1996

1996-1998 Graduate Catalog

The University of Alabama in Huntsville

Follow this and additional works at: https://louis.uah.edu/catalogs
The University of Alabama in Huntsville is committed to equal opportunity in employment and education. The University does not discriminate in any program or activity on the basis of race, color, religion, sex, age, or national origin, or against any qualified individual with a disability/handicap, and it maintains an affirmative action program for protected minorities and women.

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

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

Calendar ................................................................. 3
General Information .................................................. 6
Student Information .................................................. 10
Graduate Admissions Information ............................... 22
Financial Information ............................................... 26
Academic Information ............................................... 32
School of Graduate Studies ........................................ 40
Interdisciplinary Programs ........................................ 49
College of Administrative Science .............................. 61
College of Engineering ............................................. 79
College of Liberal Arts .............................................. 120
College of Nursing ................................................... 147
College of Science ................................................... 154
Division of Continuing Education ......................... 202
Board of Trustees .................................................... 205
Administration ....................................................... 206
Faculty ................................................................. 207
Index ................................................................. 223

Printed in Canada
Fall Semester 1996

August 16
Beginning of academic year
August 16
Faculty Convocation/New Faculty Orientation
August 16,19,20
Registration
August 21
First day of classes
August 24
First Saturday class
September 2
Labor Day holiday
October 10-11
Fall break - no classes
November 27, 28, 29
Thanksgiving holidays - no classes
December 2
Last M/W and MWF class
December 3
Last T/R class
December 3
Last Tuesday evening only class*
December 4
Last Wednesday evening only class*
December 4
Weather day
December 7
Study day
December 9
Last Saturday class
December 12
Last Monday evening only class*
December 6, 9, 10, 11, 12, 13
Last Thursday evening only class*
December 23, 24, 25, 26, 27, 30, 31
Examinations

Winter break

*One day a week classes meet 15 times with the last class being the final examination.

Spring Semester 1997

January 1
New Year's holiday
January 6, 7
Registration
January 8
Classes begin
January 11
First Saturday class
January 20
Martin Luther King Jr. holiday
March 31, April 1, 2, 3, 4
Spring break - no classes
April 5
No Saturday classes
April 21
Last MWF class
April 22
Last T/R class
April 23
Last Wednesday evening only class*
April 23
Last M/W class
April 24
Last Thursday evening only class*
April 24
Weather day
April 25
Study day
April 26
Last Saturday class
April 28, 29, 30, May 1, 2, 5
Examinations
April 29
Last Tuesday evening only class*
May 5
Last Monday evening only class*
May 18
Commencement

*One day a week classes meet 15 times with the last class being the final examination.
**ACADEMIC CALENDAR 1996-97**

**Summer 1997**

- May 15
- May 19 - June 30
- May 26
- June 2 - August 11
- July 4
- July 7 - August 15
- July 1-2
- August 12
- August 13-15
- August 18-19

**Registration**
- 1st 6-week session
- Memorial Day holiday
- 10-week session
- Independence Day holiday
- 2nd 6-week session
- Examinations, 1st 6-week session
- Study day - 10-week session
- Examinations, 10-week session
- Examinations, 2nd 6-week session

**PROPOSED ACADEMIC CALENDAR 1997-98**

**Fall Semester 1997**

- August 25
- August 26
- August 27
- August 28
- August 30
- September 1
- October 9-10
- November 26, 27, 28
- December 9
- December 9
- December 10
- December 11
- December 15
- December 17
- December 18
- December 12, 15, 16, 17, 18, 19
- December 23, 24, 25, 26, 29, 30, 31

**Beginning of academic year**
- Registration
- Faculty Convocation/New Faculty Orientation
- Classes begin
- First Saturday class
- Labor Day holiday
- Fall break - no classes
- Thanksgiving holidays - no classes
- Last T/R class
- Last Tuesday evening only class*
- Last M/W, MWF class
- Study day
- Last Monday evening only class*
- Last Wednesday evening only class*
- Last Thursday evening only class*
- Examinations

**Winter break**
PROPOSED ACADEMIC CALENDAR 1997-98

Spring Semester 1998

January 1
January 12
January 14
January 17
January 19
March 30, 31, April 1, 2, 3
April 4
April 25
April 27
April 28
April 29
April 30
May 1
May 5
May 11
May 4, 5, 6, 7, 8, 11
May 17

New Year’s holiday
Registration
Classes begin
First Saturday class
Martin Luther King Jr. holiday
Spring break - no classes
No Saturday classes
Last Saturday class
Last MWF class
Last T/R class
Last M/W class
Last Wednesday evening only class*
Last Thursday evening only class*
Study day
Last Tuesday evening only class*
Last Monday evening only class*
Examinations
Commencement

*One day a week classes meet 15 times with the last class being the final examination.

Summer 1998

May 14
May 18 - June 29
May 25
June 1 - August 10
July 3
July 6 - August 14
August 11
June 30 - July 1
August 12-14
August 17-18

Registration
1st 6-week session
Memorial Day holiday
10-week session
Independence Day holiday
2nd 6-week session
Study day - 10-week session
Examinations, 1st 6-week session
Examinations, 10-week session
Examinations, 2nd 6-week session
Mission of the University of Alabama in Huntsville

The University of Alabama in Huntsville (UAH) is an autonomous campus of The University of Alabama System dedicated to excellence in teaching, research, and service. UAH is a key participant in one of the nation's major international centers for advanced technological research and utilizes its position in this environment to provide unique opportunities and creative programs for students, faculty, and the community. UAH is committed to maintaining a diverse academic community of the highest quality, and to providing an environment that facilitates intellectual, cultural, personal, and professional growth. UAH fosters leadership, creative and critical thinking, clear communication, a respect for knowledge and the pursuit of truth, and an engagement in the challenge and pleasure of a lifetime of learning. UAH, through its graduates and its programs, contributes to economic advancement, health care, cultural enrichment, and the quality of life of the region, state, and nation.

History

The University of Alabama in Huntsville (UAH) is a part of the University of Alabama System. In June 1969, the University of Alabama Board of Trustees established the University of Alabama System with three independent, autonomous campuses at Huntsville, Birmingham, and Tuscaloosa. Each campus has a separate president who reports to the Board of Trustees through the chancellor of the system. Academic programs were initiated in Huntsville in 1950; in 1963 degree opportunities at the master's level were provided and in 1964, at the baccalaureate level. The first master's degree based on work begun and completed in Huntsville was awarded in 1964 and the first undergraduate degrees in 1968. Doctoral programs were initiated in physics and engineering in 1971, and the School of Nursing was established the same year. In 1974, in a component of the Alabama School of Medicine, the first full-time medical students began their core clinical experience in Huntsville. (These programs were transferred to direct UAB management in 1995.) In the two decades of the 1970s and 1980s, UAH implemented a broad range of undergraduate degree programs; established master's programs in the liberal arts, nursing, and administrative science; initiated professional degree programs at both the graduate and undergraduate levels; and inaugurated selected Ph.D. programs in high-technology fields in the sciences and engineering.

UAH is focused to meet the specific needs of scientific and technological enterprises and the cultural and intellectual needs of a rapidly expanding region. It is UAH's 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.
Accreditation

The University of Alabama in Huntsville is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award bachelor’s, master’s, and doctoral degrees.

Several UAH programs are accredited by their respective accrediting agencies. Academic programs in chemistry are accredited by the American Chemical Society. Six undergraduate engineering programs (chemical, civil, computer, electrical, industrial and systems, and mechanical) are accredited by the Accreditation Board for Engineering and Technology (ABET). Both undergraduate and graduate programs in nursing are accredited by the National League of Nursing (NLN). Computer science holds accreditation from the Computer Sciences Accreditation Board (CSAB). Programs in music and music education are accredited by the National Association of Schools of Music (NASM). Both the Bachelor of Science in Business Administration program and the Master of Science in Management program offered by the College of Administrative Science are accredited by the American Assembly of Collegiate Schools of Business (AACSB).

Facilities

The 354-acre UAH campus is in northwest Huntsville adjacent to Cummings Research Park. The University has 31 major buildings, including the Central Campus Residence Hall and the nine-building Southeast Campus Housing Complex, all of which have been constructed since 1960. The buildings contain modern equipment and exemplify modern functional design.

Morton Hall, which is the oldest building on campus, houses classrooms, computer laboratories, and offices for the Dean and several of the departments in the College of Liberal Arts. It also houses the offices of Multicultural Affairs, the Institute for Science Education, the Honors Program, and International Education.

Wilson Hall contains classrooms, computer laboratories and instructional laboratories for programs in biological, environmental, and physical sciences as well as offices for the Department of Biological Sciences. The Division of Continuing Education also has offices, classrooms, and computer laboratories in the building to support its programs.

The Kenneth E. Johnson Research Center contains research laboratories and offices for that Center, the Alabama Solar Energy Center, and the Office of Environmental Health and Safety.

Madison Hall contains executive administrative offices, classrooms, and the Department of Mathematical Sciences.

The Research Institute contains offices for Research Administration, and offices and research laboratories for the Center for Microgravity & Materials Research. Additionally, it houses the University's mainframe computer facility and the Information Services Department.

The Engineering Building contains classrooms, computer laboratories, and instructional and research laboratories as well as offices for the Dean and the various engineering departments that comprise the College of Engineering. It also houses the Center for Space Plasma and Aeronomics Research (CSPAR) and the Center for Automation and Robotics.

The Materials Science Building contains offices, classrooms, and state of the art research laboratories for programs in chemistry and materials science, as well as administrative offices for the Dean of the College of Science and the Dean of the School of Graduate Studies. It also has a 350-seat auditorium/lecture hall.

The Optics Building is a four-story building designed and constructed for research and graduate studies in the field of applied optics. The building contains research laboratories, clean rooms, meeting rooms, and offices for the Center for Applied Optics and the Department of Physics.

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

The Frances C. Roberts Hall, a two-unit complex, contains classrooms, laboratories, and offices for the art, history, and music departments in the College of Liberal Arts. The Humanities Center is located here, and there is a large auditorium/lecture room for varied university programs.

The College of Nursing Building is a contemporary triangular structure that houses the College of Nursing. Its four levels contain administration and faculty offices, classrooms, a auditorium, laboratories and service areas, and a large and well equipped Learning Resources Center.

The modern Administrative Science Building contains classrooms, computer laboratories, and offices for the Dean and the departments of the College of Administrative Science. This well designed teaching facility also has a large auditorium/lecture hall and several student lounge areas. The Office of Instructional and Testing Services is also housed in this building.

The Computer Science Building is located across Sparkman Drive and contains offices and computer classrooms and laboratories for the Computer Science Department as well as computer classrooms for the Division of Continuing Education.

Alumni House contains the offices of alumni affairs, development, university relations and special events of the Office of University Advancement.

Marion Beirne Spragins Hall has classrooms and offices for Health and Physical Education and Athletic Department faculty and staff, a gymnasium with a seating capacity of 2800, a swimming pool, racquetball courts, and other physical education and recreational facilities.

The Central Receiving and Shipping Building houses the shipping and receiving office and storage facility, the central mail room, and telephone services.

The Physical Plant Building contains offices, shops, and storage areas for the Facilities and Operations Department, which include administrative offices, custodial services, public safety facilities, maintenance, grounds maintenance services, stockroom and the University motor vehicle pool.

The Tom Bevill Center has 100 hotel rooms, a restaurant, offices for the U.S. Army Corps of Engineers Training Division, meeting rooms, and computer laboratories. It also has sophisticated audio-visual systems, computer networking, links to Huntsville's super computer and easy access to other facilities on campus and in the nearby Cummings Research Park.

The WLRH Radio Station facility is located on the south end of the University campus and houses public radio station WLRH-FM. The University leases the facility to the Alabama Educational Television Commission but has no involvement in the operation of the radio station.

The Printing Services Building houses Printing Services and provides offices, darkrooms, print shop, and other special facilities to meet the University’s printing needs.

Library

The UAH Library supports the academic and research programs of the University. It has a collection of 412,571 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 some 2,766 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 351,967 volumes and 6,596 journal subscriptions along with more than 1.9 million research reports make it one of the finest scientific libraries in the southeast. It is available without charge to faculty members and grad-
UAH students of the University. Reciprocal borrowing agreements are also in force with Alabama A&M University, the University of Alabama, UAB, and Auburn University to allow UAH students free access to those libraries.

The library is also a member of several consortia that are designed to make available research materials not owned by libraries in north Alabama. Its membership in OCLC and the Network of Alabama Academic Libraries facilitates rapid document delivery/interlibrary loan service to faculty and students without charge.

Library services, including study rooms, orientations for classes, and on-line bibliographic database searching, assist faculty and students in their research. The library catalog is available on-line through Internet. Guides and handouts detailing individual services of the library are available without charge at the library's reference desk.

The University Noojin House

Built in 1950 as the private residence of F. Kenneth Noojin, the house became available to the community through acquisition by the University of Alabama Huntsville Foundation, which in turn gave the facility to the University. The house is available for receptions, conferences, luncheons, parties, and workshops. The faculty, staff, students and community are encouraged to utilize this gracious facility.
Student Affairs

The Division of Student Affairs provides services to individual students that facilitate the student's attainment of academic, cultural, social and personal goals. It also coordinates and supports group activities and campus events that enhance the quality of student life at the University. The Division of Student Affairs also supports Student Government Association activities and programs, as well as interprets and administers the Student Judicial Code, which protects student rights and assists students in their awareness of student responsibilities. These student needs and interests are served by the university center, housing, athletics, club sports, student life, auxiliary services, career services, intramurals, student development programs and leadership training.

Tutoring Services

Tutoring services are available in academic subjects such as: mathematics, English, chemistry, foreign languages, history, computer science, physics, accounting, biological sciences, and engineering. Contact the Student Development Services Office, located in the University Center, Room 113. Services are free to all UAH students. Students desiring to tutor or receive help may call 890-6203 for information or make application at UC 113.

Mathematics Lab

The mathematics lab is available for students who need tutorial help in MA 004, 033, 105, 117, 119, 121, 143, and 145. Located in Madison Hall, Room 207, the mathematics lab is staffed 20 hours every week by graduate teaching assistants.

Calculus Workshop

For students enrolled in more advanced mathematics classes, the Calculus Workshop provides enrichment and experience working together in groups to solve challenging problems in calculus. It is located in Madison Hall, Room 207.

Writing Center

The Writing Center, located in Morton Hall, is designed to increase opportunities for student-centered learning through peer tutoring. Students work one-on-one and in small groups to help each other understand college-level assignments; plan, organize, revise, and edit papers; prepare oral presentations; and develop critical thinking skills. The Writing Center is open to all students. For more information, call 890-6592.
Counseling Services

Personal counseling is available to all UAH students through the Student Development Services Office. In keeping with accepted professional practice, all counseling is confidential. No information is released to University officials, faculty, parents or outside agencies without the explicit written authorization of the student, except when such information is required by law. Students may be referred by faculty or staff members or they may contact the Student Development Services office directly at 890-6203.

Services for Students with Disabilities

The Student Development Services Office provides a professional counselor for students with disabilities.

Services offered to students with disabilities include: priority registration during advance registration periods, classroom accommodations, assistance locating note-takers and readers, ordering textbooks on tape, counseling, auxiliary equipment, assistance during orientation, liaison to UAH faculty, free tutors for most subjects, liaison to Admissions, Housing and Financial Aid Offices, UAH accessibility guide and maps, and liaison to community resources.

In addition, the staff provides educational “Awareness” programs for students, faculty and staff as well as inservice faculty training on accommodating students with disabilities.

Before enrolling, students with disabilities must contact this office so that preparation can be made in advance to provide assistance needed. Official documentation of stated disability is required. Appointments may be made in person or by calling the SDS office, Room 113, University Center, voice/TDD 890-6203.

Multicultural Affairs

The Office of Multicultural Affairs assists the University in providing an atmosphere that is welcoming, supportive and rewarding as students prepare to become responsible adults. Students are encouraged to achieve and aided in attaining academic excellence while learning to be competitive with their peers. OMA endeavors to foster an understanding and a respect for cultural diversity throughout the UAH community. Programs are designed for minority as well as non-minority students in order to promote a sense of community and an acceptance of multiculturalism and racial tolerance on the UAH campus. Students may contact the Office of Multicultural Affairs in Morton Hall, Room 220, or telephone (205) 890-6822.

UAH Wellness Center

Currently enrolled UAH students with valid ID’s, may be seen for minor illnesses and injuries on an appointment basis at the Wellness Center located in the University Center, Room 203.

Basic services are fee-based; however, laboratory costs will be billed to the student at a modest charge. The Wellness Center is open Monday through Friday 8:00 a.m. to 4:45 p.m. The telephone number is 890-6775.

Career Services

The Office of Career Services provides students valuable resources throughout all aspects of the career development process. Career development includes self assessment (discovering personal interests, values and abilities), career exploration (applying self-assessment to career choices and exploring options), and job search (developing the skills to conduct a successful job search).

To help students and graduates discover both their individual abilities, interests and values and relate these factors to relevant career choices and college majors, Career Services offers several assessment tools. FOCUS, a computer assisted career guidance system, allows students to determine individual values, skills, and interests. FOCUS also contains information
concerning occupational and educational programs. One unique feature of FOCUS is that it provides information regarding careers that closely match the student's personal preferences. Another option is the COPSystem. This comprehensive, written inventory is comprised of three parts: Values, Abilities, and Interests. It is designed to increase self-awareness and facilitate connecting personal preferences with appropriate career choices. The Strong Interest Inventory compares the student's similarities and dissimilarities with those of persons currently employed in specific career fields. In addition to career assessment and individual career counseling, the office also teaches a Career Exploration (ED 111) class twice each year. Career Services encourages students to start exploring possibilities early in their college tenure.

Career exploration resources are available in the Career Resource Center, including reference books, videos, articles, and other occupational information. In addition, the Career Resource Center houses numerous books on job search issues, salary information, company literature, employer directories, and graduate school information. The Job Location and Development (JLD) program provides part-time employment referrals to currently enrolled students. Gaining work experience while in school can be a big advantage upon graduation. The annual Fall and Spring Career Fairs offer an excellent exploration tool, as potential future employers talk with students about their companies, profession, and the types of employees they hire.

A student credential file facilitates the job search process. Each senior, degree-seeking graduate student, and UAH alumni who registers with the office establishes a credential file. The file includes 10 resumes, an authorization form and a candidate registration form. Register with OCS at least 9 months prior to graduation. Participants receive a monthly newsletter which provides current employment trends, job search tips, and the monthly on-campus interview schedule. Registered individuals have access to the Resume Referral program, the full-time employment opportunities listings, and on-campus interviews. Held in conjunction with the Fall and Spring Career Fairs, Job Fairs provide the opportunity for students to interview with companies one-on-one in pre-scheduled interviews. Other job search resources include workshops conducted each semester on Resume Writing, Interviewing Skills, and Job Search Strategies, in addition to individual appointments on these issues.

The Office of Career Services seeks to provide students and alumni the knowledge to make informed career choices and the personal skills to reach their career objectives. Students may make appointments by contacting the Office of Career Services, 212 University Center, 890-6612, between 8:15 a.m. and 5:00 p.m. Monday through Friday.

University Housing

The University of Alabama in Huntsville offers a variety of housing facilities to meet the needs of its diverse student population. All first-year and sophomore students under 21 years of age who apply for University housing are assigned to the Central Campus Residence Hall, which opened in the fall of 1991. This seven-story traditional residence hall in the center of campus is connected to the University Center by an enclosed walkway. It is close to the library, the gym, and to classrooms for liberal arts, nursing, administrative science, and natural sciences. Each CCRH resident has an air-conditioned, carpeted private room in a four-person suite and shares a bathroom with one other suitemate. Suites are furnished with a mini-kitchen (small refrigerator, microwave oven, and sink), study table and chairs, small sofa, and easy chairs. Each student room has an extra-long twin bed, a wardrobe, a desk, a bookshelf, and a three-position study chair. Rooms for disabled students are available. Access to the building is by electronic access card. Laundry facilities, a recreation room, a study room, and mail service are available in the hall. The “bridge” to the University Center provides all-weather access to the cafeteria, a convenience store, the game room, the bookstore, and various student activities, offices, and meeting rooms.

Southeast Housing consists of a cluster of nine three-story buildings located on South Loop Road near Madison Hall and most engineering and science classrooms. Both double-occupan-
cy (shared) and single (private) rooms in three-bedroom suites are available in Southeast Campus Housing for upperclass students and graduate students. In addition, one-bedroom private apartments are available for graduate students and married couples without children. Several of the one-bedroom apartments are accessible to disabled students. Some unfurnished units are available.

Each three-bedroom suite in Southeast Housing has a living room, full kitchen with refrigerator, range, oven and sink, dining area, and double bathroom with an adjoining vanity area. The units are air-conditioned, carpeted and are furnished with a loveseat, lounge chairs, end tables, and a dining table and chairs. Bedrooms have extra-long twin beds, study desks and chairs, nightstands, and a built-in closet. Some unfurnished units are available. All Southeast Campus Housing residents have the use of a laundry room with coin operated washers and dryers and a pay telephone, a mailroom, and a study lounge. Ample parking is available in the large lot east of the residences. A sandpit volleyball court in the center of the Southeast complex and grassy fields surrounding the area provide recreational spaces for residents.

Central Campus Residence Hall has a Resident Director and, on each floor, a student Resident Advisor (RA); Southeast Campus is staffed with a team of RAs. These staff members and RAs develop activities and programs, provide assistance to student residents, and help create a residential community that contributes to effective student learning, personal and social growth, and responsibility.

Anyone admitted as a student to UAH is eligible for University Housing. A Housing Application Packet is mailed to every student who applies for admission. Final housing assignments are contingent upon confirmation of admission; assignment priority is based upon academic class standing (first year student, graduate student, etc.) and the date of receipt of the application and housing deposit. All single students sign a nine-month academic year housing lease (August-May); housing charges are due when tuition is due each academic semester. Summer housing for single students is available in the Southeast area (not in CCRH) under a separate summer lease. The lease for family and graduate student apartments is for twelve months (late August through mid-August) and rent payments are due monthly.

Current rates, and additional information are all available from the Housing Office, 606-A South Loop Road (205)890-6108. Individual and group tours of UAH Housing may be arranged by appointment through the Admissions Office.

Preschool Learning Center

There is an on-campus preschool provided by the University Preschool Parents Association to accommodate 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 837-9553 for information.

The University Center

The University Center is a part of the co-curricular educational program of the University and is a focal point of the campus. Designed for the entire campus community, it offers facilities and programs to meet the intellectual, social, recreational, and cultural needs of students, faculty, staff, alumni, and the entire Huntsville community.

The facility offers meeting rooms, a dining room, a cafeteria, lounges, a game room, TV viewing rooms, an information desk, an art gallery, and the University Bookstore.

The offices of the Vice-President for Student Affairs, the Student Government Association, Association for Campus Entertainment, the Exponent, Admissions and Records, Financial Aid,
Academic Advisement, Co-op, Career Services, Student Activities, Student Development Services and the Bursar are also located in the University Center.

Student Identification Cards
All students must have a valid photo I.D. for the semester in order to use the library, to participate in student elections, athletic events, and all functions for which a student may be entitled to special privileges. Photo I.D. cards are issued once and only need to be validated each semester enrolled. Validation is done at the University Center, Information Desk. Photo I.D. cards are made on the lower level of the University Center during announced hours.

Information Desk
In addition to having general campus information, the information desk sells a variety of items. The university community may pick-up or purchase tickets for campus events, or receive directions to campus or community points.

Lounges
Two well lit, spacious lounges, designed as a place to relax and meet friends, are equipped with comfortable furniture.

Game Room
Located in the lower level of the Center, the game room has pool tables and ping-pong tables as well as a wide variety of pinball machines and video games. A large number of board games are also available. Two TV lounges, with cable TV, are located in the game room.

Meeting Rooms
The Center has up to 13 meeting rooms designed for multipurpose functions. The rooms can accommodate meetings from 10 to 500 people. The Center has a large number of tables, chairs, portable stage and audio-visual equipment and can assist in designing set-up to make any conference or meeting a success.

University Bookstore
Located on the lower level in the University Center, the University Bookstore is a full-service college bookstore operating for the needs and convenience of the UAH Community. The University Bookstore provides required and supplemental textbooks, a large selection of technical and reference books, various study aids, and educationally priced software. The bookstore also buys used texts from students during the store hours year round. In addition to these services, the bookstore will special order any book in print.

In the University Bookstore, students can find UAH Campus sportswear, UAH insignia gifts, cards, imprinted notebooks, a wide variety of school supplies, calculators, and a choice of Artcarved or Josten's class rings.

University Food Service
A helpful and friendly staff provides customers of the University Cafeteria with a variety of hot entrees, grilled fare, and deli sandwiches. Also provided is a diverse convenience store located within the cafeteria. A spacious dining area is available for all guests and a more formal dining area, located behind the cafeteria, is available for luncheon buffets and catered dinners. The Food Service will cater to all areas of the Center as well as other parts of the campus. Additionally, several types of meal plans are available for purchase by students, faculty, and staff. Cafeteria hours of operation are posted outside the cafeteria entrance.

Activities
The Student Activities office offers a wide variety of activities in which students may become involved. The advisor to the sororities and fraternities and the Association for Campus Entertainment is located in this office. The Student Activities office organizes activities for students and their families such as Family Night Out and College Bowl Program. The Student Activities office also maintains a complete listing of clubs and organizations.
Student Government Association (SGA)

The Student Government Association promotes the welfare of students in all areas of University life. Its primary purpose is to help improve the educational environment. This includes promoting academic innovation and working closely with faculty and administration toward making desirable changes in institutional policies.

The SGA is responsible for developing and sponsoring programs which will enrich the student's cultural, intellectual, and social life. Each student enrolled in UAH is automatically a member of the SGA. An executive branch, a fifteen member legislature, and a five member arbitration board are responsible for carrying out the official business of the organization.

The association sponsors over ninety clubs and organizations across campus in addition to providing many student services such as health insurance, special rates for community cultural events, and a student directory.

