 Computer Geometry Modeling 3 hrs.
Numerical and computer representation of curves and surfaces, solid geometry modeling and management aspects of geometric data. Computer procedures associated with coordinate transformation, curve and surface design, orientation, cubic-tension-B-splines, Bezier curves/surfaces, and interpolation methods. Discuss graph-based and Boolean models and concepts of constructive application to Computational Fluid Dynamics CAD/CAM/CAE, Robotics, Animation, Image Processing and Computer Graphics. Lab fee: Level 4. Prerequisites: MA 515 and CS 313, or equivalents.

647 Numerical Grid Generation 3 hrs.
Introduction and applications, boundary conforming coordinate systems, computer representation of transformation relations, stretching and blending functions, algebraic and variational generation systems, Elliptic, Parabolic and Hyperbolic Generation Systems, conformal mapping and orthogonal grid generation strategies and comparisons. Develop algorithms associated with generation systems. Lab fee: Level 4. Prerequisite: CS 646 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 4. Prerequisite: CS 624.

651 Software Requirements & Design Methodologies 3 hrs.
Importance of early phases of software development, formal methods, computer-aided tools, methodology and tool assessment, rapid prototyping, requirements and design specifications. Lab fee: Level 4. Prerequisite: CS 650.

652 Software Testing and Reliability 3 hrs.
Goals of testing, testing methods, quality standards, automated testing tools, test planning, results evaluation, retesting, reliability models. Lab fee: Level 4. Prerequisite: CS 650.

653 Software Project Management and Quality Assurance 3 hrs.
Software life cycle, software risk reduction, software productivity, planning, organizing, directing and controlling software projects, software tools for cost estimation, configuration and data management, software quality and its impact upon development cycle, quality metrics. Lab fee: Level 4. Prerequisite: CS 650.

660 Large Scale Scientific Computing 3 hrs.
Advanced techniques to produce optimal algorithms for scientific and engineering applications. Vector Processing, Parallel Processing and efficient memory management techniques applied to large-scale linear full and sparse equations solvers. Sparse elimination and software for sparse matrix computations. Applications involving sparse matrices. Lab fee: Level 4. Prerequisites: MA 515 and CS 313 or equivalents.

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 4, Prerequisite: 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 4. Prerequisite: CS 586.

687 Data Base Systems 3 hrs.

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 4. Prerequisite: CS 617.
695-698 Selected Topics in Computer Science 3 hrs.
Courses in special topics requested by students. Prerequisite: approval of instructor.

699 Master's Thesis
Required each term student is working and receiving direction on master’s thesis. 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 4. 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 670 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 architectures. Lab fee: Level 4. Prerequisite: 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, and heuristic programming techniques. Class and individual projects to illustrate concepts. Lab fee: Level 5. 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 5. 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 5. Prerequisites: CS 642, CS 613.

750 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 4. Prerequisite: CS 650.
770 Supercomputing Applications in Fluid Dynamics 3 hrs.
Advanced numerical algorithms and their applications to complex fluid dynamics problems. Algorithmic strategies for efficient utilization of vectorizing compilers and multiple CPU architectures. Memory Management techniques and efficient Input/Output methodologies. Lab fee: Level 4. Prerequisites: CS 660 and ME 653.

780 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 4. Prerequisites: MA 585, CS 613.

787 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 4. Prerequisite: CS 687.

790 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 5. Prerequisite: CS 690.

795-798 Advanced Selected Topics 3 hrs.
Courses in special topics requested by students. Prerequisite: approval of instructor.

799 Doctoral Dissertation 3-6 hrs.
Required each term student is enrolled and receiving direction on doctoral dissertation. Maximum of 18 hours credit.
Materials Science

A Ph.D. degree, awarded jointly by the University of Alabama-Tuscaloosa (UA), the University of Alabama at Birmingham (UAB), and the University of Alabama in Huntsville (UAH) is available in Materials Science. All requirements can be completed on the UAH campus. The participating faculty from the UAH campus are in the departments of Biological Sciences, Chemistry, Electrical Engineering, Mechanical Engineering (including the Chemical Engineering and Civil Engineering programs), and Physics. The program faculty have a major interest in production of new materials, in the application of materials to the needs of technology, and in materials processing. These interests currently fall into the following general curricular areas which are designated as options for specialization:

1. Materials structure and properties
2. Macromolecular materials
3. Electronic, optical, and magnetic materials
4. Materials processing
5. Biomaterials
6. Mechanical behavior of materials

Students entering the program are expected to have strong, but diverse undergraduate training. They will typically have a bachelor's degree in chemistry, chemical engineering, materials science, materials engineering, mechanical engineering, or physics. Students with interest in materials science and engineering are encouraged to refer to the complete description of the Materials Sciences doctoral program contained in the Interdisciplinary Section of this catalog.
Mathematical Sciences

Degrees: Master of Arts
        Master of Science
        Doctor of Philosophy
Chair: P. M. Gibson, Professor, linear algebra, combinatorics.

Professors:
Chang, M.H.; probability, stochastic processes.
Hoomani, J.; combinatorics, statistics.
Lehnigk, S.H. (Adjunct); differential equations, special functions.
Slater, P.J.; graph theory, combinatorics.

Associate Professors:
Cook, F.L.; mathematical modeling, differential equations, orthogonal polynomials.
Dow, S.J.; combinatorics, geometry
Forte, A.; geometry, group theory, number theory.
Friedman, M.J.; numerical analysis, differential equations.
Howell, K.B.; elasticity theory, partial differential equations.
McNider, R.T.; numerical modeling, boundary layer dynamics.
Morales, C.H.; functional analysis, operator theory.
Siegrist, K.T.; probability, stochastic processes, reliability theory.

Assistant Professors:
Epperson, J.F.; numerical analysis, partial differential equations.
Fehribach, J.D.; partial differential equations, mathematical modeling.
Miller, T.L. (Adjunct); fluid dynamics, numerical modeling.
Reynolds, N.D. (Research); mathematical modeling, differential equations.
Vargas, J.G. (Research); Finsler geometry, relativity.
Welstead, S.T. (Adjunct); differential and integral equations.

The Mathematical Sciences Department offers programs leading to the Master of Arts and Master of Science degrees in mathematics and the Doctor of Philosophy degree in applied mathematics. The programs foster advanced mathematical education through closely integrated instruction and research. The concentration areas offered 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. Entering graduate students will have a variety of mathematical backgrounds and goals. Consequently, programs of study leading to the M.A., M.S., or Ph.D. degree can vary considerably. Applied mathematics is emphasized with concentrations available in ordinary and partial differential equations, combinatorics and graph theory, probability and statistic, and numerical analysis. Graduate students who wish to minor in areas such as computer science, physics, atmospheric science, optics or engineering are encouraged to do so.

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.

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Admission Requirements

In addition to fulfilling School of Graduate Studies admission requirements, all applicants for graduate study in mathematics or applied mathematics should have completed the equivalent of a complete calculus sequence, a linear algebra course, MA 440, MA 502, and six 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.

Masters of Arts and Master of Science

The Master of Arts and Master of Science degrees are conferred under Plan I or Plan II. Students should explore with their faculty advisor which plan is better for their particular objectives. For the M.S. degree, a program of study must include a minor area in the College of Engineering or the College of Science. All minors must be outside of Mathematics and must include at least six hours of approved graduate coursework. Master's programs that include a thesis (Plan I) require at least 24 hours of graduate coursework, and programs without a thesis (Plan II) require at least 33 hours of coursework. At least 50 percent of the coursework hours must be completed in courses numbered 600 or above.

Students should plan a program of study for the Master's degree with the help of a faculty advisor prior to the completion of 12 semester hours of coursework. Courses taken without an approved program of study may not apply toward a degree. Various areas of mathematics may be stressed in the program of study depending on the student's needs. The coursework for a non-thesis program of study concentrating in probability and statistics 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 numbered 600 or above; and the coursework for a non-thesis program of study concentrating in numerical analysis might be MA 515, 526, 544, 570, 614, 615, 626, 715, and three approved graduate courses, including at least two courses numbered 600 or above. Other possible concentration areas include differential equations and discrete mathematics.

Masters of Arts with Class A Teaching Certification

Teachers who hold the Alabama Class B Middle/Junior High or High School Certificate may pursue a program of study that leads to a Master of Arts degree with Alabama Class A Certification in mathematics. The coursework for such a program of study 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.

Individuals who are interested in obtaining a Master of Arts degree with Alabama Class A certification in mathematics, but who have not completed more that 12 semester hours in teacher education (graduate or undergraduate) courses, should consider the Non-Traditional Fifth Year Program. The MA and ST courses given in the preceding paragraph 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.
Doctor of Philosophy

The Ph.D degree program in applied mathematics is designed to enable students to master a significant body of mathematics, including a specialty in applied mathematics; to relate this knowledge to a coherent area of science or engineering other than mathematics; and to carry on fundamental research in applied mathematics. Students who are interested in the program should contact the graduate program director of the department at their earliest convenience.

Each program of study requires at least 54 semester hours of graduate coursework, and must include a major area of concentration consisting of at least six courses in addition to the four common core courses (see below), and a minor consisting of at least four related graduate courses in some area outside of the department. The major, minor, and other courses in the program of study must be selected so that the student will be prepared to conduct research in an area of applied mathematics.

Students must pass three examinations: the joint program examination, the comprehensive qualifying examination, and the final examination. The joint program examination is a written test of the student’s ability to successfully pursue a Ph.D. in applied mathematics. It covers a four course common core in real analysis (MA 653, 754) and linear and numerical linear algebra (MA 544, 614), and a two course sequence in one of several areas including discrete mathematics (MA 540, 640), partial differential equations (MA 526, 626), and probability and stochastic processes (MA 585, 685). The joint program examination can not be taken more than twice.

The comprehensive qualifying examination covers the entire program of study, and is administered by the student’s graduate study supervisory committee. It is part written and part oral. It can not be taken more than twice. Upon successful completion of the comprehensive qualifying examination and the foreign language requirement, the student is admitted to candidacy for the Ph.D. degree.

The final examination is an oral presentation of the dissertation in the form of a seminar before the student’s graduate study supervisory committee. The dissertation is evidence that the student can independently identify a problem of contemporary significance through familiarity with the current literature in some area of applied mathematics, organize and execute a program of research, recognize and analyze the results, and present then in cogent, well-written exposition. It must include mathematical results suitable for publication in a nationally recognized journal.

The foreign language requirement for the Ph.D. degree may be satisfied by completion of 12 semester hours in one of French, German, or Russian with an average grade of B or better, or by acceptable performance on the ETS Graduate School Foreign Language Test for one of these three languages.

The Ph.D. degree program in applied mathematics is a joint program with the other two campuses (Birmingham and Tuscaloosa) of the University of Alabama System. All requirements of the program can be completed at the University of Alabama in Huntsville. However, students are encouraged to spend time at the other two universities, and will be able to enroll in courses at UAH taught by visiting faculty from those institutions.

Undergraduate Mathematics Courses (MA)

<table>
<thead>
<tr>
<th>Course</th>
<th>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>
</tbody>
</table>
452 Introduction to Real Analysis (See MA 502) 3 hrs.
490 Selected Topics in Undergraduate Mathematics 1-3 hrs.

Graduate Mathematics Courses (MA)

502 Introduction to Real Analysis 3 hrs.
Sequences, limits, continuity, differentiation of functions of one real variable, Riemann integration, uniform convergence, sequences and series of functions, power series, and Taylor series. Prerequisite: MA 352 or 440 or approval of instructor.