Association for Campus Entertainment (ACE)

The Association for Campus Entertainment presents student activity programs for UAH through its activity boards. The purpose of ACE is to provide entertainment and to enhance the cultural, intellectual and social life of students.

ACE also provides the students with a telephone information service known as "The Source," which can be reached at 890-6666.

Cabaret

The ACE Cabaret Series presents various types of live performers to UAH, from comedians to magicians. Past entertainers have included Paula Poundstone, Renee Hicks, Del Suggs, The Spencers, and Dan LaRosa.

Cabaret operates "Mom's"- UAH's only nightclub. Each Thursday night, Mom's provides live entertainment, a selection of coffees, soft drinks, and assorted chips for just $1.00. Mom's is located in Room 146 of the University Center-just look for the stained glass window.

Film and Video

The Film Series presents weekend movies, "The Rocky Horror Picture Show", outdoor movies, and film festivals. Previous movies have included "Pulp Fiction", "While You Were Sleeping," and "Powder."

Lectures

The ACE Lecture Series helps bring together the academic and social environments within the University, presenting speakers on the serious issues of today. The Lecture Series also brings stars and speakers from popular television shows and motion pictures. Past guests have included Billy West (voice of Ren & Stimpy), Barry Williams (Greg Brady), Fusion Dance Group (performing in 1996 Olympics Openings), and Brent Staples (editorialist for The New York Times).

Publicity

The Publicity and Promotions Director informs potential audiences of all programs that the other ACE Activity Boards are bringing to campus through the Source Hotline and quarterly ACE calendars that are distributed across campus. Radio, television, and printed materials are all utilized in the effort to publicize ACE programs.

Special Events

The Special Events Committee is responsible for planning annual events such as Homecoming, Octoberfest, and Springfest, which is the culmination of a year's activities. Additionally, monthly events include Human Foosball, Virtual Reality, and Murder Mysteries On Campus.
Student Organizations

UAH has more than ninety special-interest organizations and clubs. For a complete listing, see the student organization booklet available at the University Center Information Desk.

Greeks

Interfraternity Council (IFC)
IFC serves as the governing body of the six fraternities at UAH in order to develop cooperation and coordination of activities among the member fraternities. The six national social fraternities on campus are Alpha Phi Alpha, Alpha Tau Omega, Delta Chi, Kappa Alpha Psi, Pi Kappa Alpha and Sigma Nu. For more information contact the Interfraternity Council Advisor at 890-6445.

Panhellenic Council (Panhel)
The Panhellenic Council is the organization which coordinates sorority activities at UAH. The five social sororities available to young women at UAH are Alpha Kappa Alpha, Chi Omega, Delta Sigma Theta, Delta Zeta, and Kappa Delta. For more information contact the Panhellenic Advisor at 890-6445.

Academic Honor Societies

Alpha Epsilon Delta (Pre-Health)
The UAH chapter of Alpha Epsilon Delta, the national pre-health professional honor society, was established on campus in the fall of 1978 and was chartered in the spring of 1979. Membership in Alpha Epsilon Delta is an honor bestowed in recognition of superior scholarship achievement and affords the student an opportunity to develop initiative, leadership, and self education by participating in the activities of the chapter.

Alpha Kappa Delta (Sociology)
The Epsilon of Alabama chapter of Alpha Kappa Delta was chartered by the National Sociology Honorary Society in the Spring of 1976. Membership in AKD is limited to students who have maintained a high standard of excellence in their courses of study in sociology and who show serious interest in this academic field. The candidate for membership in the chapter must be a junior with an overall GPA of 3.0, must maintain a 3.0 GPA in sociology courses taken at UAH, and must have completed at least 4 regular courses in sociology prior to initiation.

Alpha Lambda Delta (Freshman)
The UAH chapter of Alpha Lambda Delta, national scholastic honor society for freshmen, was installed in the fall of 1974. The purposes of the society are to encourage superior scholarship attainment among students in their first year in institutions of higher education, to promote intelligent being and a continued high standard of learning, and to assist students in recognizing and developing meaningful goals for their roles in society. To become a member, a student must earn a scholastic average of 3.5 during the first and second semester of enrollment.

Alpha Pi Mu (Industrial Engineering)
The national honor society for industrial engineers, Alpha Pi Mu was founded at the Georgia Institute of Technology in 1959 to recognize industrial engineering students of distinguished scholarship.

Beta Alpha Psi (Accounting)
The society encourages and recognizes scholastic and professional excellence in the field of accounting.
Beta Gamma Sigma (Business or Management)

Founded as a national organization in 1913, membership in this society is the highest national recognition a student can receive in an undergraduate or master’s program in business or management accredited by the American Assembly of Collegiate Schools of Business. To be eligible, a student must rank in the upper seven percent of the junior class, upper ten percent of the senior class, or upper twenty percent of the graduating master’s class. Members are elected to membership. The mission of the organization is to encourage and honor high academic achievement and personal excellence in the study and practice of business.

Eta Kappa Nu (Electrical Engineering)

The Theta Eta (UAH) Chapter of Eta Kappa Nu was chartered on April 29, 1978. The objectives of Eta Kappa Nu are to honor those students in electrical engineering who have excelled in scholarship, leadership, and exemplary character and to unify them with graduates and faculty who have attained prominence in the field of electrical engineering. Membership is open by chapter invitation only to graduates, faculty, professionals, juniors in the top fourth of the electrical engineering class, and seniors in the top third of the electrical engineering class.

Omicron Delta Kappa (Leadership)

The purpose of the Omicron Delta Kappa Society is to recognize individuals who have attained a high degree of leadership in collegiate and related activities, to encourage them to continue along this line, and to inspire others to strive for similar conspicuous attainment; to bring together representative individuals in all phases of collegiate life and thus create an organization which will help mold the sentiment of the institution on questions of local and intercollegiate interest; and to bring together members of the faculty and student body of the institution on a basis of mutual interest, understanding, and helpfulness.

Phi Alpha Theta (History)

UAH has a chapter of Phi Alpha Theta, international history honorary society. Membership is open by invitation only to students who have completed a minimum of 12 hours in history with a grade point average of 3.5 and an overall average of 3.0 in all courses.

Phi Kappa Phi (Multi-discipline)

The primary objective of the national honor society of Phi Kappa Phi is the recognition and encouragement of superior scholarship in all academic disciplines. The society is convinced that in recognizing and honoring those persons of good character who have excelled in scholarship in whatever field, it will stimulate others to espouse excellence. The society promotes an atmosphere conducive to academic excellence.

Phi Sigma Iota (Foreign Language)

Phi Sigma Iota recognizes outstanding ability and high standards in the field of foreign languages, literatures, and cultures, including classics, linguistics, philology, comparative literature, bilingual education, and other related areas. It promotes international communication and understanding, and a sentiment of amity among nations. Membership is open by nomination to any UAH student who is at least a junior; has a B average overall, as well as in foreign languages; has completed at least one foreign language course at the 300 level; is enrolled at UAH at the time of being offered membership; and who plan to take at least two 300 level courses in foreign languages.

Pi Sigma Alpha (Political Science)

Pi Sigma Alpha is the national honorary society for political science students with junior standing having a minimum of ten semester hours and a B average or higher in political science courses.
Pi Tau Sigma (Mechanical Engineering)

Pi Tau Sigma is the national Mechanical Engineering Honor Society. The purposes of Pi Tau Sigma are to foster the high ideals of the engineering profession, to stimulate interest in departmental activities, to promote the mutual professional welfare of its members, and to develop in students of mechanical engineering the attributes necessary for effective leadership. Eligibility extends to the top quarter of the juniors and the top third of the seniors in mechanical engineering.

Psi Chi (Psychology)

Psi Chi is a national recognition society for students in the field of psychology. The purposes of Psi Chi are to encourage, stimulate, and maintain scholarship of the individual members in all fields, particularly in psychology, and to advance the science of psychology. To achieve these goals Psi Chi offers a wide range of programs at the local, regional, and national levels. The requirements for admission are a 3.0 overall grade-point average and a 3.0 in psychology, and 12 hours of psychology for a minor or 15 hours for a major.

Sigma Pi Sigma (Physics)

The Sigma Pi Sigma honorary society operates within the Society of Physics Students. Membership is based on general scholarship. An overall GPA of 2.75 and a GPA of 3.2 in at least 5 courses in physics are required for membership in Sigma Pi Sigma.

Sigma Tau Delta (English)

The UAH chapter of Sigma Tau Delta, a national English honorary society, is Upsilon Mu. Its purposes are to assist in developing, maintaining, and promoting literary and educational activities for students and alumni of the chapter, as well as the entire University and civic community. Membership is open by chapter invitation only to English majors and minors of junior standing who have a 3.0 grade-point average.

Sigma Theta Tau (Nursing)

Sigma Theta Tau is the international honor society of nursing. The purposes of Sigma Theta Tau include the recognition of superior achievement and leadership qualities, the fostering of high professional standards and creative work, and the strengthening of the individual’s commitment to the ideals and purposes of the nursing profession. Invitation to membership may be extended to junior and senior nursing students who have completed at least one-half of the required nursing component with a grade point average of 3.0. Graduate students in nursing who have completed one-fourth of the required graduate curriculum may be eligible for membership with a grade point average of 3.3.

Society of Sigma XI (Science Research)

Sigma XI, founded in 1886, is a scientific honor society which was organized to reward excellence in scientific research by graduates, undergraduates and faculty researchers and to encourage a sense of cooperation among scientists in all fields.

Tau Beta Pi (National Engineering Honor Society)

The Tau Beta Pi Association was founded at Lehigh University in 1885 to mark in a fitting manner those who have conferred honor upon their alma mater by distinguished scholarship and exemplary character as students in engineering, or by their attainments as alumni in the field of engineering, and to foster a spirit of liberal culture in engineering colleges. Scholastic requirements include: class standing of the top eighth of the junior class or the top fifth of the senior class and demonstration of exemplary character.

Upsilon Pi Epsilon (Computer Science)

The Computer Science Honor Society is for both graduates and undergraduates.
Art Programs and Exhibitions
The Department of Art and Art History sponsors exhibitions and activities throughout the year which are important to the cultural growth and enrichment of campus life at UAH. Students and faculty are welcomed and encouraged to participate in and contribute to these worthwhile opportunities.

The UAH Galleries of Art
The Art Department organizes exhibitions and events in two galleries on the UAH campus. The Old Church Gallery, located just west of the University Center, and the University Center Art Gallery, located off the main lobby of the UC, provide opportunities for the University and Huntsville communities to view the work of local, regional, and nationally recognized artists. The exhibitions change monthly and offer a wide range of artistic perspectives.

The Annual Student Exhibition
Each spring the Art Department sponsors an exhibition, juried by the faculty, dedicated solely to showcasing the work and talents of UAH students. Any student enrolled in the University is eligible to participate.

The Faculty Exhibition
During the Spring Semester, visitors to the UC Gallery have an opportunity to study the outstanding work recently produced by UAH's own studio faculty members.

The Visiting Artist Program
This program offers opportunities for the public to meet, listen, and talk with the artists exhibiting their work in the UAH galleries. Presentations by distinguished artists visiting the campus often include studio and classroom sessions as well as public lectures.

The UAH Southeastern Student Biennial Exhibition
This exhibition, juried by noted artists or art professionals, is open to all college art students in the southeastern United States, undergraduate and graduate. This is a unique opportunity for students to see excellent work being done by up and coming young artists in the region.

Music Organizations
All musical organizations are open to all students, music and non-music majors. Students should be able to make a place for themselves in some performing group, regardless of musical background and tastes. Credit is offered for most ensemble experience, and participation may be repeated with approval of the conductor.

UAH Choral Organizations
The Concert Choir, the Chamber Choir, and the Tenor-Bass Chorale perform choral literature of the great masters of music history as well as folk music of various countries. Admission is by audition with the conductor and attendance at all rehearsals and performances is required.

Huntsville Symphony Orchestra
The Huntsville Symphony Orchestra, a semiprofessional blend of University and community talent, prepares nine formal concerts each year. International artists perform with each annual concert series. Audition with conductor is required. Attendance at rehearsals and performances is also required.

UAH Jazz Ensemble
A workshop experience providing students with instruction in jazz arranging and composition and in improvised jazz is stressed. Attendance at rehearsals and performances is required. Audition with instructor is also required.
UAH Wind Ensemble

A select group of experienced musicians who perform the best available music literature for wind ensemble and concert band. Attendance at all rehearsals and concerts is required. An audition with the conductor is also required.

UAH Pep Band

The Pep Band is a musical organization of students that promotes spirit and enthusiasm at a variety of athletic events. Members and scholarship recipients are chosen by audition and may elect to enroll in the group for class credit.

Intercollegiate Athletics

UAH is an NCAA Division II school and a member of the Gulf South Conference. The athletic department sponsors intercollegiate sports with the goal of providing the student-athlete with the opportunity to compete intercollegiately within a structured sporting environment that enhances personal growth and development in parallel with institutional goals. UAH offers ice hockey, basketball, baseball, soccer, cross country, and tennis for men, and basketball, softball, volleyball, cross country, and tennis for women. Club teams are offered in other sports.

Baseball (Men)

Baseball was added as an intercollegiate sport to UAH athletics in the spring of 1996. All home games are played at Joe Davis Stadium in Huntsville, the home of the Huntsville Stars, the AA affiliate of the Oakland A’s organization. The Gulf South Conference is nationally known as a premier conference for baseball.

Basketball (Men and Women)

The NCAA Division II tournaments are a season highlight, along with the Mayor's Cup Classic against cross-town rival Alabama A&M University. The winner of the Mayor's Cup claims the city's basketball boasting rights for a year. All home games are played on campus in Spragins Hall.

Cross Country (Men and Women)

While running is basically an individual sport, cross country at UAH is founded on a philosophy of team effort and spirit. The team hosts an annual invitational competition.

Hockey (Men)

UAH is the “Hockey Capital of the South,” building a very strong hockey program with local players as well as skaters from points north. The Chargers hosted the NCAA Division II Championship in 1996 at the Von Braun Civic Center, the site of all home games, and won the national championship.

Soccer (Men and Women)

The soccer teams attract players from around the world. Matches are played on Charger Field located on the UAH campus.

Softball (Women)

Spring 1996 saw the addition of women’s softball to UAH varsity sports. Home games are played at the Kiwanis Metro Sports Complex in Huntsville. As a member of the Gulf South Conference, competition is always on a quality level.

Tennis (Men and Women)

The Charger tennis programs provide an opportunity for competition at both singles and doubles levels. Home matches are played on campus next to Spragins Hall.
Volleyball (Women)
The volleyball team has been a consistent leader in Gulf South Conference competition. The program annually hosts a tournament on campus which attracts many outstanding teams.

Cheerleading (Men and Women)
The UAH cheerleading squads are composed of students whose primary purpose is to promote spirit and enthusiasm for intercollegiate athletics. Try-outs are conducted for any interested students.

Mascot
The UAH mascot, Charger Blue, brings recognition to the University through appearances at athletic and community events throughout the calendar year.

Intramural Sports Program
The intramural sports program serves the recreational needs of UAH students through a planned program of intramural athletics and other forms of recreational activities. It provides opportunities for the development of positive attitudes toward recreational activities throughout life, thus deriving optimum benefits of enjoyment, health, social contacts, and sportsmanship. The philosophy of intramural activities at UAH is based on the concept that students should have freedom of choice and responsibility for sharing in planning, supervising, and administering the program.

All students and members of the faculty and staff are eligible to participate in intramural activities. The sports offered include basketball, 3 on 3 basketball, flag football, floor hockey, racquetball, indoor soccer, 6 pac soccer, softball, tennis, volleyball, 4 on 4 volleyball, and weightlifting.

Student Publications
The Exponent is the UAH student newspaper. The paper is published weekly except during exams and holidays. The Exponent office is located in Room 104 of the University Center, telephone: 890-6090. The Publications Board, a joint faculty-student board, is responsible for the policies, planning, (selection of editors) coordinating and overseeing of the Exponent and the student publications under its jurisdiction.

An art and literary magazine, the printed campus forum for art and literature, is sponsored by the Publications Board. All UAH students are eligible to submit their work for publication. Anyone wishing to submit art or literature for consideration for the next issue, can bring or mail their work to the Exponent office, Room 104, University Center.
Graduate Admissions
Information

The University of Alabama in Huntsville welcomes inquiries and applications from interested persons who wish to further their education. The graduate student body is composed of individuals of all ages—traditional full-time college students and other adults who are combining their educational pursuits with work, family, and various activities. Prospective students should apply well in advance of the date of proposed entrance.

Application forms, detailed application instructions, and information brochures are available at the Office of the School of Graduate Studies in the Materials Science Building as well as at the Office of Admissions in the University Center. A copy of the UAH catalog is mailed to each new student upon admission to the University; additional copies are available for purchase in the UAH bookstore.

Information for prospective students is also available through the Office of Admissions. Campus tours on an individual or group basis are available (phone 890-6070). Faculty members and academic advisors for the various graduate programs are eager to confer with interested individuals to discuss their enrollment plans and opportunities at UAH. Students may telephone departments or program offices directly or call the School of Graduate Studies (890-6002).

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. 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 either a set of GRE scores or a score of the Miller Analogies Test for English, Nursing, and Public Affairs.

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 semester for which admission is sought.
Graduate 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. See departmental sections for specifics.

Unconditional Admission

Applicants may be admitted unconditionally if they meet the following criteria:

A minimum average of B (GPA of 3.0) on the undergraduate record, and

A score of 1500 on the aptitude test (verbal, quantitative, and analytical) portion of the GRE; or

A score of 50 on the Miller Analogies Test for English, Nursing and Public Affairs.

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

Conditional Admission

An applicant whose scholastic record does not fully meet the requirements for unconditional admission may, upon recommendation of the department chair 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 GPA of 3.0 on the last 60 semester hours or
2. Composite GRE score of 1500 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 semester 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.

Additional Requirements for International Students

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 will not be issued by UAH until acceptable results of the TOEFL are received and all admission requirements met. All international applicants must apply for admission at least three months in advance of desired attendance date.

In addition, all international students must request that:

1. Two official copies in English of 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. Since the TOEFL does not measure all language skills necessary for academic success, all international students enrolled at UAH must also take the university's English Language Placement Test and complete any course work in English as a Second Language which the test indicates is required.
5. A certified financial statement be submitted as evidence of sufficient finances to cover fees and personal expenses while attending UAH.
Evidence be presented of University-approved health insurance coverage. Proof of continued coverage must be presented by the student during each semester of enrollment.

Unclassified Graduate Status

Students interested in earning graduate credit but who are not applicants for a graduate degree at UAH may be admitted as unclassified graduate students. Admission in this category may be granted to students if the qualifications for conditional admission have been met. Such students must maintain the same grade-point average requirements expected of conditionally admitted graduate students. Courses 500-level and above taken while in this category must have prior approval by the department offering the course.

Credit earned in a unclassified graduate status may be applied toward a graduate degree program following admission to the 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 may petition to apply up to 12 semester hours of credit earned while in the unclassified status toward the degree. If the student is not admissible, the unclassified graduate credit may be considered in lieu of non-degree postgraduate requirements. (See below)

Non-degree Status

A person whose application to the graduate school has not been approved may be admitted to UAH as a non-degree student. Those admitted in this category may register for graduate level courses with approval from the departments, provided that all prerequisites for those courses have been met.

Once a student is admitted, graduate credit for courses taken during non-degree 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 non-degree status must have been B or higher.
2. Upon petition by the student, up to twelve credit hours may be granted for courses taken as an non-degree and completed with grade of A or B, subject to approval by the major department and the graduate dean. These courses will become a part of the student’s graduate GPA.

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 semester;
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 Registrar, Room 119, University Center) that requires the approval of the department chair and graduate dean. A student may not use courses taken for graduate credit as part of the baccalaureate degree.
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 semester, such change must be accomplished no later than the first day of classes for that semester. Contact the Registrar’s Office, Room 119, 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 faculty, does not meet standards in English proficiency.

All students whose native language is not English are required to take the English Language Proficiency Test (ELPT) and follow the recommendations of the English Department as to what, if any, further spoken and/or written training is required through English as a Second Language (ESL) classes.

Re-evaluation of 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 for re-evaluation of major is available at the Office of Admissions. Students who are in a master’s degree program and wish to pursue a doctorate must also complete the Re-evaluation of Major form.

General Academic Information

A student must be admitted to the School of Graduate Studies to receive graduate credit for courses taken. A full-time graduate student is one enrolled in courses totaling nine to twelve semester hours a semester. The maximum course load for a graduate student is 13 semester hours a semester. A student employed full-time (40 or more clock hours a week) may schedule no more than 6 semester hours of graduate work a semester 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 two courses a semester and a maximum of four 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 or dissertation must register for thesis or dissertation credit each semester they receive supervision. Thesis and dissertation supervision courses are graded on a satisfactory/unsatisfactory basis.
# Financial Information

## TUITION

(1996-1997)

<table>
<thead>
<tr>
<th>Credit Hours</th>
<th>Total</th>
<th>Credit Hours</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$186</td>
<td>1</td>
<td>$378</td>
</tr>
<tr>
<td>2</td>
<td>341</td>
<td>2</td>
<td>693</td>
</tr>
<tr>
<td>3</td>
<td>496</td>
<td>3</td>
<td>1008</td>
</tr>
<tr>
<td>4</td>
<td>651</td>
<td>4</td>
<td>1323</td>
</tr>
<tr>
<td>5</td>
<td>806</td>
<td>5</td>
<td>1638</td>
</tr>
<tr>
<td>6</td>
<td>961</td>
<td>6</td>
<td>1953</td>
</tr>
<tr>
<td>7</td>
<td>1083</td>
<td>7</td>
<td>2204</td>
</tr>
<tr>
<td>8</td>
<td>1205</td>
<td>8</td>
<td>2455</td>
</tr>
<tr>
<td>9</td>
<td>1327</td>
<td>9</td>
<td>2706</td>
</tr>
<tr>
<td>10</td>
<td>1449</td>
<td>10</td>
<td>2957</td>
</tr>
<tr>
<td>11</td>
<td>1571</td>
<td>11</td>
<td>3208</td>
</tr>
<tr>
<td>12</td>
<td>1693</td>
<td>12</td>
<td>3459</td>
</tr>
</tbody>
</table>

Each additional hour over 12, $122 (resident), $251 (non-resident)

## UNDERGRADUATE

Laboratory and Studio Instruction Fees

- Laboratory fees are assessed at $10 per level, i.e., level 2 is $20, level 3 is $30, etc.

Cooperative Education Fees

- Study semester is $40
- Work semester is $80
Engineering Equipment Fees
Equipment fees are assessed at $12 per credit hour.

Schedule Adjustment Charges
Drop of Course Fee ........................................................... $20
Addition of Course Fee ....................................................... $20
Change from Credit to Audit ................................................ $20
Section Change Fee ............................................................ $20
Audit fee - same as for Credit

The University reserves the right to change its fees, charges, rules and regulations at the beginning of any semester and without prior notice. Generally, the Board of Trustees of the University of Alabama System considers proposals for changes in fee structure at its May or June meeting.

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.

ACCEPTABLE FORMS OF PAYMENT
Payment can be made in cash, by check or money order, or can be charged to a VISA, MasterCard or Discover charge card. Sponsoring agencies, faculty/staff or University tuition assistance supported by written documentation, or anticipated financial aid verified by the Student Financial Aid Office are also valid payment forms. Awards may be applied directly to a student's account for charges incurred.

BILLING AND PAYMENT PROCEDURE
Tuition and fees should be paid in full by the first day of classes. Payments may be charged to VISA, MasterCard, or Discover by calling (205) 890-7321. Accounts with an amount due by the first day of classes will be subject to a $50.00 late fee.

Send payments to The University of Alabama in Huntsville, Cashier's Office, University Center Room 213, Huntsville, AL 35899-5050.

DEFERRED PAYMENT PLAN
Students enrolling for at least six semester hours of credit are eligible for the deferred payment plan. This plan enables total tuition, housing, and other current charges to be divided into two payments each semester. The first payment of at least half of the total amount of charges is due by the first day of class. The second payment of the remaining balance is due the end of the sixth week of the semester. There is a $20.00 non-refundable administration fee that must accompany the deferment agreement form. Deferment agreement forms are available in the Bursar's Office, Financial Aid Office and the Office of Student Records. After completion and authorization, the deferment agreement form should be presented with the first payment to the Cashier's Office. The deferred payment is only offered for the Fall and Spring semesters and a deferment agreement form must be completed each semester.

Other Charges
Credit by examination or validation, per semester hour ........................................ 10.00
Replacement of I.D. card ............................................................................. 15.00
Transcript .................................................................................................. 4.00
Duplicate Diploma ..................................................................................... 7.50
Thesis binding and microfilming (6 copies):
Master’s degree ................................................................. 90.00
Ph.D. degree ................................................................. 100.00

Vehicle registration
(Regulations concerning traffic and parking are available at the Campus Safety Office) ........................................ 15.00
Summer only ................................................................. 5.00

College of Nursing
Liability Insurance (per year) .................................... approximately 60.00
College of Nursing Pin (graduation) ............................. 39.00 - 130.00
Annual health examinations ....................................... variable

REFUNDS
Students may withdraw through the second week of classes and receive a 100% tuition refund. A student desiring to withdraw from one or more classes must complete a withdrawal request form at the Office of Student Records, University Center Room 116. The date of withdrawal is the date the written request is received at the Office of Student Records and the date of withdrawal will determine the amount of refund.

HOUSING CHARGES
Students assigned to suites (Central Campus Residence Hall or Southeast Campus Housing) must pay the full semester’s rent at the beginning of the semester. A student who fails to complete payment of fees due or fails to file a payment deferment request with the Cashier’s Office by the close of registration for any semester will have his or her registration canceled. Students assigned to private apartments (family units in Southeast Campus Housing) may pay their rent in equal installments on a monthly basis. Rent payments are due the first day of each month.
If a student officially withdraws from the University while residing in University Housing, he or she may qualify for a prorated refund of rent. This is determined by the date of the student’s official check-out from Housing.
+ During the first week of the academic semester - 80% refund
+ During the second week - 60% refund
+ During the third week - 40% refund
+ During the fourth week - 20% refund
+ After the fourth week - no refund.