515 Introduction to Numerical Analysis 3 hrs.
Numerical solution of ordinary differential equations, solution of linear and nonlinear algebraic systems, iterative methods in matrix algebra, error analysis, and convergence properties of selected methods. Lab fee: Level 4. Prerequisites: MA 244, 352, CS 108 or equivalent. MA 415 recommended before taking this course.

521 Introduction to Complex Analysis 3 hrs.
Complex algebra, analytic functions, Cauchy-Riemann equations, exponential, trigonometric, and logarithmic functions, integration, Cauchy integral theorem, Morera’s theorem, Liouville’s theorem, maximum modulus theorem, residue theory, Taylor and Laurent series, and applications. Prerequisite: MA 502 or approval of instructor.

525 Intermediate Differential Equations 3 hrs.
Systems of linear ordinary differential equations, first order systems with constant coefficients, plane autonomous systems, stability, and selected topics related to properties and characterization of solutions. Prerequisites: MA 244 and MA 352.

526 Partial Differential Equations I 3 hrs.
Systems of first order ordinary differential equations, first order quasilinear partial differential equations, general first order partial differential equation by Cauchy’s method of characteristics, higher-order equations, canonical forms, separation of variables, Fourier series, wave equation, heat equation, and potential equation. Prerequisites: MA 244 and MA 392.

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.

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 domains, fields, extension fields, elements of Galois theory. Prerequisite: MA 440 or approval of instructor.
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.

Functions of Several Variables 3 hrs.
Topology of $\mathbb{R}^n$, limits, continuity, and differentiation of functions of several real variables, Jacobians, implicit function and inverse function theorems, Riemann integration of functions of several real variables, and change of variables theorem for multiple integrals. Prerequisite: MA 502.

Metric Spaces with Applications 3 hrs.
Metric spaces, continuous functions, compactness, connectedness, completeness, Arzela-Ascoli theorem, Stone-Weierstrass theorem, Hilbert spaces, contraction mappings, applications to existence and uniqueness of solutions of differential and integral equations. Prerequisite: MA 502 and at least one other MA course at 500 level or above.

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.

Selected Topics in Mathematics 3 hrs.
Courses in requested selected topics.

Numerical Methods for Linear Algebra 3 hrs.
Norms and vector spaces, matrix factorizations and direct solution methods, stability and conditioning, iterative methods for large linear systems, the algebraic eigenvalue problem. Lab fee: Level 5. Prerequisites: MA 415 or 515, MA 544, CS 108 or equivalent.

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 5. Prerequisites: MA 415 or 515, MA 526, CS 108 or equivalent.

Asymptotics and Perturbation Methods 3 hrs.
Asymptotic series, regular and singular perturbation theory, asymptotic matching, Laplace's method, stationary phase, steepest descents, WKB theory. Prerequisites: MA 521, 525.

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.

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
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
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
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
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
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
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
Linear, polynomial and exponential graph theoretic algorithms, generating combinatorial objects, and NP-completeness. Prerequisite: MA 540.

652 Advanced Differential Equations
Approximate methods, oscillations and periodic solutions, stability and Liapunov theory, delay equations, and selected topics. Prerequisites: MA 502, 525.

653 Real Analysis I
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
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.
Offered upon demand. Advanced selected topics of interest in areas such as discrete mathematics, numerical analysis, differential equations, and stochastic processes.

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 nine hours credit awarded upon successful completion of the master's thesis.

Finite element methods for parabolic, elliptic, and hyperbolic partial differential equations; error analysis, stability, and convergence. Lab fee: Level 5. Prerequisites: MS 570, 615.

726 Theory of Partial Differential Equations 3 hrs.
Hilbert space theory of existence, uniqueness, and regularity for partial differential equations. Prerequisites: MA 526, 570.

754 Real Analysis II 3 hrs.
Differentiability of monotone functions, functions of bounded variation, absolute continuity, convex functions, Minkowski and Holder inequalities, Lp 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.
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.

Graduate Seminar 3 hrs.
Similar to MA 690 but conducted in a seminar format. Work is based largely on original memoirs and journal articles.

Doctoral Dissertation 3, 6, or 9 hrs.
Required each term a student is enrolled and receiving direction on his Ph.D. dissertation.

Statistics (ST)

Theory of Statistics I 3 hrs.
Distribution of statistics based on ordered samples, asymptotic sampling distributions, maximum likelihood, least squares, and other methods of point estimation, Rao-Blackwell theorem and Cramer-Rao inequality, confidence intervals, regions, and their optimal properties. Neyman-Pearson formulation and tests of simple hypothesis against simple alternatives. Prerequisites: MA 244, 585.

Special Topics in Statistics 3 hrs.
Courses in requested special topics. Prerequisite: Approval of Instructor.

Theory of Statistics II 3 hrs.
Continuation of hypothesis testing, likelihood ratio and unbiased tests, uniformly most powerful tests, power function, nonparametric tests, statistical decision theory, distribution and linear models. Prerequisite: ST 687.
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.
Emslie, A.G.; theoretical physics, solar physics.
Horwitz, J. L.; ionospheric and magnetospheric physics.
Rosenberger, F.E.; chemical physics, fluid dynamics of materials processing.
Smalley, L. L.; theoretical physics, general relativity.
Stuhlinger, E. (Adjunct); space physics.
Sung, C.C.; theoretical physics, solid state.
Tandberg-Hanssen, E. A.; (Adjunct); astrophysics, solar physics.
Torr, D.G. (Research); 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.
Fennelly, A. J. (Adjunct); theoretical physics, optics gravitation physics.
Guenther, K.H. (Adjunct); thin film physics, optical coatings, surface analysis.
Paciesas, W.S. (Research); X-ray and gamma-ray astronomy.
Torbert, R.B. experimental plasma physics and optics.

Assistant Professors
Chipman, R.A.; polarimetry, optical testing, optical design.
Stone, N. H. (Adjunct); solar physics, magnetospheric physics.