OFFICE OF FINANCIAL AID
Financial aid is available in the form of teaching and research assistantships, tuition scholarships, work-study programs, loans, and Co-op programs. Interested students should consult their advisors, department or program chairs for other types of aid.

Scholarships
*Barbara Cooper Bleier and Jo Cooper Dark Endowed Fellowship*
This fund was established by Billie B. and Edwin W. Bleier in memory of his mother and her aunt. It provides multiple scholarships annually to graduate students enrolled in the College of Administrative Science who require financial assistance and who maintain a 3.0 or greater GPA.
Delco Scholarships
Several full-tuition scholarships are available each year to Delco employees and dependents of Delco employees. This fund was established by the University of Alabama in Huntsville in recognition of generous gifts from Delco.

The Dynetics, Inc. Endowed Scholarship
The Dynetics, Inc. Endowed Scholarship, established by Dynetics, Inc., is awarded to a graduate student who has earned an undergraduate degree in an engineering or science field.

Graduate Assistantships
Graduate assistantships and fellowships are offered to encourage graduate work, to promote teaching, and to promote research. Graduate assistants and fellows have as their primary goal a graduate degree, and the assistantships and fellowships are part of their graduate education. Assistantships are available through various departments of instruction and under the auspices of the School of Graduate Studies. Any student qualified for admission to the School of Graduate Studies is eligible to apply for a graduate assistantship. Fellowships are available through various federal and private foundation programs and through the School of Graduate Studies. For information, inquire at the Office of the School of Graduate Studies.

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 (20 hours per week) service to the University but may be appointed more or less than half-time in exceptional cases. Without special permission of the student’s department and the graduate dean, a graduate assistant may not hold other employment during any semester in which this assistantship is in effect. The graduate assistant is registered for a minimum of nine semester hours and not more than ten during any semester 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 the 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. English proficiency is a prerequisite for classroom instruction.

   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. Some contracts or grants may specify U.S. citizenship as a prerequisite for appointment.

Tuition and Fees
Tuition and fees are paid for a graduate assistant who holds one-half time (20 hours per week) appointment and is registered for nine to ten 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 Aid.

Information may be obtained in the Office of Financial Aid or the School of Graduate Studies.

**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 1A) for final approval before a copy is furnished to the student.

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.

**Graduate Record Examination Fee Waiver Program**

UAH is a cooperative 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.

**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 student’s status and course load, the veteran must complete a brief form every semester enrolled. This form must be turned in to the veterans affairs clerk in the Office of Financial Aid, Room 124, University Center.
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, and spouses. 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.
Academic Information

Policies

Nondiscrimination

The University of Alabama in Huntsville is committed to making employment opportunities available to qualified applicants and employees without regard to race, color, religion, sex, age, national origin, or disability. All personnel actions and programs, including recruitment, selection, assignment, classification, promotion, demotion, transfer, layoff and recall, termination, determination of wages, conditions, and benefits of employment, etc., shall be administered in accordance with this equal opportunity policy. It is the intent of the University that, in all aspects of employment, individuals shall be treated without discrimination on any of the foregoing bases, and that employment decisions shall instead be premised upon a person's ability, experience, and other job-related qualifications.

Additionally, the University is an affirmative action employer of women, minorities, qualified individuals with a disability, and covered veterans. It is committed to making sustained, diligent efforts to identify and consider such individuals for employment and for opportunities arising during employment.

UAH is also committed to equal educational opportunity for all qualified students and does not discriminate in its educational policies, practices, programs, or activities on the basis of race, color, religion, sex, age, or national origin, or against qualified disabled persons. Its admissions, financial aid, athletics, student services, and other programs are administered in accordance with this policy.

These commitments are designed to meet nondiscrimination/affirmative action requirements imposed by the following federal and state sources of legal obligation, as amended: Title VI and VII, Civil Rights Act of 1964; Executive Order 11246; Title IX, Education Amendments of 1972; the Rehabilitation Act of 1973; the Equal Pay Act of 1963; the Age Discrimination in Employment Act of 1967; the Vietnam Era Veterans' Readjustment Assistance Act of 1974; the Immigration Reform and Control Act of 1986; the Age Discrimination Act of 1975; the Americans with Disabilities Act of 1990; contract and grant agreements with governmental agencies; and the Alabama Constitution of 1901. The University's equal opportunity policies pertaining to its employees and students include specific administrative procedures and implementing measures designed to carry out these pledges and to ensure compliance with the foregoing laws.

Inquiries or complaints concerning the application to these federal and state requirements and this policy should be directed to one of the following persons:
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 Admissions and 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, a student has a right of access to his or her educational records and may inspect and review the information contained in them. The semester 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 the student’s parents or to confidential letters and recommendations collected under established policies of confidentiality and placed in his files before January 1, 1975. Furthermore, the student may at his or her discretion waive the right to any confidential letters of recommendation.

If students believe their records contain inaccurate, misleading, or otherwise inappropriate data, they may bring the matter to the attention of the records official concerned. If by informal discussion with this official the students do not obtain the corrective action desired, they are entitled to a hearing at which the objectionable item may be challenged. The decision of the hearing official or panel shall be final. If the decision is adverse to the student, he or she may insert in the educational record an explanatory statement relating to the contested item. A student’s privacy interest in his or her records is further protected by the rule against unauthorized disclosure. The university may not without the student’s consent release 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 a 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 in order 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 the student is an athletic team member, date of attendance, degrees and awards received, and the previous educational institution most recently attended. If the student does not wish this information to be released, he or she may so indicate on the form provided at the time of registration, and the university will withhold it during that particular semester. This request for nondisclosure of directory information must be renewed each semester.

The following officials have been designated as records officials for student records within their respective area:

Associate Provost
Assistant Vice President for Enrollment Management (Admissions and Records)
Director, Academic Advisement and Information Center
Director, Cooperative Education
Assistant Dean, College of Administrative Science
Associate Dean, College of Engineering
Assistant Dean for Student Affairs, College of Engineering
Engineering Department Chairs
Associate Dean, College of Nursing
Director of Student Affairs, College of Nursing
Director, Continuing Education
Vice-President, Student Affairs
Director, Financial Aid
Director, Student Development Services

Requests concerning educational records should be directed to the appropriate official listed above. Any student who believes that his or her rights under the Privacy Act have been violated by the University may notify and request assistance from the Provost and 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.

Academic Responsibility

Students at the University of Alabama in Huntsville have the following academic responsibilities:

1. To enroll in only those courses for which the stated prerequisite(s) (if there are any) have been satisfactorily completed. Failure to comply with this procedure may result in administrative withdrawal.
2. To attend all meetings of each class in which they are enrolled. Instructors will announce at the beginning of the semester if they consider attendance in computing final grades.
3. To observe all regulations of their college and select courses according to the requirements of that college.
4. To consult their advisors on all matters pertaining to their academic careers, including changes in their programs.
5. To answer promptly all written notices from advisors, faculty, deans and other university officers.
6. To maintain the integrity of the classroom by practicing academic honesty. Students should refer to the Student Handbook for details regarding academic misconduct.
7. To file an "Application for Degree" in the Office of Student Records one semester before the expected date of graduation.

8. To be personally responsible for fulfilling all requirements for graduation and observing all regulations at UAH.

**Academic Honesty**

Plagiarism and other forms of cheating are subject to penalties as outlined in the Student Handbook. A graduate student found guilty of plagiarism or falsification of research data/results is subject to dismissal from the University.

**Academic Appeals Process**

Academic appeals will originate in written form by the student and will be processed through the chair of the student’s major department, the dean of the School of Graduate Studies, and the Office of Academic Affairs, in that order.

**Instructional and Testing Services**

The tests used for admissions, credit by examination, and placement which are administered through this office include: the Accounting Program Admissions Test (APAT), the American College Testing (ACT), the Alabama Basic Skills Test (BST), the College Level Examination Program (CLEP), the General Education Development (GED) Testing Program, the Graduate Record Examination (GRE), the Miller Analogies Test (MAT), the Medical College Admissions Test (MCAT), and the UAH Chemistry and Mathematics Placement Tests. Applications and information pertaining to the following testing programs are also available: the Graduate Management Admissions Test (GMAT), the Law School Admission Test (LSAT), the PRAXIS Series for beginning teachers, and the Test of English as a Foreign Language (TOEFL).

Testing calendars with dates and deadlines, as well as information pertaining to testing is available in the Office of Instructional and Testing Services located in Room 226 of the Administrative Science Building, telephone 890-6725.

**Student Course Load**

A full-time graduate student is one who is enrolled in courses totaling at least 9 graduate level hours a semester. A course load of 14 hours or more requires approval from the department chair or the program director and the graduate dean.

**Registration**

Dates of priority and regular registration are listed in the UAH calendar. Any continuing or returning student eligible to register may take part in priority registration. All past financial obligations to the University must be cleared before a student may register for courses.

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

**Schedule Adjustments**

After a student has completed registration, all changes in his or her schedule must be made on a change-of-course form and recorded in the Office of Student Records. Advisor signature may be required.
Credit to Audit
A student is permitted to change a course from credit to audit only during the first three 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 his 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 semester.
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 open registration and the schedule adjustment period.
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
Through the eighth week of the semester a student may withdraw from any course. After the eighth week, a student may withdraw from a course only under extenuating circumstances and with the approval of the graduate dean. In any case the 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. Any student failing to follow the established procedure for withdrawal will continue to be enrolled in the class and may receive a failing grade in that course.

Recording of Withdrawals
If the withdrawal process is completed during the first two weeks, the withdrawing student’s name does not appear on the final rolls of the class from which the student withdrew, and that course does not appear on the student’s permanent record. If the withdrawal process is completed after the first two weeks, then the withdrawing student’s name will be on the final roll of the class from which the student withdrew, and that course will be recorded on the student’s permanent record with a final grade of W. It is the responsibility of the Office of Student Records to inform each instructor in a timely manner (in writing) when a student appearing on the instructor’s final class roll withdraws from that course. The University does not use grades of W to compute grade point averages.

Approvals Required
The University does not require that the student justify any course withdrawal completed before the end of the eighth week. After the eighth week, the student must give evidence of extenuating circumstances to justify withdrawal from a course. Avoidance of an undesirable grade does not justify withdrawal. It is the duty of the dean of the college in which the student is enrolled to verify that the circumstances justify withdrawal from a course. In addition, students participating in certain programs must secure approval or give adequate notification to the appropriate officers of these programs. It is the joint duty of these programs and the Office of Student Records to insure that students participating in these programs are aware of any such requirements.
Counseling

Students need to be aware that many potential employers, as well as graduate and professional schools, view an excessive number of W's on a transcript as a flag that the student cannot be counted on to complete demanding projects. Advisors should be informed of this fact and students should be encouraged to discuss with their advisors any plans to withdraw from a course, especially after the first two weeks of the semester.

Repeating a course

There is no limit on the number of times a graduate student may repeat a course. However, some colleges may have restrictions overriding this graduate policy. It should be noted that all grades, regardless of how many times a course is repeated, will be used in determining a student's grade point average.

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 semester, one or more announced examinations of class period length may be held. At the end of each semester, a final 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 he or she is scheduled to take three or more examinations 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 prior to the final week of the semester. 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 applies except that the student shall now have the right to have both the second and third examinations rescheduled.

Grading System

The University of Alabama in Huntsville’s grading system includes grades of A, B, C, D, F, I, X, W, S, U, P, AU, and N. NOTE: The achievement levels in bold print are for undergraduate work. To be successful in graduate school, a student must achieve at the “B” or better level (which is average at the graduate level).

A Superior achievement. Four quality points given per semester hour.

AU Audit. Course attendance as a listener. No credit given, no quality points assigned, no attendance requirement.

B Above average achievement. Three quality points given per semester hour.

C Average achievement. Two quality points given per semester hour.

D Passing work. One quality point given per semester hour.

F Failing work. No credit given; no quality points assigned.

I Incomplete. Assigned by the instructor when a student, due to circumstances beyond his or her 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 semester 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.

N  **No grade.** Assigned by the Office of Student Records when a grade is not reported by the instructor.

P  **Passing work.** Assigned in some courses. See Pass-Fail System.

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. It will be counted as an F and computed in the GPA for undergraduates, but not graduate students.

W  **Withdrawal.** Recorded by the Office of Student Records when a student withdraws from a course with passing work. (See Withdrawal.)

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 semester of next regular enrollment of the student. (See Examinations and UAH calendar.) Time schedule permits a student to take only one examination on this date. If a student receives more than one grade of X, he or she should make arrangements directly with other instructors for additional make-up examinations.

**Change of Grade**

A student is permitted a maximum of one semester from the date a grade is assigned to request a change of course grade. Grades submitted to the Office of Student Records can be changed only by submission by the instructor of a Change of Grade form containing a written explanation of the error. The Change of Grade form must be approved by the department chair and the dean of the college concerned and received in the Office of Student Records no later than two semesters from the date the original grade was assigned.

**Student Grade Report**

At the completion of each semester, a report of final grades is mailed to the address furnished by the student.

**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, S, or AU is assigned are not included.

**Graduate Dean’s List**

A graduate student who (1) has a minimum grade point average of 3.85 on all graduate work and (2) has completed at least twelve semester hours of graduate work at UAH in the past twelve months and (3) has a grade point average of 4.0 on the last twelve semester hours of graduate work is eligible for the Graduate Dean’s List which is compiled by the School of Graduate Studies each semester.

**Visiting Student Program**

A cooperative arrangement exists with Alabama A&M University. Any student interested in participating in this program should consult the Office of Student Records.
Cooperative Education 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 rotate semesters of full-time study with semesters of full-time work. Students are encouraged to take one degree-related course during each work semester. Frequently, students can fulfill some University research requirements in conjunction with work they are completing with their employer. Salary during work semesters is based on the student’s qualifications and is comparable to the pay of a typical employee who has similar education and experience.

Students will be considered as candidates for Graduate Co-op positions when the following requirements are met:

1. Admission to the School of Graduate Studies as a degree candidate.
2. A minimum of a 3.0 grade point average on all graduate course work. If the student’s field of study is significantly different from his or 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) 890-6741.

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 issued to the individual student; however, the transcript is marked “issued to student.”

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

Course Numbering System

<table>
<thead>
<tr>
<th>Range</th>
<th>Year</th>
<th>Student Normally Takes Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>001-099</td>
<td>Refresher (noncredit)</td>
<td></td>
</tr>
<tr>
<td>100-199</td>
<td>Freshman</td>
<td></td>
</tr>
<tr>
<td>200-299</td>
<td>Sophomore</td>
<td></td>
</tr>
<tr>
<td>300-399</td>
<td>Junior (upper level)</td>
<td></td>
</tr>
<tr>
<td>400-499</td>
<td>Senior (upper level)</td>
<td></td>
</tr>
<tr>
<td>500-599</td>
<td>Advanced undergraduate credit or graduate credit. In the Colleges of Engineering and Administrative Science, graduate credit only. In the Colleges of Liberal Arts, Nursing, and Science may be either undergraduate or graduate credit. Check course listing for specific credit level.</td>
<td></td>
</tr>
<tr>
<td>600-799</td>
<td>Graduate (postgraduate and advanced undergraduate students only by special permission.)</td>
<td></td>
</tr>
</tbody>
</table>
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

With the Army’s Missile Command, 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 at UAH 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 master’s degrees could be awarded locally in mathematics, physics, chemistry, and engineering. The first master’s degree, in mathematics, was awarded in 1964, and the following year two master’s 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

Programs
Applied Mathematics
Atmospheric Science
Biological Sciences

Emphasis Areas:
  Cell Biology
  Environmental Biology
  Genetics and Molecular Biology
  Microbiology
  Physiology
Chemistry
Computer Engineering
Computer Science

Emphasis Areas:
  Theoretical Computer Science
  Languages and Systems
  Software Engineering
  Artificial Intelligence
  Image Processing and Vision Systems
  Computer Architecture
  Super Computer Applications

Engineering - General

Options
Aerospace Engineering
  Areas of Specialization:
    Space Environment
    Space Propulsion
    Space Structures

Computer Engineering
  Areas of Specialization:
    Architectures
    Hardware Design
    Neural/Artificial Intelligence
    Parallel Processing
    Software Engineering
    VLSI/Electronics

Chemical Engineering

Civil and Environmental Engineering

Electrical Engineering
  Areas of Specialization:
    Communications, Radar
    Control Theory
    Digital Signal Processing
    Electromagnetics, Plasma
    Electronics, VLSI
    Opto-electronics
    Optics and Photonics Technology

Industrial and Systems Engineering
  Areas of Specialization:
    Engineering Management
    Manufacturing Systems Engineering

Degrees
  Ph.D.
  M.S., Ph.D.
  M.S.
Operations Research
Quality Assurance Engineering
Systems Engineering
Systems Simulation
Mechanical Engineering
Areas of Specialization:
  Fluid and thermal Sciences
  Solids and Structures
Optics and Photonics Technology
Electrical Engineering Ph.D.
English M.A.
History M.A.
Industrial & Systems Engineering Ph.D.
Areas of Specialization:
  Engineering Management
  Manufacturing Systems Engineering
  Operations Research
  Quality Assurance Engineering
  Systems Engineering
  Systems Simulation
Management M.S.M.
Area of Specialization:
  Management of Technology
Materials Science Ph.D.
Areas of Specialization:
  Biomaterials
  Electronic, Optical and Magnetic Materials
  Macromolecular Materials
  Materials Processing
  Materials Structure and Properties
  Mechanical Behavior of Materials
Mathematics M.A., M.S.
Areas of Emphasis:
  Combinatorics and Graph Theory
  Numerical Analysis
  Ordinary and Partial Differential Equations
  Probability and Statistics
Mechanical Engineering+ Ph.D.
Areas of Specialization:
  Chemical Engineering
  Civil and Environmental Engineering
  Mechanical
Nursing M.S.N.
Tracks:
  Adult Acute Care
  Family Nurse Practitioner
  Nursing Administration
Operations Research M.S.O.R.
Optical Science & Engineering Ph.D.
Optics Specializations:
  Laser Dynamics
  Optical Computing
Optical Properties of Materials
Optical Sensors
Optical Signal and Image Processing
Optical System Design
Optical Testing
Opto-electronics
Quantum Optics

Physics+ M.S., Ph.D.

Emphasis Areas
- Optics and Photonics Technology
- Optics/Quantum Electronics
- Solid State/Materials
- Space Sciences

Psychology M.A.

Areas of Specialization:
- Cognitive
- Developmental Psychology
- Human Factors
- Industrial

Public Affairs M.A.

+Also participates in the Materials Science Ph.D. Program to offer several specialties.

Fifth Year Programs - (Secondary Education - Discipline M.A.)

Biology M.S.
Chemistry M.S.
English M.A.
History M.A.
Mathematics M.A.
Physics M.S.

Certificate Programs

Environmental Science
Family Nurse Practitioner (Post M.S.N.)
Teaching of English to Speakers of Other Languages (TESOL)
Technical Communication

Graduate Degree Requirements

The following scholastic requirements are those of the School of Graduate Studies (individual departments may list 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 who attain an overall grade average of B or better for all graduate work attempted up to and including the semester in which at least 12 semes-
2. Any time a student’s overall grade average on graduate courses drops below a B, the student will be placed on probation. A student on probation is not a candidate for a degree.
3. Probationary status is removed by raising the overall grade average to B or better on all graduate work attempted in all terms up to and including the semester in which 12 semester hours of graduate work are completed following the semester 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 petition for readmission 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 graduate coursework. Courses taken without an approved Program of Study may or may not apply toward a degree.

Plan I (Thesis)

Degree requirements under this plan include completion of at least 24 semester hours of graduate course work and at least 6 credit hours toward 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 chair of the department, by the college dean, 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 eight weeks before the date on which the candidate expects to receive the degree. After the student has passed his thesis defense and at least five weeks before graduation, six copies of the thesis approved by the thesis committee, the department chair, the appropriate college dean, and the graduate dean must be deposited in the Office of the Registrar along with a receipt for the binding fee. Theses must comply with the regulations set forth in the Graduate School’s Thesis and Dissertation Manual.

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 research is to be done. Such a plan must then be approved by the student’s advisor, the department chairman, and the graduate dean.

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 up to twelve semester hours of acceptable graduate credit earned in an approved institution and may count it toward a master’s degree. 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 (1) was enrolled in a graduate school at the time it was taken and (2) has an overall average of B or better in graduate coursework at the institution. 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 the Registrar, 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 department and approved 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 1) full-time UAH faculty members and 2) have full membership in the graduate faculty. A written notice of the time and place of examination is sent to the graduate dean and the registrar at least two weeks before the exam date. After approval by the graduate dean, the department sends a copy of the written notice to the candidate and each member of the committee. The examination must be given at least six weeks before the date of graduation and the results reported within two working days 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 years before the completion of all requirements for the degree may be validated by special examination. Such an examination, given by the department in which the course is offered, can be taken only once and will be the equivalent of a final examination in the course. When the student passes the examination, the course is considered valid through the tenth year only.

Credit for courses transferred from other institutions cannot be validated at UAH.

**Second Master's Degree**

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

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

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

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

**Form 3 A:** Petition for a change in Form 3, if any. A valid reason must be given for the change.
Form 5: Application for Advanced Degree. This is to be filed at least three months before graduation. It is available at the Office of Student Records.

Form 6: Notification of Final/Qualifying Examination. Notification of the examination date must be turned in to the Graduate Studies Office at least two weeks in advance. The final examination must be taken at least six weeks before graduation, and not earlier than the semester in which the student will complete 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. Students must register for dissertation research each semester in which they receive faculty supervision.

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 upon submission of Form 3-A.

Transfer Credit

All credit toward the Ph.D. which has not been earned at UAH must be acceptable graduate credit from an approved institution. Such credit is transferred with approval of the major department if the student 1) was enrolled in a graduate program at the time the coursework was taken and 2) has an overall average of B or better in graduate work at the institution.

Foreign Language Requirement

Some departments may have language requirements. Students should refer to a department's listing for specifics.

Residence Requirement

Residence at UAH as a doctoral 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 member of the graduate faculty who holds full membership status.
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 department with approval of the graduate dean and will examine the student’s research proposal for the dissertation. The majority of the committee must be composed of 1) full-time UAH faculty members and 2) have full membership in the graduate faculty.

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 specific departmental requirements such as 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 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. Furthermore, the dissertation should be written in fluent, acceptable English. 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 eight weeks before graduation. At least five weeks before graduation, six copies of the dissertation, approved by the student’s committee, the chair of the major department, the appropriate college dean, and the graduate dean, are to be deposited in the 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 Thesis and Dissertation Manual.

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. The examination must be given at least six weeks before the date of graduation and the results reported within two working days to the graduate dean. A student may take the final exam only twice.
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. The examination must be given at least six weeks before the date of graduation and the results reported within two working days to the graduate dean. A student may take the final exam only twice.

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

Form 6: Notification of Qualifying Examination. Students should consult with their advisors about specifics. The form must be turned in to the Graduate Students Office at least two weeks before the examination time.

Form 11: Application for Admission to Candidacy for the Degree of Doctor of Philosophy. This form must be completed after passing both the qualifying examination and the language requirement and should be filed 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 six weeks before graduation.

Cooperative Programs

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 courses. 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 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 is 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 semester 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 chair, 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 Records Office 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.

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 atmospheric science, computational fluid dynamics, materials science and optical science and engineering. 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.

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 and Aerospace Engineering

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

a. MA 615
b. MAE 653
c. CS 646
and one course chosen with the assistance of an advisor from
d. CS 647
e. MA 626
f. MAE 654

After completing the core courses, a student may follow one of the tracks listed below and must satisfy the degree requirements as delineated in this 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>
</tr>
<tr>
<td>CS 770</td>
<td>MA 626</td>
<td>MAE 654</td>
</tr>
<tr>
<td>MA 715</td>
<td>MA 670</td>
<td>MAE 655</td>
</tr>
<tr>
<td>MAE 655</td>
<td>MA 715</td>
<td>MAE 750</td>
</tr>
<tr>
<td>MA 726</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAE 654</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MATERIALS SCIENCE PROGRAM

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: C. Riley, Professor (Chemistry)

Professors:
Baird, J.K. (CH); theory of crystal growth, plasma studies
Cost, T.L. (MAE); composite materials
Franz, J. (PH); solid state materials
Gilbert, J.A. (MAE); optical materials
Gregory, J.C. (CH); interaction of atomic oxygen with surfaces
Harris, J.M. (CH); polymers, nonlinear optical materials
Ho, F.D. (EE); solid state and electronics
Kowel, S.T. (EE); nonlinear optical materials
Loo, B.H. (CH); surface Raman spectroscopy, superconductivity
McManus, S.P. (CH); polymers, nonlinear optical materials, space processing
Nauman, R.J. (MTS); crystal growth in low gravity, space processing
Riley, C. (CH); electrodeposited materials, space processing
Rosenberger, F.E. (PH); fluid dynamics of materials processing
Smith, J.E. (CHE); catalysis, powdered metals, space processing
Sung, C.C. (PH); theoretical solid state materials
Wessling, F.C. (MAE); space processing of materials

Associate Professors:
Alexander, J.I. (PH); simulation of physical processes and fluid convection
Bower, M.V. (ME); nonmetallic materials and fluid flow
Chittur, K. (CHE); biological thin films, polymer films
Leslie, T.M. (CH); nonlinear optical materials, polymer composites
Lumpkin, R.S. (CH); solar energy conversion and nonlinear optical materials
Meehan, E.J., Jr. (CH); x-ray crystallography of protein S
Nadarajah, A. (CHE); crystal growth
Weimer, J. (CH/CHE); surface bonding studies

Associate Research Professor:
Van Alstine, J. (CH); separation of macromolecules and bioparticles

Assistant Professor:
Setzer, W.N. (CH); phytochemicals

Assistant Research Professors:
Kaukler, W.F. (CH); solidification and interfacial energies, x-ray microscopy

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 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 disciplines, 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 administered 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 Chemical Engineering, Chemistry, Electrical Engineering, Mechanical Engineering, and Physics at UAH. Although science and engineering faculty participate, 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. The multidisciplinary curriculum has been structured 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 1500 on the Graduate Record Examination;
4. TOEFL score greater than 550 in case of international students; and
5. Four 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 Examination I.