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, solid state physics and superconductivity.
3. Optics/quantum electronics including studies of laser physics, propagation, laser media and materials, optical properties of matter and electromagnetic scattering.
Admission Requirements

Besides meeting the requirements established by the School of Graduate Studies for advanced degrees, the Physics Department requires the advanced portion of the GRE for unconditional admission.

Master of Science

The final exam for the M.S. degree is the Comprehensive Exam which is offered once every year, early in the spring quarter. This exam serves both as the preliminary examination for the Ph.D. program and the final exam for the M.S. degree. Details of the exam are available in the department office. Course work during the first one and a half years should be taken with the Comprehensive Exam in mind. A recommended schedule of courses for students entering UAH without previous graduate studies is given in the table below. A total of 24 credit hours in graduate courses plus a thesis is required for students under Plan I and 33 credit hours for the Plan II M.S. degree. All M.S. students are required to take two quarters of PH 792. (Physics Seminar.)

Typical Program for First 1.5 Years Leading to Comprehensive Exam

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>607</td>
<td>609</td>
<td>631</td>
<td>732</td>
</tr>
<tr>
<td>551</td>
<td>552</td>
<td>601</td>
<td>621</td>
</tr>
</tbody>
</table>

Second Year

<table>
<thead>
<tr>
<th>Spec. Top. 1*</th>
<th>Spec. Top. 2*</th>
</tr>
</thead>
<tbody>
<tr>
<td>622</td>
<td>Elective</td>
</tr>
</tbody>
</table>

*In this context the term Special Topic refers to courses taken in preparation for the Special Topic section of the Physics Department's Comprehensive Exam. For example: students wishing to be examined in Optics should take PH 541 and PH 542, while those wishing to be examined in Solid State Physics should take PH 560 and PH 561. Students should consult with their advisor regarding the selection of Special Topic courses.

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, who have not taken more than 12 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 the student's advisory committee. Transfer of credit from other insti-
tutions 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 Ser­
vice. 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 the instructor or department
chair for auditors or students with equivalent experience. A partial listing of undergraduate
courses appears below. (See general UAH Undergraduate Catalog for complete description.)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>Intermediate Mechanics I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>302</td>
<td>Intermediate Mechanics II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>310</td>
<td>Intermediate Laboratory I</td>
<td>1 hr.</td>
</tr>
<tr>
<td>311</td>
<td>Intermediate Laboratory II</td>
<td>1 hr.</td>
</tr>
<tr>
<td>312</td>
<td>Intermediate Laboratory III</td>
<td>1 hr.</td>
</tr>
<tr>
<td>321</td>
<td>Thermal and Statistical Physics I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>322</td>
<td>Thermal and Statistical Physics II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>337</td>
<td>Electronics</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>342</td>
<td>Intermediate Optic I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>343</td>
<td>Intermediate Optic II</td>
<td>3 hrs.</td>
</tr>
<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>
</tr>
<tr>
<td>451</td>
<td>Quantum Physics I</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>452</td>
<td>Quantum Physics II</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

Graduate Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>506</td>
<td>Introduction to Astrophysics of Stellar Systems</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

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.
531 Introduction to Plasma dynamics 3 hrs.
Plasma kinetic theory including charged-particle and neutral collision, ionization, electronic excitation and recombination, motion of charged particles, macroscopic equations. Transport coefficients, gas discharges, instabilities, sheaths, electromagnetic waves. Prerequisites: PH 322, 432. Fall.

541 Optics I 3 hrs.
Geometric optics review. Physical optics; interference, diffraction, partial coherence, polarization, interaction of radiation with matter. Prerequisite: PH 432 or equivalent. (Same as EE 461 and EE 541). Fall.

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 461 and 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. (Same as OPT 446).

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, 451, 442. (Same as OPT 444).

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. (Same as OPT 444).

551 Introductory Quantum Mechanics I 3 hrs.
This is course one of a two course sequence. Wave-particle duality and uncertainty principle, basic postulates of quantum mechanics, the Schrodinger wave equation, simple systems in one, two and three dimensions, matrix formulation of quantum mechanics, angular momentum and spin, addition of angular momentum, time independent perturbation theory, variational method and WKB approximation, time dependent perturbation theory, scattering theory, the interaction of electromagnetic radiation with atomic system; Quantum statistics, the band theory of electrons in crystals. Prerequisites: PH 302, 432, 452. (Same as CH 553) Fall.

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.
Crystal binding and crystal structure, crystal structure determination, phonons and lattice vibrations, free electron gas, electronic energy band theory. Prerequisite: PH 551 or equivalent. Fall.
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. Winter.

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.

621 Statistical Mechanics and Kinetic Theory I 3 hrs.
Statistical methods, systems of particles, statistical thermodynamics, applications of thermodynamics, methods of statistical mechanics, applications of statistical mechanics, equilibrium between phases of chemical species. Prerequisites: PH 552, MA 521. Summer.

622 Statistical Mechanics and Kinetic Theory II 3 hrs.
Quantum statistics of ideal gases, systems of interacting particles, magnetism and low temperatures, elementary transport theory, advanced transport theory, irreversible processes and fluctuations. Prerequisite: PH 621. Fall.

631 Electromagnetic Theory I 3 hrs.
Electrostatic and magnetostatic fields in vacuum and material matter, conservation laws, homogeneous wave equations. Prerequisites: PH 432, 607, MA 521. Spring.

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.

639 Experimental Plasma Physics and Instrumentation 3 hrs.
Techniques and instruments for plasma diagnostics, probe theory, optical, spectroscopic, radio and radar measurements, discrete particle analyzers, interactions of spacecraft and instruments with the plasma environment. Prerequisites: PH 531, 631.

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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>672</td>
<td>Optical Surface Characterization</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Types of optical surfaces, surface and scattering measurements and measurement equipment, scattering theories, micro-irregularities, optical surface characterization, surface absorption and thick films. Prerequisite: PH 542.</td>
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<tr>
<td>673</td>
<td>Fourier Optics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Diffraction theory, Fourier transforms, Fraunhofer and Fresnel diffraction, Fourier transform properties of lenses, angular spectrum coherence theory, spatial filtering, optical information processing, holography. Prerequisite: PH 542.</td>
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<tr>
<td>684</td>
<td>Aeronomy I—Photochemistry</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Neutral atmospheric composition and thermal structure, solar flux and absorption processes, photochemistry of the mesosphere, thermosphere, ionosphere, aurora and airglow. Prerequisites: PH 551, 622.</td>
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</tr>
<tr>
<td>687</td>
<td>Aeronomy 2—Dynamics and Energetics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Transport processes in the mesosphere, thermosphere and ionosphere—ambipolar diffusion, neutral dynamics and electric field effects, high latitude ionosphere and polar wind, thermospheric energetics, thermal balance-sources and sinks of heat, heating efficiencies, energy balance equations, global thermospheric energy budget, modeling of the neutral atmosphere. Prerequisite: PH 684.</td>
<td></td>
</tr>
<tr>
<td>689</td>
<td>Selected Topics</td>
<td>3</td>
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<tr>
<td></td>
<td>Offered upon demand. Previous topics: superconductivity, optical properties of solids in infrared, laser propagation, collision theory, quantum electronics, and microwave properties of solids.</td>
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</tr>
<tr>
<td>699</td>
<td>Master's Thesis</td>
<td>3</td>
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<tr>
<td></td>
<td>Minimum of two terms required for M.S. students. Maximum of nine hours credit awarded upon successful completion of master's thesis.</td>
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<tr>
<td>702</td>
<td>Classical Dynamics II</td>
<td>3</td>
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<tr>
<td></td>
<td>Continuation of PH 601. Review Lagrangian and Hamiltonian dynamics, canonical transformation, Hamilton-Jacobi theory, Lagrangian field theory, selected topics. Prerequisite: PH 601.</td>
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<tr>
<td>705</td>
<td>Relativity</td>
<td>3</td>
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<td></td>
<td>Special and general theory. A covariant formulation of electro-dynamics. Prerequisites: PH 601, 631.</td>
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<tr>
<td>706</td>
<td>Solar Flare Physics</td>
<td>3</td>
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<tr>
<td></td>
<td>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. Prerequisites: PH 531, 631.</td>
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</tr>
<tr>
<td>711</td>
<td>Problems in Physics I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Application of theoretical principles of physics to an intensive analysis and solution of representative problems. Prerequisites: PH552, 601, 622, 631.</td>
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</tr>
<tr>
<td>712</td>
<td>Problems in Physics II</td>
<td>3</td>
</tr>
<tr>
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<td>Continuation of PH 711. Prerequisite: PH 711.</td>
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</tbody>
</table>
731 Advanced Plasma Theory 3 hrs.
Kinetic theory of plasmas. Vlasov equation of plasma waves, Landau damping and kinetic theory of stability, quasi-linear and non-linear theory, transport theory in plasmas, applications to space plasmas, plasma astrophysics and fusion research. Prerequisites: PH 531, 732.

732 Electromagnetic Theory II 3 hrs.
Continuation of PH 631. Inhomogeneous wave equation and sources. Special relativity, radiation from accelerated charges, and Hamiltonian formulation of electrodynamics. Prerequisite: PH 631. Summer.

745 Quantum Electronics 3 hrs.
The propagation of optical beams in homogeneous and lenslike media, optical resonators, interaction between radiation and atomic systems, laser oscillations and specific laser systems, q-switching and mode locking of lasers, noise in laser amplifiers and oscillators, modulation of optical radiation. Prerequisites: PH 545, 552, 631.

746 Non-Linear Optics 3 hrs.
Non-linear optical susceptibilities, wave propagation in nonlinear media, second harmonic generation, parametric amplification and fluorescence, stimulated Raman and Brillouin scattering, two photon absorption, optical bistability, phase conjugation, four wave mixing. Prerequisites: PH 542, 551, 631.

751 Quantum Mechanics I 3 hrs.
This is course one of a three course sequence. General formulation of the quantum theory, angular momentum and spin, steady state perturbation, time dependent perturbation theory, identical particles, symmetry principles, tensor operators, interaction of radiation with matter, formal scattering theory, relativistic wave equations, second quantization, interaction fields, quantum electrodynamics, Feynman techniques. Prerequisites: PH 552, 601, 609.

752 Quantum Mechanics II 3 hrs.
Continuation of PH 751. Prerequisite: PH751.

753 Quantum Mechanics III 3 hrs.
Continuation of PH 751 and 752. Relativistic wave equations, second quantization, interacting fields, Feynman techniques. Prerequisite: PH 752.

760 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.

761 Quantum Theory of Solids II 3 hrs.
Continuation of PH 760. Selected topics from quantum theory of solid state physics including many-body technique, transport properties, optical properties, superconductivity. Prerequisites: PH 752, 760.
773 Fourier Optics II 3 hrs.
Review of diffraction theory and Fourier transforms, fast Fourier transforms, analytic signals, wavefront aberrations and the aberration polynomial, diffraction patterns and diffraction images, sampling theorem and band limited signals. Prerequisite: PH 673.

780-789 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.

792 Physics Seminar No credit
Student reports on journal articles or individual research. Prerequisite: PH552. Two terms required for M.S. students.

795 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.

799 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, atmospheric science, materials and computational fluid dynamics. Other areas under development include robotics, and space plasma. Inquiries about these interdisciplinary programs should be addressed to the Dean of the School of Graduate Studies.

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
- Mathematical Sciences
- Physics

A proposal to offer the Ph.D. degree in Atmospheric Science is presently being reviewed by the Alabama Commission on Higher Education for implementation in the fall of 1989.

Students choose atmospheric specializations and research projects in specific areas of atmospheric science and engineering. In addition, students must meet departmental degree requirements.