Degree Requirements

Qualifying, Comprehensive and Other Program Examinations

Program Examination 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 examination is administered simultaneously system-wide by the Tricampus Coordinating Committee at preannounced dates. Students must pass all parts of the examination according to schedule which is available from the Program Director. Program Examination 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 stage. Program Examination III is the final examination and is largely the student's defense of the dissertation. Program Examinations II and III are prepared, administered and graded by the student's Graduate Supervisory Committee.

Coursework Requirements

A minimum of 48 credit hours of graduate-level coursework and 24 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 Examination II as well as the successful presentation of a dissertation research proposal. Normally, a student will be considered eligible to take Program Examination 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.

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 student 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 an M.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 into 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 Examination I and chooses a research project. This committee will normally include the research advisor as chair 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, Chemical Engineering, Chemistry, Electrical and Computer Engineering, Mechanical and Aerospace Engineering, and Physics. In addition, the courses listed below are offered for students in the program.

501 Structure, Composition and Properties of Materials I 3 hrs.
How structure and composition determine a material’s mechanical properties and performance. Topics covered include bonding and crystal structure, disorder, defects, phase diagrams, phase transitions, diffusion and other kinetic processes, deformation, fracture mechanics, strengthening processes as applied to metals, ceramics, semiconductors, polymers and composites. Prerequisite: CH 341 or permission of instructor.
502 Structure, Composition and Properties of Materials II 3 hrs.
How reactive, electronic, magnetic, thermal, and optical properties of metals, ceramics, semiconductors, and polymers are influenced by their structure and composition. Topics considered include corrosion, oxidation, degradation process, band structure, electrical and optical dielectric constants, magnetic susceptibility, electrical and thermal conductivity and superconductivity. Prerequisites: CH 343, MTS 501.

607 Materials Processing in Space 3 hrs.
Extensive review of solidification physics with emphasis on the role of fluid transport and its effects on the process in order to develop rationales for processing materials in space. Prerequisites: MTS 501 and MA 324.

613 Synthesis and Processing of Materials 3 hrs.
Metals, semiconductors, polymers, ceramics and composite materials are included. Prerequisites: MTS 501, CH 341.

646 Thermodynamics of Materials 3 hrs.
(Same as CH 646 and CHE 646)

649 High Polymer Chemistry 4 hrs.
Same as CH 540. 600-level credit only upon approval of campus MTS program director.

650 Principles of Liquid and Solid Interfaces 3 hrs.
Applies basic principles in thermodynamics and kinetics to characterize surfaces and surface phenomena. Fundamental properties of gas-liquid, liquid-liquid, solid-liquid, and solid-gas interfaces and phenomena occurring at these interfaces. Prerequisite: CH 341. (Same as CHE 650 and CH 650)

651 Introductory Quantum Mechanics I 3 hrs.
Same as CH 553 and PH 551. 600-level credit only upon approval of campus MTS program director.

652 Introductory Quantum Mechanics II 3 hrs.
Same as CH 554 and PH 552. 600-level credit only upon approval of campus MTS program director.

660 Introduction to Solid State Physics I 3 hrs.
Same as PH 560. 600-level credit only upon approval of campus MTS program director.

661 Introduction to Solid State Physics II 3 hrs.
Same as PH 561. 600-level credit only upon approval of campus MTS program director.

690 Special Topics in Materials Science 3 hrs.
Advanced selected topics of interest in such areas as materials processing, properties, analysis and testing. Prerequisites: MTS 501, 502, or approval of instructor.

701 Fundamentals of Solid State Materials Preparation I 3 hrs.
Equilibrium concepts and applications. Overview of solid state preparation (crystal growth) techniques. Treats appropriate thermodynamics, chemical equilibrium solid-liquid-vapor phase diagrams and application in materials preparation; segregation and applications (doping, normal freezing, zone refining, macro and micro distributions). Prerequisites: Upper division undergraduate background in thermodynamics and physical chemistry.

702 Fundamentals of Solid State Materials Preparation II 3 hrs.
Transport concepts and applications. Treatment of transport as applied to materials preparation. Discussions of mass and heat transfer, fluxes, reference frames, diffusion, forced convection, free convection, non-radiative heat transfer, radiative heat transfer and vacuum and temperature measurements. Prerequisites: upper division undergraduate background in thermodynamics and physical chemistry.
### 703 Fundamentals of Solid State Materials Preparation III 3 hrs.
Nucleation and interface concepts. Discussion of spontaneous nucleation, small three-dimensional phases, adsorption and stimulated nucleation. Prerequisites: upper division undergraduate background in thermodynamics and physical chemistry.

### 704 Fundamentals of Solid State Materials Preparation IV 3 hrs.
Growth kinetics and morphology concepts. Treats interface morphology, growth mechanisms, growth kinetics and morphological stability. Prerequisites: Upper division undergraduate background in thermodynamics and physical chemistry.

### 721 Fundamentals of Electron and X-ray Techniques 4 hrs.
Fundamentals of materials characterization using electron and x-ray techniques. Topics include advanced crystallography, electron optics, and interactions of energetic electrons with solids. Some applications of x-ray diffraction (SRD) will be addressed. Prerequisite: MTS 501 or equivalent; MTS 502 or equivalent recommended.

### 722 Electron Microscopies and X-ray Diffraction 4 hrs.
Applications of materials characterization using electron and x-ray techniques. Topics include imaging and x-ray spectroscopy (EDXA) using scanning electron microscopy (SEM); imaging, diffraction, and x-ray spectroscopy using transmission electron microscopy (TEM); and advanced x-ray diffraction (XRD) techniques. Prerequisite: MTS 721.

### 723 Electron Spectroscopies for Surface Characterization 4 hrs.
Principles and operation of electron spectroscopies used in surface characterization. Techniques covered include Auger electron spectroscopy (AES), x-ray photoelectron spectroscopy (XPS), and other photoemission spectroscopies, such as ultraviolet photoelectron spectroscopy (UPS) and the use of synchrotron radiation. Students will carry out analysis of samples, prepare a written report, and present the results orally as part of the laboratory assignment. Prerequisite: MTS 502 or equivalent; MTS 660 and 721 recommended.

### 747 Polymer Physical Chemistry 3 hrs.
Prerequisites: CH 341, 540. (Same as CH 647)

### 780 Materials Science Seminar 1 hr.
Required of doctoral students during each semester of residence.

### 790 Special Topics in Material Science 3 hrs.
Offered upon demand. Advanced selected topics of interest in materials science in such areas as materials processing, materials properties and analysis, testing. Prerequisites: MTS 501, 502 or approval of instructor.

### 799 Doctoral Dissertation 3.6 or 9 hrs.
Required each semester student is enrolled and receiving direction on a doctoral dissertation.

## OPTICAL SCIENCE AND ENGINEERING PROGRAM

**Degree:** Doctor of Philosophy

**Program Director:** S. T. Kowal, Professor (ECE)

**Professors:**
- Abushagur, M.A.G. (ECE); optical signal processing, computing and metrology
- Banerjee, P.P.(ECE); nonlinear wave phenomena, optical processing
- Dimmock, J.O. (PH); spectroscopy
- Duthie, J.G.(PH); nonlinear optics, optical processing
- Fork, R.C. (ECE); optical communications, lasers
- Gilbert, J.A.(MAE); experimental stress analysis, applied optics, solid mechanics, fiber optic sensing, panoramic imaging
Kowel, S.T.(ECE); opto-electronic materials, devices and systems
Poularikas, A.D.(ECE); statistical optics
Sung, C.C.(PH); optics, solid state physics

Research Professors:
Vikram, C.S.; holography, metrology
Maderas, F.L.; E-O materials/devices

Associate Professors:
Chipman, R.A.(PH); polarimetry, optical testing, optical design
Gregory, D.A. (PH); optical processing
Hillman, L.W.(PH); optics laser dynamics
Kulick, J.H.(ECE); computer design, computer-generated holography, medical image processing
Lindquist, R.G. (ECE); liquid crystal displays, nonlinear optics
Nordin, G.P. (ECE); diffractive displays, holographic memories

Research Associate Professor:
Ahmad, A.; opto-mechanical engineering, expert systems, rapid proto-typing

Adjunct Faculty
More than 15 members from UAH, UA, UAB, and Alabama A&M make up the adjunct faculty.

Optics stands today as an area of major scientific and technological importance. Students can emphasize optics within graduate programs in many of the university’s traditional disciplines, but for those wishing to major in optics-related areas, a Ph.D. program in optical science and engineering was approved in 1992. This unique program is highly multidisciplinary, beginning with a core of basic optics, followed by a wide variety of advanced course work and research in both fundamental and applied subjects. The program spans great diversity, from the fundamental physics of light and its interaction with matter, to the design of new optical devices and development of systems for signal processing, parallel computing, and global communications. In addition to the resources of the academic departments, the program benefits greatly from interaction with the research centers at UAH, especially the Center for Applied Optics. The University of Alabama, Tuscaloosa, the University of Alabama at Birmingham, and Alabama Agricultural and Mechanical University are cooperating institutions, providing special opportunities for UAH students, and permitting their students to participate in this UAH-based program.

Optics specializations currently available at UAH include the following:
- Optical Computing
- Optical Properties of Materials
- Optical Sensors
- Optical Signal and Image Processing
- Optical System Design
- Optical Testing
- Opto-electronics
- Quantum Optics
- Laser Dynamics

Admission Requirements
In order to be unconditionally admitted to the doctoral program, a student must have satisfied the following set of requirements:
1. A bachelor’s degree, or its equivalent, from an accredited college or university, in one of the physical sciences or engineering, with an overall grade-point average of 3.0 or better; 2. A minimum score of 1600 on the combined verbal, quantitative, and analytical sections of the Graduate Record Examination.
3. TOEFL score greater than 550, in the case of international students whose native
language is not English; and

All entering students will be administered a background evaluation at admission conducted
by the Optics Coordinating Committee.

An applicant whose scholastic record reveals a deficiency in one or more of the first two
categories above, may, upon recommendation of the Program Coordinator and the approval of
the Graduate Dean, be admitted on a conditional basis, as provided by Graduate School regu-
lations. However, that student must follow the Graduate School’s policies in achieving uncondi-
tional admission status prior to taking the Preliminary Examination.

Degree Requirements

Because students will come into this program with strong but diverse undergraduate and
graduate training, the multidisciplinary curriculum has been structured on a common basis for
all entering students, but will compensate for individual differences and provide depth in spe-
cific areas. A total of 48 semester hours of graduate work, and a minimum of 24 semester hours
of dissertation research are required. The student will complete three study phases, punctuated
by three program examinations.

Phase I (the core phase) will consist of 27 semester hours of coursework. To complete this
phase and become eligible for continuation in a specialty area, the student must pass the
Preliminary Examination. (Only two attempts will be permitted.) After successful completion
of this phase, the student should have acquired the common optics background that the pro-
gram faculty believe is necessary in the doctoral program. Full-time students will normally
select a dissertation advisor during their first year and may begin dissertation research. Once
an advisor has been chosen and the Preliminary Examination passed, a graduate committee will
be appointed and a Program of Study completed. The second and third phases of the student’s
curriculum are planned by the student’s graduate committee.

Phase II of the program consists of coursework in preparation for entering Phase III which
consists of dissertation research. In this second phase, the student must complete the basic 48
hours of graduate coursework, including the 27 hours taken in preparation for the Preliminary
Examination. The remaining courses are to be decided jointly by the student, the advisor, and
the student’s graduate committee. Of the 48 hours, at least 36 should be in designated optics
courses, and the remainder will be selected in such a way as to prepare the student for research
in his chosen optics specialty (see list above).

The second phase will be completed when the student has completed most of the formal
coursework as prescribed in the Program of Study and by passing the Qualifying Examination
which is prepared and administered by the student’s graduate committee. It will contain both
written and oral parts. The written part will include a proposal for dissertation research pre-
pared by the student and distributed to the graduate committee. The proposal will demonstrate
that the student is intimately familiar with the proposed research, that published research relat-
ed to the proposal has been reviewed, and that the student has a clear understanding of how to
proceed and can set realistic goals. The graduate committee may also administer a written
examination using questions based on the coursework in the student’s Program of Study. If the
student fails the Qualifying Examination, a second attempt will be scheduled. Students who fail
in two attempts will be dropped from the program.

Since the Ph.D. is a research degree for which its recipients have to demonstrate the abili-
ty to perform independently and report original research, all students are expected to acquire a
majority of their advanced knowledge through research training and related activities. This
includes laboratory research, group seminars, directed readings and special research topics
courses. These activities for Phase III will be directly supervised by the student’s advisor. A
minimum of 24 semester hours of dissertation research is required. The Final Examination will
consist of a public, oral presentation and defense of the dissertation.
The Core Curriculum

Students in the field must hold or acquire a core of basic knowledge, which includes the contents of nine core courses described below. Because of the anticipated diversity of backgrounds of entering students, a rigid list of required prerequisite courses is inappropriate. Instead, the optics faculty will steer students into courses on the basis of background evaluation given them upon admission. Students will be given a recommended reading list for study prior to their arrival at UAH. The purpose of these steps is to ensure that entering students have achieved a minimum level of experience before starting Phase I of the program. While optics faculty, and in particular the advisor, will guide the student based on the entrance examinations and course work, students will be advised that they can judge themselves to be making satisfactory progress by grades of B or better in the core courses, but that a passing grade in the Preliminary Examination is the sole OSE Program requirement for completion of the Core Phase. Of course, all requirements of the School of Graduate Studies must be met to remain in good standing.

Contents of the Core

The core is divided into nine topical areas grouped into three major areas. Students must gain the required knowledge by taking the core courses, but they can use existing courses or use experience gained elsewhere to prepare for the Preliminary Examination. The nine core courses grouped in three major areas are:

OPTICAL SYSTEMS AND ENGINEERING
1. Geometrical Optics - OSE/EE/PH 541
2. Physical Optics - OSE/EE/PH 542
3. Optical Testing - OSE 654

QUANTUM OPTICS
4. Quantum Mechanics for Optics and Solid State - OSE 555
5. Optical Properties of Matter - OSE 655
6. Lasers - OSE 645

OPTICAL SIGNALS
7. Linear Systems - OSE/EE 601
8. Fourier Optics - OSE/EE 632
9. Random Signals and Noise - OSE/EE 500

Each student will be examined in the three broad areas identified above. Most students who are in possession of an M.S. degree in a relevant science or engineering discipline will be advised to take the examination upon entry.

There will be two types of full-time students, designated as graduate fellows or graduate assistants. Graduate fellows have no other responsibilities than the pursuit of their graduate studies. They may be persons on paid leave from their regular employer or they may hold one of many varieties of graduate fellowships that support full-time graduate study with no other major requirements. Graduate fellows should be able to complete the core requirements and take the Preliminary Examination after one full year of study. Indeed, this attractive feature of the program would allow corporations to send employees for a one-year intensive study program at UAH with the goal of completing Phase I of the program. The other full-time students, graduate assistants, are the traditional graduate students who have teaching or research commitments for which they receive payment but which demands half their work time. Such students entering with a baccalaureate degree would not normally be prepared to take the Preliminary Examination until they have completed two years of graduate study.

Residence Requirement

The minimum period in which a Ph.D. in optical science and engineering 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 student.
All requirements for the doctoral degree must be completed in no more than five years after the student has passed the Qualifying Examination. Credits earned toward a master's degree may be applied to the doctoral degree. Dated credits may be accepted if recommended by a student's committee, the Program Committee, and approved by the Graduate School. For application toward this degree, the student may be required to demonstrate competence in the dated course work.

Advisement

A student admitted to the program will have a member of the OSE Program Committee as an advisor. The student will be encouraged to consult with all faculty members in the intended area of specialization in order to develop an appropriate program of study and topic for dissertation research.

A graduate committee will be appointed for the student as soon as the student passes the Preliminary Examination and selects a research project. The committee will include an advisor and at least four other members. At least one of the committee members will be from a department other than the student's "home department." Otherwise, the composition of the committee will follow the rules governing such committees set forth by the School of Graduate Studies. The graduate committee is charged with supervision and approval of the student's research and course of study toward the completion of all requirements for the degree.

Graduate Courses in Optical Science and Engineering (OSE)

500 Random Signals and Noise

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 500.)

541 Geometrical Optics

Foundations and physics of geometrical optics, Fermat's principles and Huygen wavelets, refraction and reflection. The many forms of Snell's Law. Optical path lengths, geometrical wavefronts and rays. Ray tracing, ynu-chart and matrix methods. Gaussian imagery and paraxial optics, conjugate elements, cardinal points, and image-object relations. Stops and pupils, chief and marginal rays, vignetting, and the optical or Lagrange invariant. The y-y bar diagram, design of common systems: objectives, magnifiers, microscopes, collimators and detectors. Optical glasses and chromatic aberrations, wavefront and transverse aberrations, spot diagrams and ray fan plots. (Same as EE/PH 541.) Fall.

542 Physical Optics


555 Quantum Mechanics for Optics and Solid State

Lorentz atom, classical interaction of radiation and matter; postulates of quantum mechanics; commuting observables and constants of motion, Dirac notation, basis sets; harmonic oscillator, angular momentum; hydrogen atom, atomic and molecular spectroscopy; development of Hamiltonian for light interacting with matter, perturbation theory and first-order solutions; blackbody radiation, spontaneous emission and noise; polarization susceptibility and dispersion. Prerequisites: PH 451, EE 310.
601 Linear Systems 3 hrs.
Formulation and solution by transform methods of differential equations of linear electrical and electromechanical systems, state equations, signal-flow graphs, and discrete-time systems. Prerequisites: MA 324, EE 382, 383.

632 Coherent Optical Systems and Holography 3 hrs.
Introducing the optical system as an invariant linear system, Sommerfeld's diffraction integral, propagation of Gaussian beams, coherence theory, frequency analysis of the optical imaging systems, image formation using coherent and incoherent light, on-axis and off-axis holography, and non-destructive testing using Fourier optics and holographic techniques. Prerequisite: EE 542.

645 Lasers 3 hrs.
Incoherent light sources; atomic and molecular energy levels; equation or motion for probability amplitudes using first-order time dependent perturbation theory; electric dipole interaction. Einstein rate equations and the Planck radiation law; induced dipole moments and frequency-dependent susceptibility. Homogeneous and inhomogeneous line broadening mechanisms; laser cavities and modes, elementary laser theory, practical lasers; frequency stabilization techniques and laser linewidth; Q-switching and mode locking; photon statistics and noise; physical origins of noise; light modulation and detection. Prerequisites: OSE 555, EE 307. (Same as PH 595)

654 Optical Testing 3 hrs.
Aberrations; aspheric systems; geometric tests; interferometry and microscopy; optomechanics; optical manufacturing; properties of blackbody sources; Planck's and Wien's laws; tungsten lamps; gas discharge lamps; lasers; infrared sources and ultraviolet sources; calibration techniques for standard sources. Prerequisites: OSE 541,542.

655 Optical Properties of Matter 3 hrs.
Degree: Master of Science in Management

Dean: C. David Billings, B.S., Ph.D., Professor of Finance
Assistant Dean: Dorla A. Evans, B.S., M.B.A., Ph.D., Professor of Finance

Eminent Scholar in the Management of Technology: Souder, William E.; managing new technology development, technology transfer

Accounting and Business Legal Studies
Chair: Wayne Morse, Professor

Professors:
Morse, W.; managerial accounting
Porter, G.L.; managerial accounting

Associate Professor:
Bryson, R.E., Jr; financial accounting

Assistant Professors:
Maddock, P.M.; auditing, managerial accounting
Wampler, B.M.; financial accounting, tax accounting

Economics and Finance
Chair: Chris W. Paul, II, Professor

Professors:
Billings, C.D.; government financial management, systems analysis
Evans, D.A.; behavioral finance
Paul, C.W., II; applied microeconomics, public choice
Schoening, N.C.; regional economics
Willhite, A.W.; labor economics, public choice

Associate Professor:
Schnell, J.F.; industrial relations, labor economics

Assistant Professors:
Allen, W.D.; applied microeconomics, labor economics
Burnett, J.E.; investments
Patel, J.B.; financial institutions, capital budgeting
Management and Marketing
Chair: J. Daniel Sherman, Professor

Professors:
McCollum, J.K.: labor relations, organizational theory
Sherman, J.D.: organizational behavior theory, management of innovation

Associate Professors:
Gramm, C.L.: industrial and labor relations, human resource management
Olsen, E.A.: organizational behavior/theory, human resource management
Simpson, J.T.: marketing channels, structure, and behavior

Assistant Professor:
Wren, B.M.: marketing strategy, business-to-business marketing
Seale, D.A.: strategic management
Berkowitz, D.: market research, new product development

Management Information Systems and Management Science
Chair: Chris W. Paul, II, Professor

Professors:
Souder, W.E.; management of technology
Stafford, E.F.Jr.; production scheduling, systems simulation, manufacturing

Associate Professors:
Trueblood, R.P.; data base design
Tseng, F.T.; management science, production/operations management

Assistant Professors:
Floyd, S.A.; systems analysis and design, knowledge-based systems
Lai, V.S.; data base design, distributed network design
Mahapatra, R.K.; data base design, management of information technology
Patel, J.B.; business statistics and information systems

Adjunct Assistant Professor:
Ballenger, J.P.; software engineering

The Bachelor of Science in Business Administration (BSBA) and the Master of Science in Management (MSM) programs offered by the College of Administrative Science are accredited by the American Assembly of Collegiate Schools of Business (AACSB).

Mission
The College of Administrative Science is a professional school with the mission of providing a high quality business education primarily to students from North Alabama. This education leads to the Bachelor of Science in Business Administration (BSBA) degree and to the Master of Science in Management (MSM) degree with an emphasis on the management of technology. The College produces research which furthers the knowledge in its disciplines and in the interdisciplinary area of technology management. The College provides service to the University, to the public, and to professional and academic organizations.

Accreditation and Membership
The College of Administrative Science is accredited by the American Assembly of Collegiate Schools of Business (AACSB). The AACSB is a not-for-profit corporation comprised of member organizations and institutions devoted to the promotion and continuous improvement of higher education for business administration and management. Organized in 1916, AACSB is recognized by the Council on Postsecondary Accreditation and by the Office of Postsecondary Education of the U.S. Department of Education as an accrediting agency for programs in business administration and accounting.
The College is a member of the Association for University Business and Economic Research (AUBER). Organized in 1947, AUBER is the professional association of business and economic research organizations in universities.

The College is a member of the Alabama Small Business Development Consortium (ASBDC). The ASBDC provides management counseling and training to small business owners throughout Alabama.

**Center for the Management of Science and Technology (CMOST)**

The Center for the Management of Science and Technology (CMOST) is devoted to improving the state-of-the-art in the management of science and technology. CMOST funds and conducts research to develop new management techniques, is a “window on the world” source of the latest practices and a world-wide center for scientists, researchers and managers interested in the management of science and technology. CMOST focuses on the management of R&D, engineering, innovation, manufacturing, high-technology marketing, and new product development. CMOST is staffed by personnel with degrees and backgrounds in science and engineering, who also have advanced degrees in management. Most of the staff have several years of business experience in managing science and technologies.

**Center for Management and Economic Research (CMER)**

The center’s broadest goal is to stimulate expansion of the economy of North Alabama by helping local managers define and realize growth opportunities and solve specific problems. 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’s staff does contract research on business and economic problems for governmental organizations and private industry.

**Small Business Development Center**

The NorthEast Alabama Regional Small Business Development Center (NEAR SBDC) provides assistance to small businesses and aspiring entrepreneurs. The mission of NEAR SBDC is to help small businesses survive and grow. The Center provides four types of assistance: business management counseling, startup counseling, training/workshops, and a resource library.

Small business owners or managers receive professional assistance and direction in operating a business profitably. This may include counseling in one or more of the following areas: financial capital, business planning, personnel, record keeping, licensing, taxes, intellectual property, government procurement, governmental regulations, marketing, commercialization, small business innovation and research programs, market research, inventory control, or how to conduct a feasibility study. Small business reference materials (books and videos) are maintained in the NEAR SBDC reference library. Small business owners and entrepreneurs may visit the center and use business planning guides, watch or check out one of more than two dozen videos on business management, or work interactively with Internet, Electronic Data Interchange demos, and Electronic Commerce demos. For additional information, contact NEAR SBDC at 225 Church Street, Huntsville AL (Mail: P. O. Box 168, Huntsville AL 35804-0168; phone: (205) 535-2061; FAX: (205) 535-2050; email: Smallbus@hsvchamber.org).

**Executive Education Program**

The executive education program is designed to assist the members of the business, industry and governmental communities in keeping abreast of changes in a complex environment. The College of Administrative Science in cooperation with the Division of Continuing Education’s Office of Business and Management offers an interactive blend of management educational programming ranging from one-session seminars on specific problems to a sub-
Manual sequence of classes custom-tailored for corporate and governmental audiences. For more information, call the Division of Continuing Education Business and Management Department (205) 890-6440 or 1-800-239-6946.

Master of Science in Management

Purpose

The Master of Science in Management (MSM) program is designed as a specialized graduate degree in business administration offering a unique education in the management of technology. The educational emphasis of the program builds upon knowledge and skills in all of the business disciplines to prepare students to apply them to the special needs of the technology-based and -impacted organizations in the Huntsville region and beyond.

The MSM program was fashioned to be an interdisciplinary program in business for practicing administrators, primarily for early- and mid-career managers. The typical student has an educational background in business, engineering, or science, but aspires to mid-level and upper-level managerial positions in organizations in technology-driven environments. The curriculum is designed to accommodate students from the liberal arts and other non-business backgrounds. The students in this program are more mature than traditional full-time students. Most have been out of school and employed full-time from five to fifteen years. They aspire to upward career mobility or are seeking to change career paths.

The MSM program is recognized nationally through the American Assembly of Collegiate Schools of Business, and by the National Research Council when it named the program as one of nineteen programs in the nation with a major thrust in the management of technology.