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
- Mathematical Sciences
Mechanical Engineering
Physics

Students choose specializations and research projects in specific areas of optics. In addition, students must satisfy departmental degree requirements.

**Computational Fluid Dynamics**

Research and instruction in the area of Computational Fluid Dynamics (CFD) have been underway at UAH for many years. Pioneering work in the Finite Element Method established its roots at UAH in the early 1960’s. Current activities blend finite difference and finite element methods with research in numerical grid generation, algorithm development and advanced computing to create an active computational environment. Much of this active research is in support of NASA’s Marshall Space Flight Center and the Army Missile Command, both located at the Redstone Arsenal in Huntsville. The scope of this work ranges from the analysis of external flows over guided missiles to the internal flows of the Space Shuttle main engines. The design and analysis of propulsion systems has been a focus of both UAH and the Huntsville technical community for many years and much of the ongoing research is in support of rocket engines. Research potential exists in virtually all phases of fluid dynamics ranging from incompressible subsonic to compressible hypersonic flows.

As Computational Fluid Dynamics continues to mature as a discipline, it is becoming more apparent that an interdisciplinary approach is required for the solution of these complex problems. The modeling and description of physical phenomena, innovative mathematical approaches, and the generation of new computing architectures and algorithms all contribute to the problem solution. The proper combination of these disciplines will give the student emphasizing CFD the tools needed to address the next generation of problems. With this as an underlying theme, the interdisciplinary program in CFD was created. The synergism developed through the cooperation of the departments of Computer Science, Mechanical Engineering, and Mathematical Sciences, form a program which is academically strong and yet flexible enough to accommodate students with diverse backgrounds.

A student interested in pursuing the Master of Science or the Doctor of Philosophy degree with a specialization in Computational Fluid Dynamics must first affiliate with one of the following departments:

- Computer Science
- Mathematical Sciences
- Mechanical Engineering

Furthermore, a student takes a four-course core consisting of

a. MA 615
b. ME 653
c. CS 646

and one course chosen with the assistance of an advisor from

d. CS 647
e. MA 626
f. ME 654

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After completing the core courses, a student may follow one of the tracks listed below and must satisfy the degree requirements as delineated in the Graduate Catalog under the particular department. The student’s program will include a part or all of the courses listed here depending on the degree:

<table>
<thead>
<tr>
<th>Supercomputer Applications</th>
<th>Applied Mathematics</th>
<th>Computational Fluid Dynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 590</td>
<td>CS 660</td>
<td>CS 660</td>
</tr>
<tr>
<td>CS 647</td>
<td>CS 770</td>
<td>CS 770</td>
</tr>
<tr>
<td>CS 660</td>
<td>MA 614</td>
<td>MA 715</td>
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<tr>
<td>CS 770</td>
<td>MA 626</td>
<td>ME 654</td>
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<tr>
<td>MA 715</td>
<td>MA 670</td>
<td>ME 655</td>
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<td>ME 655</td>
<td>MA 715</td>
<td>ME 750</td>
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<td>ME 726</td>
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<td></td>
<td>ME 654</td>
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</table>

**Materials Science**

Degree: Doctor of Philosophy awarded jointly by the University of Alabama-Tuscaloosa (UA), the University of Alabama at Birmingham (UAB), and the University of Alabama in Huntsville (UAH).

**UAH Program Director:** S.P. McManus, Professor (Chemistry); microgravity synthesis and processing of polymers; reactivity of polymers; medium effects.

**University Professor:**
Anderson, E.E. (Physics); experimental solid state physics, magnetic and optical materials.

**Professors:**
Baird, J.K. (Chemistry); theory of Ostwald ripening, electron transport, radiation effects.
Cost, T.L. (Mechanical Engineering); composite materials, viscoelastic behavior, fracture mechanics.
Gilbert, J.A. (Mechanical Engineering); holointerferometric measurements of thermal deformation.
Gregory, J.C. (Chemistry); interaction of atomic oxygen and high energy particles with surfaces and bulk materials.
Harris, J.M. (Chemistry); reactions and applications of polymers; microgravity science and processing.
Loo, B.H. (Chemistry); surface enhanced Raman spectroscopy, electrochemistry.
Riley, C. (Chemistry); laser photochemistry; electroplating in low gravity.
Rosenberger, F.E. (Physics); crystal growth; microgravity science.
Sung, C.C. (Physics); theoretical solid state physics, optics.

**Research Professor:**
Fredericks, W.J. (Chemistry); crystal growth, light scattering.
Associate Professors:

Emerson, M.T. (Chemistry); x-ray crystallography.
Ho, F.D. (Electrical and Computer Engineering); electronics, materials in computers and integrated circuits.
Meehan, E.J., Jr. (Chemistry); crystal growth of proteins; x-ray crystallography of protein single crystals.
Smith, J.E. (Mechanical Engineering); materials processing.
Young, R. (Biological Sciences); bioprocessing of materials.

Assistant Professors:

Bower, M.V. (Mechanical Engineering); applied mechanics, engineering applications of polymers and composites.
Setzer, W.N. (Chemistry); nmr and X-ray conformational analysis of novel organic compounds.
Thomas, D.L. (Mechanical Engineering); electrochemical processing.

Assistant Research Professor:

Kaukler, W.F. (Chemistry); microgravity processing.

Adjunct Faculty

More than 40 faculty members from UAB and UA make up the Adjunct Faculty. Each is an expert in at least one area of science, engineering, or medicine.

The Materials Science Program

The study of materials is concerned with the generation and application of knowledge relating to the chemical composition, micro- and macro-structure, uses and properties (chemical, physical, and mechanical), and processing of materials. The broad discipline which deals with materials includes both science and engineering. On the side of the science of materials we find the application of biology, biochemistry, chemistry, and physics. The relevant engineering discipline, in particular ceramic, chemical, mechanical, and metallurgical, may generally be more interested in processing and assessing properties. However, there is considerable overlap as scientists become interested in uses and as engineers become interested in modifications that may enhance value. Hence, materials science or materials engineering disciplines may overlap.

The program is novel in that the three University of Alabama System campuses offer a joint doctoral program without a Materials Science department on any campus. Instead, faculty from several departments constitute the program faculty. The overall program is governed by a committee of faculty members from the three campuses. The program is administer locally by the Material Science Program Committee which is chaired by the UAH Program Director. Participating faculty are from the departments of Chemical Engineering, Chemistry, Engineering Mechanics, Metallurgical Engineering, Mineral Engineering, and Physics at UA, from the departments of Biochemistry, Biomedical Engineering, Biomaterials, Chemistry, Materials Engineering, Optometry, Physics, and the School of Medicine at UAB, and from the departments of Biological Sciences, Chemistry, Electrical Engineering, Mechanical Engineering, and Physics at UAH. Although science and engineering faculty par-
ticipate, the program deals with the science of materials and leads to a Ph.D. degree in Materials Science with a diploma issued jointly by all three universities. The Program places special emphasis on production of new materials, on the application of materials to the needs of technology, and on materials processing.

Students entering the program are expected to have strong, but diverse, undergraduate training. They will typically have bachelor’s degrees in chemistry, chemical engineering, materials science, materials engineering, mechanical engineering, or physics. Owing to the differences in undergraduate concentration, students will have different basic knowledge in the field of materials science. We have structured our multidisciplinary curriculum to correct for these differences and to provide depth in a specialty area.

The faculties of each campus will build on their individual research strengths in providing options for students to pursue. These strengths currently fall into the following general curricular areas which we designate as options for specialization:

1. Materials structure and properties
2. Macromolecular materials
3. Electronic, optical, and magnetic materials
4. Materials processing
5. Biomaterials
6. Mechanical behavior of materials

Admission Requirements
In order to be unconditionally admitted to the doctoral program, a student must have satisfied the following set of minimum requirements common to all three universities.
1. A bachelor’s degree or its equivalent from an accredited college or university in engineering or one of the physical sciences;
2. A minimum B level scholarship overall or over the last 60 semester hours of undergraduate credit;
3. A minimum score of 1100 on the verbal and quantitative section of the Graduate Record Aptitude Test;
4. TOEFL score greater than 550 in case of international students; and
5. Provide letters of reference.

An applicant whose scholastic record reveals a deficiency in one of the first three categories above may, upon recommendation of the UAH Program Director and approval of Graduate Dean, be admitted on a conditional basis as provided in the Graduate School regulations. The student must then follow the Graduate School’s policies in achieving unconditional admission status before completing Program Exam I.

Degree Requirements
Qualifying, Comprehensive and Other Program Examinations. Program Exam I is a four-part examination of the program’s core material and qualifies the student to enter the advanced program. The four parts are:
I. Structure and Analysis of Materials
II. Condensed Matter Science
III. Thermodynamics and Kinetics
IV. Structure, Processing and Properties

The exam is administered simultaneously System-wide by the Tricampus Coordinating Committee at preannounced dates. Students who do not pass all four parts must retake the parts failed at the next scheduled date. Program Exam II is a comprehensive examination covering material in the student’s specialization area. This examination is normally taken
near the end of the formal coursework state. Program Exam III is the final examination and is largely the student’s defense of the dissertation. Program Exams II and III are prepared, administered and graded by the student’s Graduate Supervisory Committee.

Coursework Requirements
Forty-eight credit hours of graduate-level coursework and twenty-four credit hours in activity related to the dissertation are required.

Candidacy and Dissertation Requirements
Admission to candidacy for the doctoral degree will be contingent upon the successful completion of Program Exam II, satisfaction of the foreign language requirement, and the successful presentation of a dissertation research proposal. Normally, a student will be considered eligible to take Program Exam II when all of the required coursework has been completed. After being admitted to candidacy, the student must then complete the remaining requirements for the degree, with the principal remaining requirement involving the doctoral research and dissertation.

Foreign Language Requirement
Each student is required to demonstrate reading proficiency in a foreign language, extensively used in the materials science field, which is not the native tongue of the student. Competency will be established by an examination which consists of the student translating (with dictionary) a research article, chosen by the student’s Graduate Supervisory Committee. The pass/fail determination will be made by the student’s Graduate Supervisory Committee with assistance from an appropriate Foreign Language faculty member.

Residence Requirement
The minimum period in which the doctoral degree can be earned is three full academic years of graduate study. The student must spend the last or penultimate academic year in continuous residence as a full-time graduate at one of the campuses.

Time Limits
All requirements for the doctoral degree must be completed within a period of six years after the completion of Program Exam II. Credits earned towards a Master’s or Ed.S. degree may be applied to the doctoral degree provided that they are applicable to the area of specialization or to the core. Dated credits may be accepted if recommended by a student’s supervisory committee, the UAH Program Committee, and approved by the Graduate School. For application toward this degree, the student may be required to demonstrate competence in the dated coursework.

Advisement
Students admitted into the program will be assisted in program planning and other academic matters by a temporary faculty advisor appointed by the Program Director. Also, for administrative reasons, upon being accepted in the program, students will be assigned to one of the participating departments as their temporary “home” department. They may apply for an assistantship and if awarded, the teaching or research duties would normally be assigned in that department by the department chair. A student may select a dissertation research project in a participating department other than the temporary home department. If the research project is acceptable to the UAH Materials Science Program Committee, a permanent advisor (normally the research supervisor selected by the student) will be assigned.
A Graduate Supervisory Committee will be appointed for the student as soon as the student passes Program Exam I and chooses a research project. This committee will normally include the research advisor as chairperson and at least four other members. The graduate committee members will be selected based on the student’s academic interest and areas of research. At least one of the committee members will be from the student’s research area at one of the other cooperating universities and another will be from a department other than the home department on the home campus. The graduate committee is charged with supervision and approval of the student’s research and course of study toward the completion of all requirements leading to the award of the degree.