The MSM program emphasizes the development of integrative systems thinking skills in order to build 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 orients students to the rigors of holistic thinking about technology-driven problems and opportunities, introduces students to concepts and tools from all the business disciplines to operate in a technological environment, draws on the expertise of managers from the technology-based and -impacted firms in the Huntsville area who daily face technology problems, and instills a commitment to teamwork.

The program recognizes the influence of computer technology on all management processes by thoroughly integrating computer applications into coursework. It increases skills in information management through the use of computerized classrooms, laboratories and computer-assisted instruction.

The curriculum provides instruction in financial reporting, analysis and markets; domestic and global economic environments of organizations; creation and distribution of goods and services; and human behavior in organizations. It provides advanced study in the decision science and human aspects of organizational problem-solving. It provides education in managing technological innovations and processes, and integrating technology into the organization's strategic objectives. It addresses such issues as analyzing problems through economic and financial frameworks, developing and using information systems, providing information on accounting costs, marketing, managing the development of technology, reducing new product development time, managing technical professionals, and integrating technology into the overall strategic objects of the organization.

Policies, Procedures, and Assistance

Admission Requirements

Individuals who are interested in obtaining application forms and information concerning admission procedures should contact Dr. Dorla Evans, the College's Assistant Dean, Room...
Admission to the MSM program is granted to students who show high promise of success in graduate 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, business, liberal arts, education, science, and nursing. Highly qualified science and engineering students seek the MSM degree to broaden their educational backgrounds and to prepare for careers in management. Highly qualified business students seek the MSM degree to prepare for technology-based or -impacted management positions. 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) also are required for the applicant whose native language is not English.

The GMAT measures general verbal, mathematical, and analytical writing skills that are developed over a long period of time and are associated with success in the first year of study at graduate schools of management. The GMAT does not presuppose any specific knowledge of business areas.

Applicants may arrange to take the GMAT by making application to: Graduate Management Admission Test, Educational Testing Service, P. O. Box 6103, Princeton, NJ 08541-6103. To ensure registration and to avoid a late fee, your registration form and proper fees must be received in Princeton approximately five weeks in advance of the test date. One should allow at least ten days for first-class mail delivery from U. S. locations. Applications to take the GMAT may be obtained from the College’s Assistant Dean, Room 102, Administrative Science Building. Indicate on the GMAT application that a copy of the test score be sent to the College of Administrative Science, the University of Alabama in Huntsville, Huntsville, AL 35899. The College’s code number is 1854.

One should take the GMAT at least two months in advance of the desired entry date, and should allow about four weeks from the date the GMAT is administered for scores to reach the college. The GMAT is offered four times each year in October, January, March, and June.

Once an applicant has submitted an application, transcripts from all institutions, and a GMAT score report, 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. The foregoing are minimum requirements. Applicants meeting the formula are not guaranteed admission into the MSM program. In making the admission decision the Admissions Committee considers the applicant’s baccalaureate program of study, verbal skills, quantitative skills, and writing skills.

2. Conditional Admission

This category is for non-native English speaking students who may qualify for conditional admission by meeting all the admission requirements but scoring less than 20 on the GMAT verbal score. Students may be admitted provided they take the UAH English Language Placement Test and complete any needed coursework in English as a Second Language.

Advisement and Registration Procedures

The faculty advisor for each MSM student is the Assistant Dean of the College of Administrative Science. After being admitted to the program, each student will meet with the College’s Coordinator of Advisement to file a Program of Study outlining a degree program,
including choice of electives. Each student must file a Program of Study before the completion of 12 hours of graduate work. During each registration period, all registration cards must be approved by the College's Coordinator of Advisement.

All students are encouraged to pre-register for classes during the priority registration period.

A major premise underlying counseling at the graduate level in the College of Administrative Science is that each student will act in the student's own best interest and that the student will use the advice provided to self-select into courses if the student's knowledge is weak in an area, even if the student has prior credit for the topic.

A student who has had previous coursework in one or more of the business administration core areas and has not been required to take a course is encouraged to take the department examination to evaluate the current level of preparation in the area. This would be particularly appropriate, for example, if the coursework were completed several years ago, if only minimum grades were earned, or if the grades earned do not reflect current proficiency. A student may enroll for credit or for audit in a course in which the student needs review.

**Course Load**

The usual course load for a full-time graduate student in management is from nine to twelve semester hours. Students who are employed full time should seek counsel from the faculty advisor (Assistant Dean) before enrolling in more than six semester hours per semester. Once admitted, students are expected to make satisfactory progress toward the degree, with such progress defined as the satisfactory completion of at least three courses during each twelve-month period following admission.

**Transfer Credit**

Courses taken at the graduate level which are transferred to satisfy courses in the business administration core areas are excluded from the UAH policy on the maximum number of hours permitted to be transferred. For the transfer credit policy applicable to courses beyond the business administration core areas, please refer to the section of this catalog entitled School of Graduate Studies, The Master's Degree, Transfer Credit.

**Time Limit**

All requirements for the MSM degree must be completed in six years or less. In the event a student does not complete the MSM degree requirements in six years, the student may petition for an exception for courses completed at UAH over six years ago but within the last ten years. The petition must be reviewed by the College's Graduate Program Advisory Committee (GPAC) and approved by the Dean of the College of Administrative Science and the Dean of the Graduate School.

If an exception is granted, any course completed at UAH more than six years but less than ten years before the completion of all requirements for the degree must be validated by a special examination. Such an examination, given by the faculty of the discipline in which the course was offered, can be taken only once and will be the equivalent of a comprehensive 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 and must have been earned within the six-year period.

Instead of requesting an exception for a course more than six years old, the student may substitute another course taken within the six-year limit and subject to approval of the GPAC and the Dean. If a course is substituted, a new program of study must be filed.

**Transition Policies for Students Who Entered Prior to Fall 1994**

A student who entered the MSM program prior to Fall 1994 should request the Assistant Dean to review his or her Program of Study. The College's Graduate Program Advisory Committee has authorized certain course substitutions. The Assistant Dean can provide assistance in making changes.
Advanced Standing

Students with the academic preparation in basic skills (written and oral English communication, quantitative analysis, and computer usage) and the business administration core areas may be granted advanced standing in the MSM 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 courses by having completed equivalent coursework with a minimum grade of “B.” Undergraduate credit by department examination is available for courses in the business administration core areas at the 500-level. A student seeking to take one of these examinations should see the Assistant Dean. At the time a student is admitted to the program, the transcript is reviewed to determine if these courses have been satisfied. The MSM program may consist of as few as 33 graduate hours for students who receive equivalent credit for all of the courses in the basic skills and business administration core areas.

Degree Requirements

A. Program of Study

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 for the program of study to be eligible for graduation:

Plan I - MSM thesis option:
1. Attainment of basic skills;
2. Completion of the business administration core areas;
3. Completion of 33 graduate semester hours;
4. Completion of the required advanced curriculum;
5. Completion of six hours of thesis;
6. A minimum “B” average for all degree credit coursework;
7. Submission of an acceptable thesis describing original research;
8. Successful completion of the final comprehensive examination on the coursework and thesis.

Plan II - MSM non-thesis option:
1. Attainment of basic skills;
2. Completion of the business administration core areas;
3. Completion of 33 graduate semester hours;
4. Completion of the required advanced curriculum;
5. Completion of six hours of graduate electives;
6. A minimum “B” average for all degree credit coursework;
7. Successful completion of the final comprehensive examination on the coursework.

B. Basic Skills Curriculum

Basic skills in (1) written and oral English communication; (2) quantitative analysis; and (3) computer usage must be achieved either by prior experience and education or as part of the MSM curriculum. The following list constitutes the courses at UAH most frequently used to provide students with basic skills in the three areas:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EH 101 and 102 (Composition)</td>
<td>6</td>
</tr>
<tr>
<td>MA 145 (Math Applications II)</td>
<td>3</td>
</tr>
<tr>
<td>MSC 287 (Statistics)</td>
<td>3</td>
</tr>
<tr>
<td>MIS 146 (Computer Usage)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

There are many variations in the content of statistics courses. While a student who has had a statistics course previously and earned a “C” or better can be exempted from MSC 287, the course may not have covered all the topics found in MSC 287. A student should self-select into MSC 287 if the student does not have a working knowledge of probability and hypothesis testing.
C. Computer Proficiency Requirement

As part of program requirements, each MSM student must be proficient with basic computer skills which include the use of operating systems, word processing, spreadsheet, and database software applications common to all modern computer applications. Because skill in the use of these applications is critical to the student's success in graduate school as well as in a management career, students with deficiency in computer skills will be required to take computer courses every semester they are enrolled until the deficiency is removed. Students with deficiency in computer skills will be advised at the time of their admission.

D. Business Administration Core Areas Curriculum

The MSM curriculum includes instruction in the following business administration core areas: financial reporting, financial analysis, financial markets, domestic and global economic environments of organizations, creation and distribution of goods and services, and human behavior in organizations. Coverage of these business administration core areas requires 18 graduate semester hours. The American Assembly of Collegiate Schools of Business (AACSB) requires each student to complete this curriculum to receive an AACSB-accredited master's degree in management. UAH satisfies this curriculum standard through the following graduate courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC 599</td>
<td>Foundations in Financial Accounting</td>
<td>3 hrs</td>
</tr>
<tr>
<td>FIN 601</td>
<td>Financial Decisions Under Uncertainty</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MGT 550</td>
<td>International Business</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MGT 599</td>
<td>Organization Theory, Behavior &amp; Environment</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MKT 599</td>
<td>Survey of Marketing Management</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MSC 599</td>
<td>Operations Management</td>
<td>3 hrs</td>
</tr>
</tbody>
</table>

18 hours

Part of this business administration core areas curriculum requirement may be completed at the undergraduate level. A student may be waivered from a 500-level course by having completed approved substitute undergraduate coursework with a minimum grade of "B". At the time a student is admitted to the program, the transcript is reviewed to determine if any of the 500-level coursework has been satisfied. Also, undergraduate credit by department examination is available for business administration core areas which are covered at the 500-level.

E. Advanced Curriculum

The advanced curriculum focuses on the management of technology, and consists of the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC 602</td>
<td>Managerial Accounting</td>
<td>3 hrs</td>
</tr>
<tr>
<td>ECN 626</td>
<td>Managerial Economics &amp; Technology</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MGT 601</td>
<td>Introduction to Technology Development</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MGT 622</td>
<td>Management of Technical Professionals</td>
<td>3 hrs</td>
</tr>
<tr>
<td>or MGT 631</td>
<td>Strategic Human Resource Management in Technological Environment</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MGT 698</td>
<td>Strategy for Management of Technology</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MIS 634</td>
<td>Management of Information Technology</td>
<td>3 hrs</td>
</tr>
<tr>
<td>MKT 606</td>
<td>Marketing in a High Technology Environment</td>
<td>3 hrs</td>
</tr>
</tbody>
</table>
MSC 690 Managing Technology Development 3 hours
Electives 6 hours
Students following Plan I select 6 hours of thesis
Students following Plan II select 6 hours of graduate electives with approval from the GPAC

30 hours

F. Strategic Management Requirement

Formally the curriculum includes two courses, Introduction to Technology Development (MGT 601) and Strategy for the Management of Technology (MGT 698) as the primary means of integrating the core areas and applying cross-functional approaches to organizational issues. Segments of Managing Technology Development (MSC 690) also deal with integrating across functional areas.

MGT 601 is the first course in the curriculum beyond the core and sets the stage for the integration of the courses that follow. MGT 601’s integration goals include introducing students to holistic management of technology issues, assisting students in acquiring an integrative systems approach to thinking about and managing the organizational impacts of technologies, especially emerging technologies, and introducing students to key management processes and process thinking. These goals are achieved by using an introductory strategic management perspective and by using College of Administrative Science faculty from each department to introduce the rest of the Management of Technology curriculum. The course also utilizes managers of technology in the local area to discuss cross-functional issues in their organizations.

MSC 690 addresses the integration of new product and technology development across traditional organizational boundaries, for example, managing relationships among R&D, marketing, and production. Boundary-spanning roles also are emphasized.

MGT 698 plays the capstone role of integration. The primary mechanism is the use of strategic management cases. By presenting organization-wide cases with interrelated, multifunctional, complex, and unstructured problems, the faculty requires students to use the specific knowledge and skills from the core areas to analyze each case and to make comprehensive recommendations to solve the problems uncovered by the analysis. The course also heightens the students’ appreciation of the organization-wide perspective of the Chief Executive Officer (CEO). Additionally, the course is designed to help students understand and appreciate how a business fits into its environment and the world at large.

The faculty’s goal is to produce graduates who are integrative, systems thinkers, or horizontal, as opposed to vertical, thinkers. Graduates should be able to think about and solve problems that cut across organizational boundaries and involve organizational processes. Graduates should be boundary-spanning problem solvers whether those boundaries are within the organization or external to it.

G. Final Comprehensive Examination

A final comprehensive written examination is required of all candidates for the Master of Science in Management degree. The candidate will be examined on the coursework and thesis in Plan I and on the coursework in Plan II. In the semester when a student completes MGT 698, the student may sit for the final comprehensive examination. The examination must be passed before the student may receive the degree. A student may take the final comprehensive examination only twice.

The final comprehensive examination evaluates candidates’ abilities to solve problems that cut across organizational boundaries and involve organizational processes through integrative and systems thinking. The format of the comprehensive examination is a case, appropriate to the integrative orientation of MGT 698 and MSC 690. These courses require students to use the knowledge and skills they have learned throughout the program. The graduate faculty believes the case approach allows students to demonstrate their strengths. The case does not test specif-
ic details of courses. Rather it allows students to illustrate their ability to apply knowledge to new situations. Successful examinations will demonstrate logical links between the facts of the case and students’ interpretations, and between the interpretations and recommendations.

One week before the examination students may pick up a copy of the actual case which will be the comprehensive examination. The assignment for the case will not be included. However, students are encouraged to familiarize themselves with the information in the case, work with others analyzing any issues in the case, use any resources they wish (other than faculty) to prepare for the possible assignment to be given. The faculty encourages teamwork on the case preparation because teamwork is encouraged throughout the program.

The examination is conducted by the College’s Graduate Program Advisory Committee. The examination committee is usually different from the thesis supervisory committee. The members of the examination committee are selected by the College’s graduate faculty. Moreover, the examination committee is composed of full-time UAH faculty members.

A written notice of the time and place of examination is sent to the Graduate Dean and the Registrar. The College sends a copy of the written notice to the candidate and each member of the committee. The examination is given in the fall and spring semesters at least one month before the date of graduation and the results are reported promptly to the Graduate Dean.

**Recommended Sequencing**

A proper sequence of courses is recommended to help students receive the maximum benefit from their degree program. The sequence enables faculty to presume that students have certain background knowledge when they enter courses. Contact the Assistant Dean to establish a sequence to fit individual needs. In general, the following is recommended:

1. Complete the basic skills requirements before enrolling in any business administration core areas. The skills may be achieved by completing undergraduate courses, presenting prior experience or by passing department examinations.
2. Complete the courses in the business administration core areas.
3. Complete MGT 601, Introduction to Technology Development, in the first semester that 600-level courses are scheduled.
4. Complete MKT 606 and MSC 690 after MGT 601.
5. MGT 698, Strategy for Management of Technology, is the capstone course and draws on the entire curriculum. Complete MGT 698 after the other 600-level courses and preferably in the last semester of the program.

Students may start in the Fall or Spring Semester or the Summer Term.

**Class Sessions**

Classes in the Fall and Spring Semesters meet from 5:30 P.M. to 8:20 P.M. with a ten-minute break. Classes meet on the nights shown. Classes in the Summer Term meet two nights per week from 6:00 P.M. to 9:20 P.M. on the nights shown.

<table>
<thead>
<tr>
<th>Night 1</th>
<th>Night 2</th>
<th>Night 3</th>
<th>Night 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MGT 622</td>
<td>ACC 602</td>
<td>ECN 626</td>
<td>MGT 601</td>
</tr>
<tr>
<td>MSC 690</td>
<td>MGT 698</td>
<td>MKT 606</td>
<td>Elective</td>
</tr>
<tr>
<td>MKT 599</td>
<td>ACC 599</td>
<td>MGT 599</td>
<td></td>
</tr>
<tr>
<td>Spring:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MGT 631</td>
<td>MIS 634</td>
<td>FIN 601</td>
<td>MGT 601</td>
</tr>
<tr>
<td>MSC 690</td>
<td>MGT 698</td>
<td>MKT 606</td>
<td>Elective</td>
</tr>
<tr>
<td>MSC 599</td>
<td>MGT 550</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer (1st):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIN 601</td>
<td>MIS 634</td>
<td>FIN 601</td>
<td>MIS 634</td>
</tr>
<tr>
<td>Summer (2nd):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACC 602</td>
<td>ECN 626</td>
<td>ACC 602</td>
<td>ECN 626</td>
</tr>
</tbody>
</table>
The list above indicates which classes are offered together on a given night. The day of the week may change across semesters and academic years.

Business Practice Opportunities

Students who have no meaningful work experience are encouraged to gain experience while they are in the MSM program. Students may enroll in an internship course (MGT 595, ACC 595) as one of their electives or may participate in the Cooperative Education program.

In an internship students earn credit for working 10 hours per week in a position relevant to their career preferences. No salary is earned. Students interested in the internship program should contact the Assistant Dean for the requirements to participate, and Career Services in University Center, Room 212, 890-6212, for opportunities.

The Co-op Office is responsible for placing qualified students with qualified employers and making sure both parties are satisfied. The Co-op Office is also responsible for ensuring students make satisfactory progress toward their degrees, receive relevant work experience, and earn competitive wages for the work they perform. To learn more, contact the Co-op Office in University center, Room 212, 890-6741, or through the World Wide Web at http://coop.uc.uah.edu.

Graduate Division Courses

Only students admitted to the graduate school may enroll for courses numbered 500 to 599. Baccalaureate candidates may register for a dual course number in the 400 to 499 series. Additional work will be required of the graduate student registered in the 500 level course to bring the course up to graduate level.

Courses numbered 600 to 699 are designed for graduate students only. Students may not be admitted to these courses unless they have been admitted to the Graduate School.

Offerings

The following abbreviations indicate the terms of the calendar the course normally will be offered: Su - Summer Term, F - Fall Semester, and Sp - Spring Semester. Where courses are offered on alternate years only, the words “even” or “odd” will indicate which years the courses will be offered. Course offerings by semester are subject to change dependent upon availability of faculty resources and to accommodate the needs of students.

Graduate Courses in Accounting (ACC)

513 Income Tax Accounting II

Tax accounting for partnerships, corporations, Sub chapter S corporations, estates, and trusts. Tax administration and research are emphasized. Lab Fee: $30. Prerequisite: ACC 313 and permission of the Accounting Advisor. F.

532 Advanced Auditing

Practical application of auditing concepts and standards. An understanding of auditing principles is reinforced and expanded by exposure to problems and cases. Lab Fee: $30. Prerequisite: ACC 431 and permission of the Accounting Advisor. Su.

550 Seminar in International Accounting

Current topics in international accounting. Prerequisite: ACC 311 and permission of the Accounting Advisor.

570 Seminar in Contemporary Accounting Issues

Current topics in professional accounting. Prerequisite: ACC 431 and permission of the Accounting Advisor. F, Sp.

590 Special Projects

Independent study in the field of accounting which is of interest to a student. Prerequisite: Permission of the Accounting Advisor.
595 Internship in Accounting 3 hrs.
Active involvement in a project in a business enterprise, professional organization, or government agency that has particular interest and relevance to the student. Prerequisite: Permission of the Accounting Advisor. F, Sp, Su.

599 Foundations in Financial Accounting 3 hrs.
Foundation course in financial accounting and reporting. Emphasis on analysis and use of accounting information in making economic decisions. Lab Fee: $10. Prerequisite or Co-requisite: MIS 146 and permission of Assistant Dean. F.

602 Managerial Accounting 3 hrs.
Examines the managerial uses of accounting information but is primarily non-technical. The focus 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. Prerequisite: ACC 599 or equivalent. F, Su.

607 Advanced Accounting Information Systems 3 hrs.
In-depth examination of accounting information systems. Emphasis on computer-oriented systems and current developments in systems. Prerequisites: ACC 307 and permission of the Accounting Advisor.

614 Advanced Managerial Accounting 3 hrs.
A study of alternative approaches to identifying and proactively managing the costs of providing services and/or manufacturing and distributing products. The focus is on the development of cost data useful to managers for decision making rather than for financial reporting. Special attention is given to current issues in cost management. Prerequisites: ACC 602 and permission of the Accounting Advisor. Sp.

615 Advanced Financial Accounting 3 hrs.
Analysis of issues and alternatives in advanced problem areas including partnerships, intercorporate investments, business combinations, and foreign exchange. Lab Fee: $30. Prerequisite: ACC 311 and permission of the Accounting Advisor. F.

642 Advanced Internal and Operational Auditing 3 hrs.
Introduction to the methodology of internal and operational auditing and to the utilization of results of the audit by management in decision making. Prerequisites: ACC 431 and permission of the Accounting Advisor.

650 Selected Research Topics 3 hrs.
Research in a particular topic relative to accounting 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 standard of accounting research. Prerequisites: ACC 602, 12 additional credit hours of graduate courses, and permission of the Accounting Advisor.

680 Accounting Theory 3 hrs.
Brief historical development of accounting followed by a study of recent developments, research, and literature in accounting theory promulgated by the various professional accounting associations and related financial organizations. Prerequisites: ACC 615 or equivalent and permission of the Accounting Advisor. Sp.

699 Master's Thesis 3 hrs.
Required each semester a student is working and receiving direction on a master's thesis. A minimum of two semesters is required but not more than six hours of credit is allowed. Prerequisite: Permission of the Accounting Advisor.
Graduate Courses in Business Legal Studies (BLS)

511 Business Law for Accountants 3 hrs.
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 or equivalent and permission of the Accounting Advisor or Assistant Dean. F, Sp.

625 Legal Aspects of Engineering 3 hrs.
Legal problems and principles relevant to the practice of professional engineers. The legal system, contracts, torts, business organizations, employment law, intellectual property law, and environmental law. Sp.

Graduate Courses in Economics (ECN)

554 International Finance 3 hrs.
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. Prerequisites: FIN 301 or equivalent and permission of the Assistant Dean. Sp.

561 Portfolio Management 3 hrs.
Functional application of investment portfolio management with emphasis on theory and models of investment management. Use of models in effective investment decision-making is stressed. Lab Fee: $30. Prerequisites: FIN #361 and permission of the Assistant Dean. Sp.

570 Commercial Bank Management 3 hrs.
Financial management of commercial banks with emphasis on asset and liability management and techniques such as hedging and financial engineering to management interest rate risk. Lab Fee: $10. Prerequisites: FIN 352 and permission of the Assistant Dean. Sp.

Graduate Courses in Finance (FIN)

531 Short-term Capital Management 3 hrs.
Financial principles applied to financial management problems such as cash management, payables and receivables management, cost of short-term credit, and forecasting and financial planning. Lab Fee: $30. Prerequisites: FIN 301 and permission of the Assistant Dean. F.

554 International Finance 3 hrs.
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 301. Sp.

561 Portfolio Management 3 hrs.
Functional application of investment portfolio management with emphasis on theory and models of investment management. Use of models in effective investment decision-making is stressed. Lab Fee: $30. Prerequisites: FIN #361 and permission of the Assistant Dean. Sp.

570 Commercial Bank Management 3 hrs.
Financial management of commercial banks with emphasis on asset and liability management and techniques such as hedging and financial engineering to management interest rate risk. Lab Fee: $10. Prerequisites: FIN 352 and permission of the Assistant Dean. Sp.

Principles of asset valuation, followed by an in-depth study of long-term financial decision making under uncertainty. Concepts and techniques of capital budgeting and cost
of capital are emphasized in domestic and global environments. Lab Fee: $10. Prerequisites: ACC 599 or equivalent and permission of Assistant Dean. Sp, Su.

### Graduate Courses in Management (MGT)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>501</td>
<td>Introduction to Contract Management</td>
<td>3 hrs.</td>
<td>Contracting basics, covering contracting procedures as prescribed by the Federal Acquisition Regulations, statutes, ethics, policies and other pertinent authorities that govern government contracting operations. Prerequisite: Permission of the Assistant Dean.</td>
</tr>
<tr>
<td>503</td>
<td>Contract Pricing and Cost Analysis</td>
<td>3 hrs.</td>
<td>Review of the contracting environment’s sources of data for cost and price analysis; methods for analyzing direct and indirect costs; methods for performing profit analysis; ethics of contract pricing. Individual and group negotiation sessions address the fundamentals of the negotiation process. Lab Fee: $20. Prerequisites: MGT 501 and permission of the Assistant Dean.</td>
</tr>
<tr>
<td>504</td>
<td>Negotiation Techniques</td>
<td>3 hrs.</td>
<td>Develops principles, skills, and techniques for effective negotiations of procurement actions. Includes verbal and nonverbal mannerisms, need to communicate, team approach, buyer’s preparation for negotiations, and various tactics and strategies for negotiating. Lab Fee: $20. Prerequisite: Permission of the Assistant Dean. Sp.</td>
</tr>
<tr>
<td>506</td>
<td>Government Contract Law</td>
<td>3 hrs.</td>
<td>Provides an understanding of the impact of government contract law on daily decision making in acquisition. Introduces basic legal principles and sources of contract law as they apply to the government’s acquisition of supplies and services. Court cases and administrative decisions are discussed with emphasis on how the law affects the government/contractor interface and how to avoid legal disputes. Lab Fee: $10. Prerequisites: MGT 301, 501 or equivalents and permission of the Assistant Dean. F.</td>
</tr>
<tr>
<td>511</td>
<td>Pre-Award Contract Management</td>
<td>3 hrs.</td>
<td>Concentrates on management functions in the pre-award phase of contracting and contracting problem analysis and resolution. Case studies and classroom activities expose students to contracting problems and management functions in the pre-award phase to help students develop decision-making skills relevant to managing a variety of government acquisitions. Prerequisites: MGT 501, 503.</td>
</tr>
<tr>
<td>521</td>
<td>Post-Award Contract Management</td>
<td>3 hrs.</td>
<td>Intensive examination of important areas of contract management. Topics include cost accounting principles, financial management, contract administration, organizations, terminations, disputes, quality assurance, labor relations, subcontractor controls, and environmental contract management. Prerequisites: MGT 301, 501, and 503 or equivalents and permission of the Assistant Dean. Sp.</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 units 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. Prerequisites: Permission of the Assistant Dean. F, Sp, Su.</td>
</tr>
</tbody>
</table>
550 International Business  
A cross-discipline, team-taught course combining theoretical and practical aspects of doing business in the global market. Three modules consisting of international management, marketing and economics/finance. Topics include the legal, socio-political environment, negotiation/diplomacy, import/export mechanics, international distribution, balance of payments, hedging, trade agreements (GATT), and international business strategy. Prerequisites: Permission of the Assistant Dean. F, Sp.