Graduate Courses in Materials Science (MTS)

Since the Materials Science program is interdisciplinary, most of the courses are offered through the participating departments. Thus, students are directed to the course listings in the departments of Biological Sciences, Chemistry, Electrical and Computer Engineering, Mechanical Engineering, and Physics. In addition, the courses listed below are offered for students in the program.

**MTS 501 Introduction to Materials Science**  
3 hrs.  
This course addresses the relationship between the structure and properties of materials, the factors controlling the internal structure of solids, and the processes for altering the structure and properties of solids. Metals, ceramics, polymers, and composites are considered, and methods for analysis and characterization of materials are reviewed. Perquisite: ME 294 or equivalent and senior- or graduate-level standing.

**MTS 780 Materials Science Seminar**  
1 hr.  
Required of doctoral students during each term of residence.

**MTS 799 Doctoral Dissertation**  
3, 6, or 9 hrs.  
Required each term student is enrolled and receiving direction on a doctoral dissertation.
The University of Alabama

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Fourth
Fifth
Sixth
Seventh

O. H. Delchamps, Jr., Mobile, 1994
Aaron M. Aronov, Montgomery, 1992
Winton M. Blount, Montgomery, 1989
(Ye a tta G. Samf ord, Jr., Opelika, 1990
Cleophus Thomas, Jr., Anniston, 1993
Garry Neil Drummond, Jasper, 1992
John T. Oliver, Jr., Jasper, 1989
Martha H. Simms, Huntsville, 1993
Frank H. Bromberg, Jr., Birmingham, 1992
Thomas E. Rast, Birmingham, 1989
Sandral Hullett, M.D., Eutaw, 1989
George S. Shirley, Tuscaloosa, 1993
Cordell Wynn, Tuscaloosa, 1991

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James L. Sumner, Jr., Assistant to the Chancellor for State Relations

Executive Administration
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Academic Affairs
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for Research

School of Graduate Studies
Samuel P. McManus, B.S. M.S., Ph.D. ................................. Dean
Graduate Faculty

(Date refers to original appointment to the university; asterisk designates full membership in the Graduate Faculty.)

ABUSHAGUR, MUSTAFA A. G., B.S. (Tripoli University, Tripoli, Libya), M.S., Ph.D. (California Institute of Technology). Assistant Professor of Electrical and Computer Engineering, 1984.*


AMIN, ASHOK T., B.E., M.S. (University of Baroda, India), M.S., (University of Tennessee), Ph.D. (Northwestern University), Associate Professor of Computer Science, 1984.*

ANDERSON, ELMER E., A.B. (Occidental College), M.S. (University of Illinois), Ph.D. (University of Maryland). University Professor of Physics, 1979.*

AUDEH, NADEEM F., B.S. (South Dakota State College), M.S., Ph.D. (Iowa State University). Professor of Electrical Engineering, 1964.*

BAIRD, JAMES K., B.S. (Yale University), M.A., Ph.D. (Harvard University). Chairman of Department of Chemistry and Professor of Chemistry, 1982.*

BARR, THOMAS A., B.S. (University of Chattanooga), M.S., Ph.D. (Vanderbilt University). Research Professor of Physics, 1982.*

BARTELL, FREDERICK O., A.B. (University of California), M.S., Ph.D. (University of Arizona). Associate Professor of Physics, 1983.*


BENEDICT, SUSAN B., B.S.N. (Villa Maria College, Erie, PA), M.S.N. (University of Alabama Huntsville), D.S.N. (University of Alabama, Birmingham). Assistant Professor of Nursing, 1984.*

BIGGS, ALBERT W., B.S. (Washington University), M.S. (Stanford University), Ph.D. (University of Washington). Professor of Electrical and Engineering, 1984.*

BILLINGS, C. DAVID, B.S. (Southwest Missouri State University), Ph.D (University of Missouri at Columbia). Professor of Finance, 1981.*

BOND, MARGARET S., L.L.B. (University of Poitiers), S.J.D. (University of Paris). Professor of Economics, 1964.*

BOSWORTH, EDWARD, B.A. (University of the South), Master of Divinity (Episcopal Divinity School), M.S. (University of Alabama, Huntsville), Ph.D., (Vanderbilt University). Assistant Professor of Computer Science, 1984.


BOWER, MARK V., B.S.E., M.S.E., Ph.D. (University of Michigan). Assistant Professor of Mechanical Engineering, 1984.*
BRAINERD, JEROME, J., B.S., M.S. (University of Notre Dame), Ph.D. (Cornell University), P.E. Associate Professor of Mechanical Engineering, 1965.


BROWN, ROBERT A., B.S. (U.S. Naval Academy), M.S., Ph.D. (Ohio State University), P.E. Professor of Industrial and Systems Engineering, 1967.*

BRYSON, ROSCOE E., Jr., B.B.A. (Memphis State University), M.B.A., Ph.D. (Georgia State University), C.P.A. Associate Professor of Accounting, 1976.*

BURGE, JANET MARIE, R.N. (Hendrick Memorial Hospital), B.S. (Hardin-Simmons University), M.N. (Emory University), Ph.D. (University of Florida). Director of Graduate Program and Professor of Nursing, 1980.*

BURGER, KENNETH J. B.S. (North Dakota State University), M.B.A. (Kent State University), Ph.D. (University of Kentucky). Assistant Professor of Marketing, 1986.*

CAMPBELL, C. WARREN B.S. (University of Alabama), M.S., (University of Alabama in Huntsville), Ph.D., (Colorado State University), Adjunct Assistant Professor of Mechanical Engineering, 1987.

CAMPBELL, P. SAMUEL, B.S. (Marietta College), M.S. (Ohio University), Ph.D. (Purdue University). Professor of Biological Sciences, 1973.*

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## Department Chairs

The University of Alabama in Huntsville  
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