560 Employee Training and Development  
Introduction to the development of employee training and development programs, assessment of training needs, program evaluation, and organizational development. Prerequisites: MGT 301 or equivalent and permission of the Assistant Dean. F.

561 Wage and Salary Administration  
Introduction to compensation practices, legal constraints, wage and salary determination, and benefits programs. Prerequisites: MGT 301 or equivalent, MGT 363 and permission of the Assistant Dean.

562 Government Regulation of Employment Relations  
Analysis of the impact of government regulation on the management of human resources. Examines the implications for employer responsibilities and employee rights of evolving public policies pertaining to unfair dismissal, equal employment opportunity, unemployment, occupational safety and health, employee privacy, and union-management relations. These topics will be analyzed from a multidisciplinary perspective. Prerequisite: Permission of the Assistant Dean. Sp.

570 Special Topics in Technology Management  
Investigation of current theory, research, and practice on selected topics related to management in the high technology field. Prerequisite: Permission of the Assistant Dean. Su.

595 Internship in Management  
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: graduate standing, approval of department chair, and subject to college’s guidelines on internships.

599 Organizational Theory, Behavior and Environment  
Provides the conceptual tools to analyze the behavioral and organizational influences on systematic outputs such as quality, profitability, employee well-being. Focuses both on macro-level issues (e.g. organizational design, culture, power and politics, and strategic leadership) and on micro-level issues (e.g. motivation, decision-making, socialization, and diversity). Covers these topics in the broader social, legal, regulatory, environmental, and ethical context. Prerequisite: Permission of the Assistant Dean. F.

601 Introduction to Technology Development  
Introduction to the master’s program, introducing the student to emerging technologies, the macro-environmental and industry drivers for these technologies, the organizational issues facing firms affected by emerging technologies, and business research methods in management. Prerequisite: Permission of the Assistant Dean. F, Sp.

622 Management of Technical Professionals  
Differences in the nature of the research task and in the talents and skills required of scientists and engineers create special problems for the manager. Examines special issues in managing engineers, scientists, and technical support personnel. Topics include incentive systems and motivation, problems in team decision making, job design, evaluating performance, and leadership in R&D organizations. Prerequisite: MGT 599 or equivalent. F.
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. Prerequisite: MGT 599 or equivalent.

631 Strategic Human Resource Management in a Technological Environment  
Major functions of human resource management—planning, internal and external staffing, compliance with laws regulating employment relations, training and development, performance appraisal, compensation, employee relations, and union-management relations from a strategic perspective. Particular attention is given to special challenges faced by high technology firms and organizations experiencing technological change. Prerequisite: MGT 599 or equivalent. Sp.

640 Principles of Project Management  
Conceptual foundation and organization of project management. The project life cycle, planning, control, marketing, utilization of human resources, and financial management. Prerequisite: Permission of the Assistant Dean.

650 Selected Research Topics  
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 permission of the Assistant Dean.

698 Strategic Management  
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. Prerequisite: Completion of management core. F, Sp.

699 Master's Thesis  
Required each semester the student is working and receiving direction on a master's thesis. A minimum of two semesters is required but not more than six hours credit is allowed for the thesis. Prerequisite: Permission of the Assistant Dean.

Graduate Courses in Management Information Systems (MIS)

500 Decision Support Systems and Expert Systems  
Analysis of information system components and technologies which aid the manager in the decision making process. Concepts supported by use of current DSS/ES software. Lab Fee: $30. Prerequisites: MIS 301 or equivalent and 15 hours in the MSM program.

507 Accounting Information Systems  
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. Lab Fee: $40. Prerequisites: ACC 212, MIS 301 or equivalent and permission of the Assistant Dean. (Same as ACC 507.)

560 Data Communications and Distributed Processing  
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. Lab Fee: $20. Prerequisite: MIS 301 or equivalent and permission of the Assistant Dean.
Management of Information Technology  
Organizations large and small are increasingly becoming information-driven and information technology intensive. Focuses on issues concerning the impact of information technology on organizations, on organizational structure and competitive strategies. Lab Fee: $30. Prerequisite: Permission of the Assistant Dean. Sp, Su.

Selected Research Topics  
Research in a particular topic relevant to management information systems 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 information systems research. Lab Fee: $30. Prerequisites: 12 additional hours of graduate courses and approval of department chair.

Master’s Thesis  
Required each semester 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. Prerequisite: Permission of the Assistant Dean.

Graduate Courses in Management Science (MSC)

Decision Support Systems and Expert Systems  
Analysis of information support systems which aid the manager in the decision making process. Lab Fee: $30. Prerequisites: MIS 301 or equivalent and completion of the MSM foundation courses.

International Production Management  
Current topics related to international production management, such as Japanese production management systems, “off shore” production arrangements, joint production systems, vertical quality management. Prerequisites: MSC 385 or equivalent and permission of the Assistant Dean.

Advanced Production/Operations Management  
Further examination of the concepts, processes, and institutions involved with the production function of the firm. Topics include forecasting, production planning, and control, materials management, and quality control. Applications of management science tools to production problems. Lab Fee: $30. Prerequisite: MSC 385 or equivalent and permission of the Assistant Dean.

Operations Management  
Focuses on the concepts, processes, and problem-solving tools involved with the production function of a firm. Topics include applied linear programming, waiting line analysis, regression, statistical quality control, reliability, inventory, production planning and scheduling, and learning curves. Lab Fee: $30. Prerequisites: MSC 287 and permission of Assistant Dean.

Selected Research Topics  
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. Lab Fee: $30. Prerequisites: MSC 325, 12 additional credit hours of graduate courses; and approval of the department chair.

Managing Technology Development  
Practical management of technology methods and techniques from current research and successful industrial practice. Examines the state of the art in industrial new product development management. Lectures, cases, readings and an emphasis on student dis-
missions, presentations and interactions. The course has a strong research orientation, while at the same time focusing on management policies and principles. Prerequisites: MGT 599 or equivalent, FIN 301. F, Sp.

699 Master’s Thesis 3 hrs.
Required each semester 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: Permission of the Assistant Dean.

Graduate Courses in Marketing (MKT)

514 Marketing Emerging Technologies 3 hrs.
Comprehensive review of the new product development process. Specialized application of marketing research and marketing strategy to new product development, concept development and concept testing. Prerequisites: MKT 301 or equivalent and permission of the instructor and the Assistant Dean.

515 International Marketing 3 hrs.
Procedures and problems associated with establishing and carrying out 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 or equivalent and permission of the Assistant Dean.

570 Advanced Marketing Seminar 3 hrs.
Investigation of advanced marketing topics including marketing in high technology environment, relationship marketing, channel design and strategy, retailing, transportation, and logistics. Prerequisites: MKT 301 and permission of the Assistant Dean. F.

580 Marketing Management 3 hrs.
Management of marketing function of the firm: determination of objectives, organization and controls for effective utilization of marketing resources in coordinated effort with other major functional areas. Identification and selection of market opportunities. Competitive strategies and development of marketing policies and programs. Prerequisites: MKT 301 or equivalent and 15 hours in the MSM program. F, Sp.

599 Survey of Marketing Management 3 hrs.
Seminar format with case analysis is used to introduce students to the tools and concepts necessary for planning, organizing, and controlling marketing activities. Typical topics include market analysis and segmentation, market planning, market research, and product pricing, promotion, and distribution strategies. Lab Fee: $10. Prerequisite: Permission of the Assistant Dean. F.

606 Marketing in a High Technology Environment 3 hrs.
Investigation of the many functions, strategies, systems, environmental forces, and competitive activities involved in the marketing of ideas, goods, and services to organizational customers which include businesses, industries, institutions, and governments. These issues will be evaluated within the context of a high technology environment. Using a seminar format, case analysis and class participation will be important dimensions of the course. Prerequisites: MKT 599 or equivalent. F, Sp.
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  
Assistant Dean for Student Affairs: Jerrod K. Young, Lecturer  

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.  

Laboratory fees have been eliminated from engineering courses. A surcharge (presently $12 per semester hour) is assessed on all engineering courses. The proceeds are earmarked for the upgrading of engineering laboratories, and for the acquisition, maintenance, repair, and replacement of instrumentation and equipment to support the various engineering programs.  

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. Research areas for the M.S.E. and Ph.D. are the following:  
Aerospace Engineering  
Applied Mechanics  
Architectures  
Artificial Intelligence/Neural Networks  
Atmospheric Dynamics  
Combustion  
Communications, Radar  
Composites  
Computational Fluid Dynamics  
Control Theory
Cryogenic Engineering
Digital and Neural Computer Architecture
Digital Signal Processing
Electromagnetics, Plasma
Electronics, VLSI
Energy-Power
Engineering Management
Environmental Engineering
Hardware Design
Heat and Mass Transfer
Human Factors Engineering
Manufacturing Systems Engineering
Materials Engineering
Network Theory
Operations Research
Optoelectronics
Parallel Processing
Process Dynamics
Propulsion
Quality Engineering
Reaction Engineering
Software Engineering
Solar Terrestrial Environment
Solid State Electronics
Structural Engineering
Systems Engineering
Systems Simulation
Thermodynamics, Heat & Mass Transfer
VLSI/Electronics

In addition to the above, the College of Engineering participates in a Ph.D. level Materials 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. The program is described in this catalog under “Interdisciplinary Programs.” The College of Engineering also participates in a Ph.D. level Biomedical Engineering program in cooperation with the University of Alabama at Birmingham. Within UAH, the College of Engineering participates in the Ph.D. level Optical Science and Engineering program described under ‘Interdisciplinary Programs.’

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 1500 on the aptitude 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 a student who has a baccalaureate degree and, after evaluation of the quantity and quality of the work by the major department, is considered to be prepared and capable of successfully pursuing graduate work. To continue graduate study, a student admitted conditionally is required to maintain at least a B average in the first 12 semester hours of graduate coursework and to remove any other conditions imposed at the time of initial enrollment.
3. A student admitted to the University as nondegree postgraduate but denied admission to graduate school because of a deficiency in gradepoint average or GRE score may be reconsidered for graduate admission if such a student is otherwise eligible to pursue a particular engineering discipline. To be reconsidered, an applicant 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 Program 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 chair 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 chair. A supervisory committee, which usually is but does not have to be the same as the final examining committee, should be appointed after a student has completed 12 semester hours.

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

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

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

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

Plan II (No Thesis). Students planning to complete degree requirements under Plan II must (a) successfully complete an approved basic Program of Study, (b) successfully complete an approved extended program of study consisting of a minimum of 9 semester hours of courses numbered 500 or above, including Master’s Project for Plan II (697) or EM 697, and (c) pass a comprehensive final examination. Under certain conditions students may satisfy the degree requirements by satisfactorily completing 36 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 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**

Applicants desiring the Ph.D. must be admitted to the School of Graduate Studies as Ph.D. students. M.S. students who desire to become Ph.D. students must request to be re-evaluated for admission as Ph.D. students. 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: (a) foreign language requirement (if applicable), (b) basic program of study, (c) at least 18 hours of coursework in residence at UAH subsequent to passing the preliminary examination, and (d) advisory committee’s assurance of adequate preparation in the major and minor fields. 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.

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 chair of the department directs a student’s work until the preliminary examination is successfully completed. Thereafter the student immediately chooses an advisory committee, subject to acceptance by the faculty members chosen and approval by the Dean of Graduate Studies. This committee consists of at least five members of the graduate faculty, three representing the major field of study and one from each of the minor fields. The committee chairman must be a full graduate 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 semes-
ter 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 semester 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 or her 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. Residence at UAH as a doctoral 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. Residence includes full time study (enrollment in a minimum of 9 semester hours) in two consecutive semesters. All research effort presented for residence credit toward the Ph.D. degree must be performed under the direction of a member of the graduate faculty who holds full membership status.

Language Requirement

The student must satisfy the language requirement (if applicable) before applying for permission to take the qualifying examination.

Dissertation Registration

Students must register for doctoral dissertation (799) during the time they are actively conducting research and consulting their dissertation advisor. A minimum of 18 semester hours of 799 must be included in the program of study.

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.

Optional Programs within Existing Ph.D. Programs

The Ph.D. degree with options in chemical and materials engineering or civil and environmental engineering is available under a cooperative program with the Mechanical and Aerospace Engineering Department. Students interested in either option should contact the participating departments for specific details.
CHEMICAL AND MATERIALS ENGINEERING

Degrees: Master of Science in Engineering

Chair: J. E. Smith, Jr. Professor

Professors:
Grohse, E. (Emeritus)
Smith, J.E. Jr.; microgravity processing of ceramic and metallic composites, direct coal liquefaction, catalysis and reaction engineering, fiber optic chemical sensing, high temperature furnace development and modeling, and high speed shear layer mixing.

Associate Professors:
Chen, C.P.; multiphase transport, spray combustion, computational fluid dynamics, turbulence modeling of chemically reacting flows, and non-equilibrium thermo-physical phenomena associated with hypersonic flows.
Chittur, K.K.; blood materials interactions through infrared spectroscopic (FT-IR/ATR) techniques, protein-surface interactions and biological process monitoring techniques.
Nadarajah, A.; kinetic and transport phenomena associated with materials processing using computational fluid dynamics and statistical mechanics, numerical modeling of chemical processes and hydrodynamic stability theory.
Weimer, J.; characterization of the chemistry and structure of molecular adsorbates on solid surfaces and determination of the kinetics of surface processes using spectroscopic techniques in ultra-high vacuum or at process conditions.

Assistant Professor:
Hayes, D.G.; enzymatic reactions in nonaqueous media, protein behavior at interfaces, colloids and surfactants, lipid chemistry, and utilization of agricultural commodities

The Department of Chemical Engineering offers coursework and research leading to the Master of Science in Engineering degree. The Doctor of Philosophy degree is available through either the Materials Science Ph.D. program or through the option in chemical and materials engineering of the Department of Mechanical and Aerospace Engineering Ph.D. program.

The range of research interests in the chemical engineering faculty is broad. It affords graduate students opportunities for advanced work in processes, reaction engineering, electrochemical systems and material processing. The M.S.E. degree granted in these areas of concentration is equivalent to those available in a traditional chemical engineering program. Support is available at attractive levels for all qualified students including research or teaching assistantships, tuition grants as well as graduate fellowships and Co-op’s with federal and industrial research organizations. Please contact the Department of Chemical Engineering (205-890-6810) or visit our Homepage at http://cb-p5.cb.uah.edu for further details.

Admission Requirements
For unconditional admission to the chemical engineering graduate programs, a student must hold a bachelor’s degree from an ABET accredited program, have a grade point average of at least 3.0 and a GRE score of 1500. Outstanding (3.5 GPA) students from other technical fields may gain admittance to CHE by completing certain undergraduate courses.

Graduate Courses in Chemical Engineering (CHE)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>540</td>
<td>Physical Properties of Fluids</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

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.
541 Chemical Kinetics and Reaction Design
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
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: CHE 442. (Same as CE 549.)

550 Environmental Control
Engineering design and synthesis of environmental control systems. Control of multiphase systems with application to air and water pollution control. Prerequisite: CHE 442. (Same as CE 550.)

559 Selected topics in CHE
Credit to be arranged

570 Mechanical Behavior of Engineering Materials
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 microscopic viewpoint. Prerequisites: MAE/CHE 294, CE 370.

641 Advanced Thermodynamics
Application of classical thermodynamics. Treatment of problems involving nonideal gases and liquids, phase equilibrium, and chemical equilibrium. Prerequisite: CHE 344. (Same as MAE 641.)

642 Physicochemical Hydrodynamics
Treatment of electrokinetic phenomena, axial dispersion, convective diffusion in liquids, Brownian motion, flows driven by surface tensions, capillary motion.

644 Introduction to Electrochemical Systems
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. Prerequisite: CHE 443.

646 Thermodynamics of Materials
Treatment of thermodynamic topics as they apply to behaviors observed in metallic and non-metallic materials. Prerequisite: CH 341. (Same as CH 646.)

649 Transport Phenomenon
Mass, energy, and momentum transport in steady and transient motions in real and rheological substances. Prerequisite: CHE 442. (Same as MAE 649.)

650 Principles of Liquid and Solid Interface
Applies basic principles in thermodynamics and kinetics to characterize surfaces and surface phenomena. Fundamental properties of gas-liquid, liquid-liquid, solid-liquid, and solid-gas interfaces and phenomena occurring at these interfaces. Prerequisite: CH 341. (Same as CH 650 and MTS 650.)

652 Introduction to Air Pollution
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.)
654 Multiphase Transport and Particulate Phenomena 3 hrs.
Fundamental principles of gas-liquid/gas solid flows, particle size analysis, particle/droplet dispersion, pneumatic transfer, adhesion and agglomeration, atomization and spray, jump conditions at interface, numerical solutions. Prerequisite: CHE/MAE 649.

657 Advanced Process Control 3 hrs.
Application of modern control theory to chemical processes; multivariable control; estimation and adaptive control, optimal control. Prerequisite: CHE 445.

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

659 Selected Topics in Chemical Engineering Credit to be arranged

699 Master’s Thesis 3 or 6 hrs.
Required each semester in which student is working and receiving direction on a master’s thesis. A minimum of two terms and six hours is required for M.S.E. students. A maximum of nine hours of credit is awarded upon successful completion of master’s thesis.

747 Advanced Topics in Bioengineering 3 hrs.
Engineering aspects of microbial processes and the processing of biological materials. Integrating knowledge of governing biological properties and principles with chemical engineering methodology. Emphasis on current literature in the areas of purification and separation technology, bioprocess development and biomaterials. Prerequisite: B.S. in chemical engineering or permission of instructor.

749 Mass Transport 3 hrs.
Mass transfer in solid and fluid systems under steady and transient conditions. Integration of momentum, heat and mass transfer equations with application to reactive, rheological and multicomponent systems. Lab fee: $70. Prerequisites: MAE 643 and 651. (Same as MAE 749.)

757 Optical Techniques in Fluid Mechanics 3 hrs.
Discussion of laser courses, molecular interactions with light and diatomic spectroscopy needed fluorescence, Brillouin scattering, four wave mixing, CARS and other applications in optical fluid diagnostics. Prerequisites: MAE 552, OSE 542.

799 Doctoral Dissertation 3 or 6 hrs.

CIVIL AND ENVIRONMENTAL ENGINEERING

Degree: Master of Science in Engineering

Chair: William P. Schonberg, Professor

Professors:

Kubitza, W.K. (Emeritus)
Cruise, J.F.; hydrologic modeling, stochastic hydrology, remote sensing and GIS applications, sediment transport modeling, steady and unsteady full surface flow.
Schonberg, W.P; orbital debris impact of space structures, impact damage formation and growth in metallic and composite beams and panels, linear and nonlinear dynamic response of large space structures, armor/anti-armor studies, penetration mechanics.

Associate Professor:

Campbell, W.; chemical fate and transport, karst (caves and limestone) hydrogeology, pollution transport in karst, protection and modeling of endangered species habitats, remote sensing applied to karst hydrogeology.
Assistant Professor:
Leonard, K.; environmental engineering, water quality control, groundwater contamination, hazardous waste remediation, environmental assessment, hydraulics and modeling, remote fiber optic chemical sensing, hydrologic systems.

The Civil and Environmental Engineering Department offers coursework and research leading to the M.S.E. degree. The Ph.D. degree with an option in civil and environmental engineering is available under the auspices of the Mechanical and Aerospace Engineering Department.

Research performed by the civil engineering faculty emphasizes state-of-the-art technology and is geared largely toward space-based applications. The philosophy and unique qualifications of the faculty afford graduate students opportunities for advanced work in structural engineering, engineering mechanics, environmental engineering, hydraulics, and experimental mechanics/applied optics. Under a cooperative agreement, several courses are co-listed and jointly taught by civil and mechanical engineering faculty so that a variety of courses can be offered on a regular basis. Support is available at attractive levels for qualified students in the form of assistantships and/or tuition grants. Graduate Co-op positions are also available with many local research and industrial organizations. UAH has the intellectual and social environment to provide a well-rounded, technologically-oriented degree. The M.S.E. degree granted by the department is equivalent to that available in traditional civil and environmental engineering programs.

Admission Requirements
For unconditional admission to these programs, a student must hold a bachelor’s degree from an ABET accredited program, have a grade point average of at least a 3.0, and have a GRE score of at least 1500. Outstanding (3.5 GPA) students from other technical fields may gain admittance to the graduate program by completing certain undergraduate courses. Please contact the department for further details.

Degree Requirements
All M.S.E. students in civil and environmental engineering are guided through one of two specialized areas of concentration: structures and mechanics or environmental engineering. Enrolling in CE 559/659/759 allows CE graduate students to take courses not listed in this catalog which are pertinent to their major. All M.S.E. students must choose to follow either the Plan One or Plan Two program of study, regardless of their area of concentration. Students selecting the Plan One program of study must (a) successfully complete an approved basic program of study; (b) complete an acceptable thesis (CE 699) for which an additional 9 hours of credit can be obtained; and (c) pass a thesis-related final examination. Students planning to complete the M.S.E. degree requirements under the Plan Two program of study must (a) successfully complete an approved basic program of study; (b) successfully complete an approved extended program of study consisting of a minimum of 9 semester hours of graduate coursework and submit an acceptable independent research paper (CE 697); and (c) pass a comprehensive final examination.

The department cooperates with the Mechanical and Aerospace Engineering Department to offer students a program leading to a doctoral degree. Such work is supervised by an experienced researcher and recognized authority in the field. Coursework, written and oral examinations, and the dissertation are all essential components of the doctorate. All Ph.D. students must enroll in the departmental seminar, CE 683, for three semesters. Ph.D. students must meet the minimum requirements set by the School of Graduate Studies, the College of Engineering, and the department. Please contact the department for further details regarding degree requirements, including required examinations.
Graduate Courses in Civil Engineering (CE)

503 Reinforced Concrete Design 3 hrs.
Design of reinforced concrete structures with emphasis on the ultimate strength method. Aspects of prestressed concrete design: computer applications. Prerequisite: CE 381 or consent of instructor. (Same as CE 403.)

504 Structural Design 3 hrs.
Principles of the design of steel structures using ASD methods. Analysis and design of structural elements including beams, columns, connection details. Prerequisite: CE 371 or consent of instructor. (Same as CE 404.)

530 Concrete Mix Proportioning 3 hrs.
Classification of concrete aggregates and their effects on concrete properties. Mixing, placing, and testing of normal weight, high strength, and lightweight concretes. Proportioning according to ACI methods. Laboratory included. (Same as CE 430.)

541 Open Channel Hydraulics 3 hrs.
Design and analysis of erodible and non-erodible channels. Uniform flow, channel roughness, gradually and spatially varied flow, rapidly varied flow, hydraulic jumps, gradually varied unsteady flow, flood routing, flow measurements, channel models, channel and culvert design. Prerequisite: CE 472.

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: MAE 352. (Same as CHE 549.)

550 Environmental Control 3 hrs.
Engineering design and synthesis of environmental control systems. Control of multiphase systems with application to air and water pollution control. Prerequisite: MAE/CHE 442. (Same as CHE 550.)

552 Industrial Waste Treatment 3 hrs.
Advanced topics in the area of hazardous waste management and water quality control. Emphasis on industrial waste, including hazardous waste management. Topics include: generation, storage, collection, transfer, disposal, recycling, economic, environmental, and regulatory considerations. Prerequisite: CE 549.

553 Water Resources Planning 3 hrs.
Identification and evaluation of water management plans to meet the demands for water quantity and quality at specific locations and times. Topics include: quantitative methods, uncertainty analysis, identifying objectives, and water quality management modeling. Focus is on surface water sources. Prerequisite: CE 549.

555 Water Quality Laboratory 3 hrs.
Properties of natural water sources and laboratory methods associated with municipal water and wastewater treatment systems. Student design and demonstration of a water treatment system to bring a water sample into compliance with drinking water standards. Prerequisite or parallel: CE 456/556. (Same as CE 455.)

556 Water Quality Control Processes 3 hrs.
Principles of public water supply design. Source selection, collection, purification, and distribution for municipal use. Collection of waste waters, their treatment, and disposal. Prerequisite: MAE 352. (Same as CE 456.)

557 Hydrology 3 hrs.
Occurrence and movement of water over the earth's surface for engineering planning and design. Relationship of precipitation to streamflow with frequency analysis, flood routing, and unit hydrograph theory. Prerequisite: MAE/CHE 352. (Same as CE 457.)
Environmental Engineering Design  
Engineering design and project management of environmental quality/restoration systems. Students will complete a design project focusing on one of the following systems: sanitary landfill, municipal incinerator, or groundwater/site remediation. Lectures will address skills for technical presentations and proposal writing, as well as process design and decision making. Prerequisite: CE 449. (Same as CE 458.)

Selected Topics in Civil Engineering  
Credit to be arranged

Vibrations of Elastic Systems  
Formulation of the equations of motion of discrete and continuous systems, analytical and numerical methods of solution, eigenvalue problems, and dynamic response. Prerequisite: MAE 488. (Same as CE 461 and MAE 461/561.)

Mechanical Behavior of Engineering Materials  
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 microscopic viewpoint. Prerequisites: MAE/CHE 294, CE 370.

Applied Mechanics of Solids  
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: CE 370. (Same as CE 474 and MAE 474/574.)

Experimental Techniques in Solid Mechanics  
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: CE 370 and junior standing. (Same as CE 477 and MAE 477/577.)

Matrix Methods in Structural Mechanics  
Matrix application to formulation and solution of linear problems in structural mechanics. Stresses, vibrations, and stability of engineering structures. Prerequisite: MAE 362, CE 370. (Same as CE 478 and MAE 478/578.)

Advanced Soil Mechanics  
Continuum mechanics applied to soil behavior. Theoretical approaches to consolidation, shear strength, slope stability and soil stabilization. Prerequisite: CE 372. (Same as CE 481.)

Soil Dynamics  
Behavior of soils under dynamic, earthquake and blast loading. Analysis of foundation vibration and isolation. Prerequisite: CE 372. (Same as CE 482.)

Foundation Engineering  
Design of foundations with emphasis on reinforced concrete, footings, caissons, piles, retaining walls, and mat foundations. Effect of bearing pressure on foundations. Prerequisites: CE 372 and 403. (Same as CE 485.)

The following courses are open to graduate students only:

Erosion and Sedimentation  
River morphology and river response, incipient erosion and its prediction, bed form and roughness, degradation, aggradation, and local scour in alluvial rivers. Design of stable channels, computation of bed load. Prerequisites: CE 472, 554.
650 Environmental Impact Analysis 3 hrs.
National environmental policy act and its implementation. Environmental impact process. Writing an environmental impact statement. Prerequisite: CE 549.

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

653 Groundwater Engineering 3 hrs.
Application of engineering principles to the movement of groundwater. Influence of physical and geological environment on groundwater hydraulics. Water well hydraulics and aquifer evaluation. Emphasis on practical groundwater engineering problems. Prerequisite: MA 526 or MAE 693.

654 Environmental Transport 3 hrs.
Fundamental principles of mass transport, chemical partitioning/transformations in environmental systems. Practical transport examples for surface water, ground water, and atmospheric systems will be presented and mathematical modeling will be utilized for solutions. Prerequisite: CE/CHE 549.

655 Hazardous Waste Management 3 hrs.
Topics include definition of hazardous waste, regulatory considerations, risk assessments, and categories of waste. Current and emerging treatment and disposal technologies will be explored. Prerequisite: CE/CHE 549.

659 Selected Topics in Civil Engineering Credit to be arranged

660 Structural Dynamics 3 hrs.

671 Continuum Mechanics 3 hrs.
Kinematics and kinetics, various coordinate systems, constitutive equations for continuous media: applications to solids, liquids, and gases. Prerequisites: MAE/CHE 352, CE 370. (Same as MAE 671.)

672 Theory of Elasticity 3 hrs.
Formulation of boundary-value problems of classical elasticity. Application to plane problems, prismatic members, and axisymmetric problems. Introduction to three-dimensional problems. Prerequisite: CE 671. (Same as MAE 672.)

673 Plasticity 3 hrs.
Fundamentals of mechanical behavior of metals and nonmetals for stress states greater than the yield stress state. Deformation and flow theories. Stress-strain relations and yield criteria. Solution of boundary value problems with plastic bodies. Limit analysis of structures. Prerequisite: CE 671. (Same as MAE 673.)

674 Finite Element Analysis I 3 hrs.
Finite element theory, variational methods, weighted residuals. Applications to linear partial differential equations in continuous media. Solution of boundary value and initial value problems. Prerequisite: CE 671. (Same as MAE 674.)

675 Rock Mechanics 4 hrs.
Principles of continuum mechanics applied to the design of structures in rock; tunnels, underground structures and foundations. Joint behavior; stresses; analysis of rock slopes; instrumentation. Prerequisite: CE 372.
Viscoelasticity 3 hrs.

Optical Techniques in Solid Mechanics 3 hrs.
Conventional methods for experimental stress analysis. Introduction to applied optics with emphasis on non-destructive, laser-based testing methods, fiber optic recording systems, photoelectronic-numerical data acquisition, and computer aided analysis. Prerequisite: CE 577. (Same as MAE 677.)

Mechanics of Composite Materials 3 hrs.
Introduction to composite materials, micro- and macro-mechanical behavior of laminae; bending, buckling and vibration of laminated plates. Prerequisites: CE 671, 672 (Same as MAE 678.)

Hypervelocity Impact Phenomena 3 hrs.
Fundamental principles of penetration mechanics. Analytical and numerical approaches to perforation and penetration problems. Shock jump conditions, hugoniots, and equations of state; low, high, and hypervelocity impacts of finite and thin targets. Prerequisites: CE 574, 671, or permission of instructor.

Graduate Seminar 0 hrs.
Professional activities designed to promote the skills required to organize and deliver oral technical presentations and to broaden the individual's awareness of technical issues. Each student will deliver one oral technical presentation and attend and submit a brief written summary of two professional lectures during each semester of enrollment. Minimum one-semester enrollment required of M.S.E. students and minimum three-semester enrollment of Ph.D. students. (Same as MAE 683.)

Master's Project for Plan II 3 hrs.
Required for completion of requirements for Plan II master's degree in the CE department. A written report is due at the end of the semester in which this course is taken for credit.

Master's Thesis 3 or 6 hrs.
Required each semester in which a student is working and receiving direction on a master's thesis. Minimum of two semesters 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.

Hazardous Waste Remediation 3 hrs.
Engineering design skills applied to the solution of real world hazardous waste remediation problems. Remedy screening and selection; treatment train development for a Superfund facility. Prerequisite: CE 655 or equivalent.

Selected Topics in Civil Engineering Credit to be arranged

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: CE 660. (Same as MAE 762.)

Random Vibration of Elastic Systems 3 hrs.
Dynamic analysis of elastic systems including the response of complex structures to random excitations. Typical excitations include random wind, thermal, earthquake, aerodynamic, and ocean wave phenomena. Probabilistic mechanics methods. Concepts of reliability. Stationary and ergodic processes. Prerequisite: CE 561. (Same as MAE 765.)
772 Theory of Structural Stability  
Energy criterion for stability of elastic structure under conservative loading. Stability concept for general continuous systems. Rigorous and approximate methods of analysis. Buckling of structural elements under impulsive and nonconservative loading. Postbuckling behavior. Prerequisite: CE 671. Offered upon demand. (Same as MAE 772.)

773 Theory of Shells  
Analysis of thin plates and shells, including higher approximations theories and transverse-shear deformations; Illustration of theories by selected problems. Prerequisite: CE 671. (Same as MAE 773.)

774 Finite Element Analysis II  
Advanced topics in finite element analysis: application to nonlinear partial differential equations in continuum mechanics: theoretical studies of convergence and stability of solutions. Prerequisite: CE 674. (Same as MAE 774.)

778 Fracture Mechanics  
Theory of crack propagation, stress intensity factors, mapping techniques, series expansion, asymptotic approximations, field singularities, integral transforms, numerical solutions. Prerequisite: CE 672. (Same as MAE 778.)

779 Advanced Penetration Mechanics  
Advanced analytical modeling of penetration and perforation phenomena, hydrocode development and applications, and similitude analysis. Prerequisite: CE 679 or permission of instructor.

799 Doctoral Dissertation  
3 or 6 hrs.

ELECTRICAL AND COMPUTER ENGINEERING

Degrees: Master of Science in Engineering  
Doctor of Philosophy

Chair: Stephen T. Kowel, Professor  
Associate Chair: R. R. Adhami, Associate Professor

Distinguished Professor:  
Johnson, C.D.; control and dynamic systems

Professors:  
Abushagur, M.A.G.; optical signal processing, computing, and metrology  
Audeh, N.F.; electromagnetics, antenna, microwaves, numerical methods  
Banerjee, P.P.; nonlinear wave phenomena, optical processing  
Fork, R.; photonics, optical communications  
Ho, F.D.; microelectronic devices and integrated circuits, photovoltaic devices, electronic materials  
Jarem, J.M.; electromagnetics, antenna theory, microwave theory, optics  
Kowel, S.T.; opto-electronic materials, devices and systems  
Porter, W.A.; neural computing, array architectures, signal processing  
Poularakis, A.D.; statistical optics  
Singh, N.; electromagnetics, plasma, space research  
Stensby, J.; communication systems and signal processing

Associate Professors:  
Adhami, R.R.; digital signal processing, digital systems design  
Katsinis, C.; computer architecture
Kulick, J.H.; computer design, computer-generated holography, medical image processing
Lindquist, R.G.; nonlinear optics, liquid crystalline materials and devices
Nordin, G.P.; volume holography, optical interconnections and memories, opto-electronics
Shen, D.; electrical materials and devices, thin film deposition
Shtessel, Y.; automatic control theory, sliding modes, multicriteria control

Assistant Professors:
Boykin, T.B.; theory and modeling of nanostructures, solid state devices
Cohen, W.; computer engineering, compiler design
Gacde, R.K.; computer engineering and design for testability
Maier, M.W.; radar, communications, system architecture
Wells, B.E.; computer architecture

The Department of Electrical and Computer Engineering offers both the M.S.E and the Ph.D. in electrical and computer engineering. The Ph.D. in optical science and engineering, an interdisciplinary program, is offered jointly by the College of Science and the College of Engineering. NSF Graduate Traineeships are available for U.S. permanent residents and citizens with outstanding credentials. This flexible program prepares students with varied scientific backgrounds for research careers in such fields as classical optics, spectroscopy, optical processing and computing, optical inspection, optical materials, and opto-electronics. In addition, the M.S.E. degree is offered in optics and photonics technology, a practice-oriented program for students desiring to prepare for a career in the design, manufacturing, and marketing optical and opto-electronic technology. Details of this area are available in the departmental office.

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. For more information, consult the department’s Website, http://www.eb.uah.edu/ece, which provides descriptions of faculty research interests, research facilities, and academic programs. The department’s e-mail address is ece@ebs330.eb.uah.edu.

Degree Requirements

Like the general Graduate School requirements, the M.S.E. has two options: Plan I which requires 24 of coursework hours plus thesis, or Plan II of 33 hours plus a technical paper. Under certain conditions students may satisfy the degree requirements by satisfactorily completing 36 hours of coursework. A comprehensive oral exam is required for all options.

Applicants admitted to the Ph.D. program must pass a written preliminary examination to remain in the program. 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.

Computer Engineering

There are several areas of specialization within the subject of computer engineering. A student may choose any one of these areas for a major and another for a minor. They include:
- Architectures
- Hardware Design
- Neural/Artificial Intelligence
- Parallel Processing
- Software Engineering
- VLSI/Electronics

Admission Requirements

Students with a B.S. degree in electrical engineering or computer engineering may be admitted according to the Graduate School admission requirements. They are a minimum GPA
of 3.0 and a minimum GRE composite score of 1500. Students with a B.S. degree in computer science or in other physical sciences may be admitted pending the completion of knowledge-base requirements, namely:

- EE 315 Electronics
- CPE/EE 302 Computer Design
- CPE 355 Real Time Systems
- CPE/EE 429 Microcomputers
- CPE 454 Computer Systems Software

Software Engineering

A non-thesis M.S.E. degree program with a concentration in software engineering is available. Admission requirements are the same as above. In this 36-hour program, students fulfill a double major, one of which is a five-course cluster in computer science. The rest of the program is composed of CPE courses in addition to meeting other Graduate School general requirements for the M.S.E.

Electrical Engineering

The electrical engineering program includes specialization to suit the desired needs of students. From these specializations students choose majors and minors for both degree programs. A student may also choose a minor from computer engineering or other engineering areas based on the advice of a faculty member in the ECE department. These specializations are:

- Communications, Radar
- Control Theory
- Digital Signal Processing
- Electromagnetics, Plasma
- Electronics, VLSI
- Opto-electronics

Optics and Photonics Technology

The M.S.E. program in optics and photonics technology offers a mix of optical science and engineering courses, augmented by courses in management. Special courses with strong application orientation are followed by an off-site practicum at a federal or industrial laboratory culminating in a master's thesis. The course component is composed of 21 hours of required core courses, including 6 hours of optics principles, 9 hours of optical design and manufacturing, and 6 hours of engineering management; 6 hours of electives; and 6 hours for the practicum and thesis. The elective component is a two-course sequence chosen from optical systems, quantum optics, optical signals, optical communications, optical materials, physics, management, marketing, or a manufacturing technology specialty.


Admission Requirements

Students with a B.S. degree in electrical engineering from an ABET accredited program may be admitted according to the Graduate School admission guidelines. They are a minimum GPA of 3.0 and a minimum GRE composite score of 1500. Students with a B.S. in other engineering programs or in other physical sciences may be admitted pending the completion of courses which demonstrate certain minimal proficiency in electrical engineering subject matter.
Graduate Courses in Computer Engineering (CPE)

510 Selected Topics in Computer Engrg. Credit to be arranged

542 Parallel Processing 3 hrs.
Introduction to parallel processing. Emphasis on the many possible forms and ramifications of parallelism in a computer system. Topics include parallelism in uniprocessor systems (vector, pipeline), multi-processor systems (hypercube, shared memory systems), and IO systems, array and systolic processors, algorithms, and operating systems. Prerequisite: CPE 433.

582 Introduction to VLSI Design 3 hrs.
Modern VLSI design techniques and tools, such as silicon compilers and (V)HDL modeling languages. Students are expected to design and simulate a VLSI chip. Prerequisite: EE 402.

595 Microcomputer Development Systems 3 hrs.
Development of general purpose stand-alone microprocessor systems using a microprocessor development system. Prerequisites: EE 509, 402. (Same as EE 595.)

602 Digital Computer Design 3 hrs.
Digital arithmetic, logic matrices, redundant logic circuits. Flip-flops, delayers, shift registers, counters, parallel and serial adders, subtracters, multipliers, dividers, comparators, accumulators. Structure of simple digital computer, digital differential analyzer, and digital filter. Prerequisite: EE 402. (Same as EE 602.)

610 Selected Topics in Computer Engineering Credit to be arranged

623 Design of Knowledge-Based Systems 3 hrs.
Introduction to engineering methods pertinent to application of expert systems to engineering problem solving. Knowledge representation and engineering knowledge modeling, system architecture and control knowledge, user interfacing, knowledge acquisition, and survey of commercial tools and shells for electrical and computer engineering applications. Exposure to symbolic (LISP) and object-oriented programming techniques. Prerequisite: EE 505 or 513. (Same as EE 623.)

625 Systolic Array Processing 3 hrs.
Systolic structure of fast algorithms and switchable array realizations. Prerequisite: CPE 542.

628 Fault Tolerant Computing 3 hrs.
Introduction to fault tolerant computing systems and testing of digital electronic circuits. Topics include: fault modeling, testing problems, testing schemes, test generation for combinational and sequential circuits, the complexity of testing, and design for built-in self-testing. Prerequisite: CPE 542.

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 and 509.

631 Architectures for Parallel Processing 3 hrs.
Parallel Computation 3 hrs.
Parallel computers and efficient algorithms for parallel computation. Models of parallel computation, designing parallel algorithms, sorting and FFT, matrix multiplication, numerical algorithms, graph algorithms, NP-complete and NP-hard problems and combinatorial search, parallel heuristic solution techniques such as parallel simulated annealing and logic programming. Prerequisite: CPE 542.

Analytic Models of Interconnection Networks 3 hrs.
Single and multi-stage interconnection networks, communication bandwidth, queuing networks, simulation techniques, hardware support, network operating systems. Analysis of representative systems: hypercube, tree, ring, lattice, bus, butterfly networks. Prerequisites: EE 420 and CPE 542.

Computer Networks 3 hrs.
Introduction to hardware and software problems related to computer networking. (Ethernet, FDDI, Sonet) models (OSI/ISO), and specific protocols (TCP/IP, x25, and others). Prerequisite: CPE 542.

Advanced VLSI Design 3 hrs.
Implementation details of advanced processors. Will require the student to implement using VLSI technology, a RISC processor. Prerequisite: CPE 582.

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

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

Selected Topics in Computer Engineering Credit to be arranged
Architectures for Symbolic Processing 3 hrs.
Special-purpose computer architectures for symbolic processing. Includes symbol and list representations, dynamic memory allocation, matching, logic programming, production systems, constraint propagation, semantic networks, and belief networks. Prerequisite: CPE 623.

Projects in Systolic and/or Neural Computing 3 hrs.
Detailed study of selected applications for systolic and/or neural computing. Prerequisite: CPE 625 or EE 649.

Uncertainty, Common Sense, and Qualitative Reasoning 3 hrs.

Adaptive Modeling, Planning, and Engineering Design 3 hrs.
Modeling engineering artifacts using symbolic representations. Includes structure, function, and behavior models, qualitative and constraint-based models. Emphasis on planning, design, and learning from past failures and successes. Prerequisite: CPE 623.

Parallel Processing Design 3 hrs.
Develops a framework for parallel program architecture design. Hardware ramifications of all models. Parallelism and programming, programming logic, architectures and mappings, program structuring, communicating processes, termination detection, fault tolerance, combinatorial search, systolic arrays as programs and alternate programming models. Prerequisite: CPE 642.
Graduate Courses in Electrical Engineering (EE)

Courses at the 500-level are taken by seniors and first year graduate students. Up to 12 hours of 500-level courses may count toward 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  
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, OSE 500.)

502 Advanced Logic Circuits  
Boolean algebra, consensus functions; star array, hypercube, Quine-McCluskey, Karnaugh maps; full transformations, partial transformations; synthesis of symmetric functions and multiple input adders; algebraic theory of flip-flops; the binary comparator; serial and parallel arithmetic. Prerequisite: EE 202. (Same as EE 422.)

503 Random Signals in Communication  
Random processes applied to communication and control. Concepts covered include stationarity, correlation, power spectrum, Brownian motion, thermal noise, Markov processes and queuing theory. Emphasis placed on systems with noisy excitation. Prerequisite: EE 500.

505 Introduction to Control and Robotic Systems  
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  
Transmission of information including effects of networks, modulation systems, noise, and use of statistics in analysis of information transmission. Prerequisite: EE 500. (Same as EE 426.)

509 Microcomputers  
The microcomputer as a component in digital design. Laboratory experience in interfacing and design projects. Prerequisites: EE 202 and 315; EE 516 recommended. (Same as EE 429.)

510 Selected Topics in Electrical Engrg.  
Credit to be arranged

512 Advanced Senior Design Project in Electrical Engineering  
Individual design project under the direction of an EE faculty member. Prerequisite: Senior standing.
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.

516 Digital Electronics

Electronic devices. Integrated-circuit logic families (DTL, TTL, ECL, etc.) and their design theory. MOSFET circuits and their design theory. Flip-flop, registers and counters. Arithmetic operations. Solid-state memories. Analog switches. Analog-to-digital conversion. Prerequisites: EE 202, 315. (Same as EE 436.)

519 Digital Electronics Laboratory

Experiments and reports related to logic circuit realization of digital hardware. RTL, D, T, C families for combinational and sequential switching circuits. Must parallel EE 516. (Same as EE 439.)

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. (Same as EE 452.)

534 Optical Fiber Communications

Introduction to optical fibers and their transmission characteristics, optical fiber measurements, sources and detectors, noise considerations for digital and analog communications, optical fiber systems. Prerequisite: EE 407 or PH 432. (Same as OPE 454.)

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.

542 Optics II

Physical optics, and electro-optics; interference, Michelson & Febry-Perot interferometers; optical fiber gyros and sensors; Fraunhoffer and Fresnel diffraction; coherence theory; light sources, lasers, optical detection and modulation. Prerequisite: EE 541.

595 Microcomputer Development Systems

Development of general purpose stand-alone microprocessor systems using a microprocessor development system. Prerequisites: EE 509, 302.

600 Bit-Slice Design

Theoretical and practical aspects of computer hardware design using AMD 2900 family bit-slice components. Prerequisite: EE 509.

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


603 Computer Methods in Power Systems

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, 501.
604 Digital Image Processing 3 hrs.
Derivative matrices and u-notch, r-notch filters. Periodic images, their transformation
and scanning, their two-dimensional Fourier transforms. Rational vectors and image
filtering. Prerequisite: EE 601.

605 Classical Control Design 3 hrs.
Design of feedback, feedforward, and minor-loop controllers/compensators using classical
control engineering techniques and classical performance criteria. Frequency domain syn-
thesis of lead, lag, lead-lag, etc. compensators; tuning of PD and PID controllers; error bud-
gets; use of commercial CAD software for classical control design and performance evalua-
tion; digital simulation techniques. CAD laboratory sessions. Prerequisite: EE 425/505.

606 Statistical Communications Theory 3 hrs.
Generalized harmonic analysis. Correlation, convolution, power density spectra.
Prerequisites: EE 503 and 506.

607 Robotic Systems Control 3 hrs.
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 con-
trol. Prerequisite: EE 425/505.

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

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

610 Selected Topics in Electrical Engineering Credit to be arranged.

611 Signal Analysis 3 hrs.
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 trans-
forms. Prerequisites: EE 425/505, EE 426/506.

612 Graduate Design Project 3 hrs.
Graduate design project in support of an M.S.E. program. Prerequisite: approval by
M.S.E. committee.

613 Laser Electronics 3 hrs.
Resonant optical cavities. Atomic radiation. Laser oscillation and amplification. General
characteristics of lasers. Laser excitation. Semiconductor lasers. Gas-discharge phe-
nomena. Transition rates. Spectroscopy of common lasers. Detection of optical radia-
tion. Prerequisite: EE 416 or 516.

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

616 Microelectronic Devices and Integrated Circuits 3 hrs.
Analysis and design of microelectronic devices for integrated circuits. Properties of
semiconductors important to microelectronic device operation. Analysis and modeling
of MOS devices and circuits. Analysis and modeling of metal semiconductor devices,
junction diodes, bipolar transistors. Device fabrication technology. Prerequisite: EE 516.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Prerequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>617</td>
<td>Very Large Scale Integration Devices</td>
<td>3 hrs.</td>
<td>Operation and modeling of the MOS transistor. Second-order considerations for a MOSFET, VLSI device fundamentals and scaling laws. Micron-length and submicron-length semiconductor devices. Basic technology and applications of VLSI. Impact of VLSI on computer architecture. VLSI computer aided design.</td>
<td>EE 616.</td>
</tr>
<tr>
<td>618</td>
<td>Very Large Scale Integrated (VLSI) Circuits</td>
<td>3 hrs.</td>
<td>VLSI design route; MOS device electronics; MOS processing and design rules; circuit design with MOS; MOS circuit technique; clocks and communication; circuit techniques for array structures; system design styles and chip engineering; computer aids to design.</td>
<td>EE 516 or equivalent.</td>
</tr>
<tr>
<td>619</td>
<td>Introduction to Radar Systems</td>
<td>3 hrs.</td>
<td>Topics include radar equation, CW radar, MTI and pulse Doppler radar, tracking radar, major systems components, detection in the presence of noise and clutter, ambiguity, and resolution.</td>
<td>EE 503.</td>
</tr>
<tr>
<td>623</td>
<td>Design of Knowledge Based Systems</td>
<td>3 hrs.</td>
<td>Introduction to engineering methods pertinent to application of expert systems to engineering problem solving. Knowledge representation and engineering knowledge modeling, system architecture and control knowledge, user interfacing, knowledge acquisition, and survey of commercial tools and shells for electrical and computer engineering applications. Exposure to symbolic (LISP) and object-oriented programming techniques.</td>
<td>EE 505 or 513. (Same as CPE 623.)</td>
</tr>
<tr>
<td>632</td>
<td>Coherent Optical Systems and Holography</td>
<td>3 hrs.</td>
<td>Introducing the optical system as an invariant linear system, Sommerfeld's diffraction integral, propagation of Gaussian beams, coherence theory, frequency analysis of the optical imaging systems, image formation using coherent and incoherent light, on-axis and off-axis holography, and non-destructive testing using Fourier optics and holographic techniques.</td>
<td>EE 542.</td>
</tr>
<tr>
<td>634</td>
<td>Optical Communications</td>
<td>3 hrs.</td>
<td>Optical communication systems; counting statistics; the optical detector response process; direct detection; heterodyne detection parameter estimation in optical communications; pointing, spatial acquisition and tracking.</td>
<td>EE 506.</td>
</tr>
<tr>
<td>642</td>
<td>Data and Digital Communications</td>
<td>3 hrs.</td>
<td>Introduction to digital and data communications; transmission channels; modulation and coding; telephone networks; data communication standards; noise and distortion; computer interfacing; protocols.</td>
<td>EE 506, 509.</td>
</tr>
<tr>
<td>672</td>
<td>Digital Processing of Random Signals I</td>
<td>3 hrs.</td>
<td>Discrete signals, linear systems, spectral analysis and probability; and random discrete-time signals. Introduction to statistical interference, time-series analysis and spectral estimation of random discrete-time signals. Cross correlation and cross spectra, multitaper spectrum estimation and multivariable spectral analysis.</td>
<td>EE 503 or equivalent.</td>
</tr>
</tbody>
</table>
673 Digital Processing of Random Signals II 3 hrs.
Parametric models for random signal processing; AR (autoregressive), MA (moving average), ARMA (autoregressive moving average), and Prony method. Two-dimensional spectral estimation; higher-order spectral analysis and multiresolution signal analysis. Prerequisite: EE 672.

690 Uniform Geometrical Theory of Diffraction 3 hrs.
Geometrical optics fields, geometrical optics reflected fields, two-dimensional wedge diffraction (GTD and UTD), three-dimensional wedge diffraction and corner diffraction, equivalent currents, diffraction at a smooth convex conducting surface, radar cross section. Prerequisite: EE 407.

699 Master's Thesis 3 or 6 hrs.
Required each semester student is working and receiving direction on a master's thesis. Minimum of two semesters 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.

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

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

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

703 Modern Control Design 3 hrs.
Use of modern (state-variable) control concepts and theories to design high-performance controllers for multi-input/multi-output set-point regulation and servo-tracking/pointing problems. Modeling of uncertain disturbances; design of disturbance-accommodating controllers; introduction to adaptive and stochastic control. Use of commercial CAD software for modern control design and performance evaluation. CAD laboratory sessions. Prerequisite: EE 701.

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

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

706 Stochastic Control Theory 3 hrs.
The analysis and control of dynamical processes subject to random inputs, noisy measurements and uncertain parameter variations. Topics studied include the mathematical theory of random processes, linear operations on random processes, Wiener and Kalman filtering theories, the LQG control problem, the Separation Principle, the identification problem. Prerequisite: EE 701.
Information Theory 3 hrs.
Self-information, entropy, mutual information, and channel capacity, encoding, error
detecting and correcting codes. Sampling theorem. Discrete and continuous channels.
Prerequisite: EE 506.

Discrete Random Signals & Spectral Estimation 3 hrs.
Review of linear systems theory, random discrete processes, classical spectral estimation,
parametric models of discrete random processes, autoregressive (AR), moving average
(MA), autoregressive moving average (ARMA) models. Prerequisites: EE 503, 648.

Selected Topics in Electrical Engineering
Credit to be arranged.

Antenna Theory 3 hrs.
Antennas and antenna arrays. Radiation patterns and impedance characteristics.
Spheres, cylinders, horns, slots, microwave lenses, traveling-wave, and frequency inde­
pendent 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 net­
works. Realization of inductors and supercapacitors with operational amplifiers enables
discretization of RLC filters. Prerequisite: EE 615.

Device Modeling for Integrated Circuit Design 3 hrs.
Fundamental limits in integrated circuits. Advanced and detailed development of the
theory of MOS and bipolar transistors. MOS and bipolar transistor models for IC design.
Numerical algorithms for modeling microelectronic devices. Measurement of bipolar-
polar devices for IC design. Computer-aided design and VLSI device development.
Prerequisite: EE 616.

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. Prerequisite: EE 608 or MAE/PH 531 or permission of instructor.

Microwave Techniques 3 hrs.
Network representations and analysis of microwave devices. Discontinuities from a cir­
cuit point of view. Symmetry consideration. Scattering matrices in circuit design. Cavity
resonators. Prerequisite: EE 609.

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

Computer-Aided Design of Control Systems 3 hrs.
Application of computer-aided design techniques to problems of analysis and control
design for single-input and multi-input dynamic systems. Canonical decompositions,
eigen structure assignment output 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 mul­
tilevel (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 esti-
malum, 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. Advanced techniques include CFAR, binary modulation, frequency agility, polarization agility, and synthetic aperture. Prerequisites: EE 503, 619.

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 503.

727 **Numerical Methods in Electromagnetics**
3 hrs.

733 **Nonlinear Optical Devices and Applications**
3 hrs.
Modeling of optical nonlinearities; Kerr, thermal and photorefractive effects; nonlinearity-induced beam distortion; applications of nonlinearities in crystals and fibers; quantum well and SEED devices; soliton-based communication system; nonlinear optical switches, deflectors and limiters; measurements of nonlinearities. Prerequisite: EE 633.

734 **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.

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.

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, 608.

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.

744 **Digital Communication and Spread Spectrum**
3 hrs.
Linear block coding techniques. Convolutional codes and the Viterbi decoding algorithm. Probability of error bonds. Channels with intersymbol interference and additive gaussian noise. Introduction to spread spectrum-direct sequence and frequency hopping methods. Prerequisite: EE 503.
745 Modulation and Phase Locked Techniques in Communication 3 hrs.
Treatment of analog and digital phase locked loops. Applications in carrier regeneration,
demodulation, and synthesis discussed. Linear and nonlinear PLL models and analysis.
Noise analysis via Volterra Series and Fokker-Planck equation. False lock phenomenon.
Prerequisites: EE 505, 506.

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.

748 Digital Signal Processing Algorithms and Applications 3 hrs.
Introduction to digital signal processors hardware architecture. Applications of digital
signal processing in telecommunications, speech and image processing, radar and sonar.
Development and implementation of DSP algorithms; DSP laboratory session.
Prerequisite: EE 648.

749 Neural Networks and Their Applications 3 hrs.
Elements of threshold logic and discriminant functions, pattern classification and gen­
eral mappings with feedforward networks, training algorithms and self-organization,
Hopfield model and Boltzman machine computations, selected topics. Prerequisite: EE
604 or CPE 542.

799 Doctoral Dissertation 3-6 hrs.

INDUSTRIAL AND SYSTEMS ENGINEERING

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

Interim Chair: J. D. Westbrook, Professor

Professors:
Brown, R.A. (emeritus); systems, stochastic processes
Schroer, B.J.; simulation, manufacturing processes
Westbrook, J.D.; engineering management, organization structure and motivation, TQM, pro­
ductivity and quality, and strategic management
Wyskida, R.M.; operations research, engineering economic analysis, systems modeling

Associate Professors:
Dorsett, M.J. (adjunct); operations research, statistics, logistics
Messimer, S.L.; manufacturing systems, optimization, applied statistics
Safie, F.M. (adjunct); reliability, forecasting, and applied statistics
Swain, J.J.; applied statistics, computer simulation, numerical methods, operations research
Tippett, D.D.; engineering management, technical project management, management of tech­
nology, labor relations, collective bargaining, TQM
Walker, J.R. (emeritus); engineering management, engineering economy, applied statistics

Assistant Professors:
Componation, P.J.; systems ergonomics, concurrent engineering, statistics, engineering econo­my, computer applications.
Evans, J.L. (adjunct); manufacturing methods, engineering economy
Farrington, P.A.; manufacturing systems, quality engineering, engineering economy, computer
simulation, integrated product development
Fogle, F.R. (adjunct); engineering economy, operations research
Lawler, P.B. (adjunct); experimental design, logistics, applied statistics, quality control
Mog, R.A. (adjunct); linear and nonlinear programming, optimization
Thomas, L.D. (adjunct); operations research, applied statistics
Utley, D.R.; engineering management, engineering economy, management systems analysis

The Department of Industrial and Systems Engineering offers major options and associated minors in the subject areas of operations research, systems engineering, engineering management, manufacturing systems, quality engineering, and systems simulation. Applied statistics provides the foundation for study in these areas. The Master of Science in Operations Research (M.S.O.R.) degree is also offered 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 Master of Science in Engineering (M.S.E.) degree. All students are encouraged to tailor their graduate programs with a blend of theory and applications. Admission to the M.S.E., M.S.O.R. and Ph.D. programs is governed by the requirements of the College of Engineering and the School of Graduate Studies.

Degree Requirements

Requirements for the M.S.E. and M.S.O.R. degrees include 24 semester hours of graduate coursework plus a thesis. Twelve hours of coursework must be in the major area. Two minor areas of 6 hours each are also required. A non-thesis option (Plan II) is also available. This consists of 33 semester hours of graduate coursework plus a technical paper. An additional course from departmental offerings at the 600-level may be substituted for the technical paper with approval of the student’s advisor. A comprehensive oral examination is required for all options.

M.S.E. Options

The Engineering Management Option in the ISE Department M.S.E. Program has been developed to meet the needs of practicing engineers who find themselves performing engineering management functions without the benefit of formal management education. As today’s society becomes more and more dependent upon technology, more engineers are moving into managerial positions. The Engineering Management Option is designed to build upon the mathematical and analytical expertise gained from both a formal engineering education and professional experience. In addition to regular classroom instruction, courses in the Engineering Management Option are video taped for distribution to organizations throughout the region. The video-taped format accommodates the needs of practicing engineers. The Engineering Management curriculum emphasizes the application of the management function in the technological setting while recognizing the basic and applied sciences in engineering systems. Emphasis is placed on the engineering relationships between the management tasks of organizing, staffing, planning, financing, and the human element in production, research, and service organizations. The curriculum was developed specifically for graduate engineers who wish to apply the management function in the technological setting. Thus, the curriculum includes engineering management course content that complements the engineering backgrounds of the students.

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, and forecasting will provide students with the analysis and design tools to supplement those learned in their baccalaureate engineering degree program.

The Quality Engineering Option provides a background in quality control, quality and product assurance, and provides individuals with a better understanding of the process required to ensure a quality product. Concentration is on understanding variation within processes, and the available means to reduce variation.
The Operations Research Option is for persons with a bachelor’s degree in a traditional engineering area who desire to broaden their background into the operations research oriented aspects of engineering. Methods of problem identification, problem formulation, and problem solution will be addressed. Specific subject matter courses in the curriculum, such as linear programming, optimization, simulation, and systems modeling, will provide the student additional analysis and design tools to supplement those learned in the baccalaureate engineering degree program.

The Systems Simulation Option provides an understanding of the simulation process including the appropriate design of simulation experiments based upon properly collected and analyzed data, and model verification and validation. As systems become more complex and expensive, more and more reliance is being placed on simulation rather than direct experimentation. Specific subject matter courses in the curriculum such as digital simulation, system simulation, and advanced simulation design and analysis will provide the student the analytical and design tools to perform in this area.

The Manufacturing Systems Engineering Option focuses on the design, analysis, and implementation of advanced manufacturing and production systems. Students selecting this area of concentration will take courses that introduce them to advanced manufacturing technologies such as computer numerical control, robotics, automated guided vehicle systems, automated storage and retrieval systems, flexible manufacturing systems, cellular manufacturing systems, and computer integrated manufacturing. In addition, they are expected to take supporting courses related to statistical quality control, system simulation, engineering economics, ergonomics, and/or systems engineering.

Contact the departmental office for more detailed information.

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 this 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 201), and (3) 6 hours of either applied or mathematical statistics.

Doctor of Philosophy

The Ph.D. program is available to graduates of ABET accredited engineering programs. Admission and degree requirements are those outlined by the School of Graduate Studies and the College of Engineering. In particular, the Ph.D. program requires a minimum of 60 semester hours of graduate coursework beyond the B.S. degree, satisfying the language requirement in one of the three ways specified by the department, satisfying the residence requirement, satisfactory completion of the preliminary and the comprehensive qualifying examinations, and the preparation and defense of an acceptable dissertation.
Graduate Courses in Industrial & Systems Engineering (ISE)

523 Statistical Quality Control
Statistical theory and techniques to control quality of manufactured products. Prerequisite or parallel: ISE 391 or ISE 690. (Same as ISE 423).

524 Ergonomics and Methods Analysis
Introduces basic principles of methods analysis and ergonomics. Methods analysis topics include: work measurement, work measurement tools, work sampling, job analysis, job evaluation, and development and use of flow and activity charts for methods improvement. Ergonomics topics include: anthropometric data, workplace design, design of the physical environment, work organization, and display and control design. Includes term project and laboratory exercises. Prerequisite: ISE 391 or 690. (Same as ISE 424).

526 Design and Analysis of Experiments
Advanced topics in statistical experiments with emphasis on design aspect. Confounding, fractional replication, factorial and nested designs. Includes computer laboratory exercises. Prerequisite: ISE 391 or 690. (Same as ISE 426).

530 Manufacturing Systems and Facilities Design
Overview of modern manufacturing systems design with emphasis on facility location and plant layout. Includes classical systems, just-in-time systems, basic principles of integrated manufacturing systems design, as well as analysis of process flow, process productivity, and available space to determine plant layout. Includes laboratory exercises. Prerequisite: Graduate standing. (Same as ISE 430).

537 Electronics Manufacturing Processes
Current concepts, facilities, and technology utilized in the manufacture of electronic components and products. Includes printed wiring board fabrication and component mounting methods, automation, quality and reliability, product testing, and economic issues. Prerequisite: Graduate standing. (Same as ISE 437).

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

541 Quality Assurance
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 690, 523.

547 Introduction to Digital Simulation
Philosophy and elements of digital simulation. Generation of random variates simulation controllers; discrete-event simulation with emphasis on analysis of systems and models. Prerequisites: EE 197 or CPE 197, ISE 391 or 690. (Same as ISE 447).

570 Integrated Product and Process Design
Introduces concepts and tools which support integrated products and process design. Particular attention devoted to multifunctional teams and their value in promoting the concept of life-cycle engineering. Provides experience with tools and technologies that support the IPPD philosophy. Prerequisite: Graduate standing.

624 Advanced Ergonomics: Man-Machine Interfaces
Psychological, physiological, and anthropometric requirements of human beings and their relationship to design specifications for machines in man-machine interfaces. Prerequisite: ISE 524.

626 Introduction to Operations Research
627 Introduction to Systems Engineering 3 hrs.
Overview of engineering analytic methods applied to design of operational, procedural,
and hardware systems. The systems engineering process, the system life cycle concept,
parametric analysis, cost-benefit and tradeoff analysis. Use of engineering models of
components, logic, signals, and organization in systems analysis and design optimization
from a total system and life cycle perspective. Prerequisite: ISE 690.

630 Computer Integrated Manufacturing 3 hrs.
In-depth analysis of integrated manufacturing/computer integrated manufacturing.
Reviews the tools, concepts, and enabling technologies necessary to integrate the physi­
cal, information, and managerial aspects of a manufacturing enterprise. Prerequisite:
ISE 530.

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 690.

635 Linear Programming 3 hrs.
Application of linear programming to complex allocation problems. Methods for deter­
mining 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.

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

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

647 System Simulation 3 hrs.
Methods and procedures for simulation of large and complex systems. Discrete incre­
ment, continuous time and combined models. Comparison of discrete-event simulation
languages. Model verification and validation. Statistical inference. Input data collection
and analysis, output analysis, and comparison of alternatives. Prerequisite: ISE 547, 690.

690 Statistical Methods for Engineers 3 hrs.
Application of probability and statistics useful in research work. Descriptive statistics,
theoretical distribution functions, point and interval estimates, tests of hypotheses, lin­
ear regression, and analysis of variance. Prerequisites: MA 201.

697 Master's Project for Plan II 3 hrs.
The master's project (Plan II) paper must demonstrate competence in the major disci­
pline of the student's program of study. The paper must meet departmental standards and
must be defended before a faculty committee during an oral examination. Must be taken
at the end of the student's program of study. May be repeated. Maximum 3 hours cred­
it toward degree. Required each semester student is working and receiving direction on
a Plan II project.

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

723 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 390 or 690, ISE 321 or instructor approval.
Systems Modeling 3 hrs.
Philosophy and methodology for modeling probabilistic systems. Includes Markov processes, queueing theory, and inventory theory. Team project required. Prerequisites: ISE 390 or 690, ISE 626 or 627.

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, 690.

Advanced Nonlinear Programming 3 hrs.
Continuation of ISE 728 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 728.

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 I 3 hrs.
Industrial forecasting methods. Simple forecasting models, multivariate regression, correlation, and spectral analysis, exponential smoothing, and Box-Jenkins forecasting. Prerequisite: ISE 690.

Industrial Forecasting and Analysis II 3 hrs.
Industrial forecasting methods. Box-Jenkins model diagnostic checking, seasonal models, and transfer function modeling. Prerequisite: ISE 732.

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 690.

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.

Reliability, Availability, and Maintainability 3 hrs.
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.

Selected Topics in Industrial and Systems Engineering Credit to be arranged

Product Assurance 3 hrs.
Application and control of the product assurance process during design and production; systems engineering approach to providing product quality. Quality improvement and associate management philosophies, including Deming, Juran, and Crosby. Prerequisite: ISE 690.

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

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

Doctoral Dissertation 3, 6 or 9 hrs.
Graduate Courses in Engineering Management (EM)

660 Engineering Management Theory 3 hrs.
Comparison of classical management principles and theory with the environment, goals, and practices of high technology, research and development, and other scientific-engineering organizations. Cases used to illustrate contemporary problems and environments. Prerequisite: Graduate standing.

661 Strategic Engineering Management 3 hrs.
Analysis of industries; generic, market share, vertical integration, and life-cycle strategies as applied to technology-based organizations. Relationship between buyers and suppliers. Environment and competitor analysis in a global marketplace. Prerequisite: EM 660.

662 Foundations of Total Quality Management 3 hrs.
Basic understanding of TQM in context of fundamental building blocks of effective management; measurement, problem solving, continuous improvement, teamwork, customer focus, and supportive culture. Prerequisite: EM 660 or permission of instructor.

665 Financial Methods for Engineers 3 hrs.
Financial and managerial accounting for the engineering manager; accounting fundamentals, transaction recording, understanding financial statements, and management applications including costing, budgeting, performance evaluation and control, and ratio analysis. Prerequisite: Graduate standing.

666 Engineering Project Management 3 hrs.
Management and control of multifaceted engineering and technological projects. Coordination and interactions between client and various service organizations. Project manager selection. Typical problems associated with various phases of project life cycle. Case studies illustrate theories and concepts. Prerequisite: Graduate standing.

667 Labor Relations for Engineers 3 hrs.
Negotiation and administration of labor agreements. Survey of historical, legal, and structural environments that influence collective bargaining process. Simulation of collective bargaining. Prerequisite: Graduate standing.

679 Selected Topics in Engineering Management Credit to be arranged.

697 Engineering Management Project I 3 hrs.
Application-oriented student project designed to show competence in engineering management.

698 Engineering Management Project II 3 hrs.
Application-oriented student project designed to show competence in engineering management. Continuation of EM 697.

760 Organization Structure and Motivation 3 hrs.
Application of motivational theories in technology-based organizations. Impact of various organization structures in relation to the goals of the organization. Use and effectiveness of contemporary organizational systems. Prerequisite: EM 660.

Development of applicable engineering management theory using classical concepts, contemporary studies and practices at successful technology-based organizations. Prerequisite: EM 660, 760.

762 Productivity and Quality Engineering 3 hrs.
Productivity and quality measures defined and used to analyze current competitive position of important sectors of American industry with respect to national and international competition. Study of management theories and systems which promote or inhibit productivity or quality improvements. Prerequisite: EM 660 or permission of instructor.
766 Implementation of Technology 3 hrs.
Challenges to implementing advanced technology equipment, systems, and methods in engineering organizations. Justifying technology, assimilating change, changing management roles, personnel practices and organizational structure, and dealing with impact of new technologies on business policies and strategic planning. Prerequisite: EM 666 or permission of instructor.

767 Contemporary Applications in Engineering 3 hrs.
Application of key qualitative and quantitative principles of engineering management to real-world case problems. Students work both as teams and as individuals to solve multidimensional management/organizational problems which require an integrative point of view. Prerequisites: EM 666, 760, 766.

779 Selected Topics in Engineering Management Credit to be arranged.

MECHANICAL AND AEROSPACE ENGINEERING

Degrees: Master of Science in Engineering
Doctor of Philosophy

Chair: Gerald R. Karr, Professor

Eminent Scholar in Propulsion, Professor:
Coleman, H.: propulsion, fluid mechanics, heat transfer, experimentation and uncertainty analysis

Distinguished Professors:
Chung, T.J.: combustion, fluid mechanics, heat transfer, continuum mechanics, computational fluid dynamics
Wu, S.T.: magnetohydrodynamics, gasdynamics and radiative gasdynamics, plasmadynamics, solar phenomena, numerical simulation methods for fluids, heat transfer and plasma

Professors:
Cost, T.L.: structural dynamics, composite materials, finite element application, shock propagation in explosives, solid rockets
Gilbert, J.A.: experimental stress analysis, applied optics, solid mechanics, fiber optic sensing, panoramic imaging
Hawk, C.: ducted rockets, hybrid rockets, turbomachinery, application of composite materials to rocket motor or engine design
Hung, R.J.: microgravity cryogenic fluid management, space based propulsion, space environment, satellite and radar remote sensing, ionospheric, middle atmospheric and atmospheric studies, robotics, computational fluid mechanics, combustion, propulsion
Karr, G.R.: fluid mechanics, heat transfer, cryogenic systems
Musielak, Z.E.: magnetohydrodynamics and plasmadynamics, wave phenomena, turbulence, nonlinear dynamics and chaos, astrodynamics, space plasma environment, solar and stellar phenomena, methods of solving differential equations
Wallace, D.B.: solar energy, photovoltaics, computer aided engineering analysis, robot dynamics
Wessling, F.C.: design of apparatus for use in low gravity, heat transfer and materials studies in low gravity

Associate Professors:
Bower, M.V.: metallic and nonmetallic materials, solid and structural mechanics; fracture mechanics, CAEDM
Thompson, K.O. (Emeritus)
Assistant Professors:
Elrod, D.A.; dynamics, vibrations, fluid mechanics, turbomachinery
Feikema, D.A.; laser diagnostics, flow visualization, turbulent combustion, fluid dynamics
Frederick, R.; propulsion, combustion diagnostics, real-time radiography, image processing
Landrum, D.B.; hypersonics, gas dynamics, aerodynamics, propulsion

Assistant Research Professor:
Moser, M.; solid and liquid rocket combustion, laser-based diagnostics

The range of faculty research interests in the Department of Mechanical and Aerospace Engineering is broad. It affords graduate students opportunities for advanced work in fluid and solid mechanics, heat transfer, aerodynamics, thermodynamics, transport phenomena, propulsion, combustion, computational mechanics, experimental mechanics, environmental engineering and systems. The M.S.E. and Ph.D. degrees granted by the department in these areas are equivalent to those available in traditional mechanical, civil, and aerospace engineering programs. Support is available at attractive levels for all qualified students, including assistantships, tuition grants and graduate Co-op's with many local research and industrial organizations. UAH has the intellectual and social environment to provide a well-rounded, technologically-oriented degree.

Admission Requirements
The Department of Mechanical and Aerospace 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.A.E. by completing certain undergraduate courses. Please contact the department for further details.

M.S.E. Option in Aerospace Engineering
All M.S.E. students in the Mechanical and Aerospace Engineering Department have the option to enroll in the aerospace engineering program. There are three specialized areas: space propulsion, space structures, and space environment. Details concerning this program may be found in the M.A.E. Graduate Student Handbook.

M.S.E. and Ph.D. in Mechanical Engineering
All M.S.E. students in the Mechanical and Aerospace Engineering Department are guided through one of two specialized areas of concentration: fluid and thermal sciences or solid and structures area. MAE 671 is the required course for all graduate students. Students majoring in environmental engineering may replace MAE 671 by MAE 649. 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, MAE 683, for one semester.

The Department of Mechanical and Aerospace 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 examinations, 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 traditional mechanical engineering advanced degrees. All Ph.D. students must enroll in the departmental seminar, MAE 683, for three semesters.

Ph.D. students in mechanical and aerospace engineering must meet the minimum requirements set by the School of Graduate Studies. MAE doctoral students must also meet some additional requirements set by the department. (Contact the chair.)
Graduate Courses in Mechanical Engineering (MAE)

531 Introduction to Plasma dynamics 3 hrs.

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: MAE 342, 454, MAE/CHE 442.

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: MAE 454, 544; MAE 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: MAE 446, 544; MAE 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: MAE/CHE 352, MAE 442, 454; MAE 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: MAE 342, 454, MAE/CHE 442.

552 Experimental Techniques in Fluid Mechanics 3 hrs.
Overview of intrusive and nonintrusive experimental techniques in fluid mechanics for measurement of pressure, velocity, temperature, and species; Schlieren, interferometry, laser Doppler velocimetry, thermocouples, emission and absorption spectroscopy, laser-induced fluorescence. Prerequisite: MAE 454 or consent of instructor. (Same as MAE/CHE 452, MAE/CHE 552.)

556 Turbomachinery 3 hrs.
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: MAE 342, 454.

557 Fundamentals of Aerodynamics 3 hrs.
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: MAE 342, 454. (Same as MAE 457.)
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: MAE 488. (Same as CE 461/561.)

563 Intermediate Dynamics  3 hrs.  
Kinematics and dynamics of particles, system of particles, and rigid-bodies. Variational principles and Lagrangian mechanics. Prerequisite: MAE 362. (Same as MAE 463.)

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: MAE 370. (Same as MAE 474 and CE 474/574.)

577 Experimental Techniques in Solid Mechanics  3 hrs.  
Experimental methods to determine stress, strain, displacement, velocity, and acceleration in various media. Theory and laboratory applications of electrical resistance strain gages, brittle coatings, and photoelasticity. Application of transducers and experimental analysis of engineering systems. Prerequisites: MAE 370 and junior standing. (Same as MAE 477 and CE 477/577.)

578 Matrix Methods in Structural Mechanics  3 hrs.  
Matrix application to formulation and solution of linear problems in structural mechanics. Applications to trusses, beams, and frames. Prerequisites: MAE 370, 442. (Same as MAE 478 and CE 478/578.)

580 Aircraft Stability and Control  3 hrs.  
Stability and control of aerodynamic vehicles. Design of aircraft to obtain good flying characteristics. Complete governing equations and analog solutions of linearized equations. Prerequisites: MAE 454, 488. (Same as MAE 480.)

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

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

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

The following courses are open to graduate students only

641 Advanced Thermodynamics  3 hrs.  
Application of classical thermodynamics. Treatment of problems involving nonideal gases and liquids, phase equilibrium, and chemical equilibrium. Prerequisite: MAE 342. (Same as CHE 641.)
643 Intermediate Heat Transfer 3 hrs.
Continuation of MAE 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: MAE 442.

644 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.

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

646 Combustion I 3 hrs.
Review of chemical thermodynamics, chemical kinetics, governing equations, detonation, laminar diffusion and premixed flames, droplet vaporization and combustion. Prerequisite: MAE 651.

647 Uncertainty Analysis in Experimentation 3 hrs.
Uncertainty analysis concepts and techniques; application in planning, design, construction, debugging, execution, data analysis and reporting phases of experimental programs. Discussion of national and international standards and current engineering uncertainty analysis literature.

649 Transport Phenomena 3 hrs.
Mass, energy, and momentum transport in steady and transient motions in real and rheological substances. Prerequisite: MAE 442. (Same as CHE 649.)

651 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: MAE 454.

652 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: MAE 442, 454.

653 Computational Fluid Dynamics I 3 hrs.
Formulations by finite difference, finite element, finite volume, and spectral element methods for incompressible and compressible flows. Explicit and implicit methods, Von Neumann error analysis, consistency, convergence, and accuracy. Prerequisites: MAE 352, 396.

654 Computational Fluid Dynamics II 3 hrs.
Continuation of Computational Fluid Dynamics I, advanced topics in finite difference, finite element, finite volume, and spectral element methods. Prerequisite: MAE 653.

655 Computational Fluid Dynamics III 3 hrs.
Grid generation techniques, adaptive methods, vectorization, parallel processing as applied to computational fluid dynamics. Prerequisite: MAE 653.

659 Selected Topics in Mechanical Engineering Credit to be arranged
660 Structural Dynamics
3 hrs.
Application of the theory of vibrations to discrete and continuous models of structures. Numerical methods of analysis for both spatial and temporal variables. Modal synthesis and step-by-step time integration methods. Finite element applications; substructuring techniques. Prerequisite: MAE 561. (Same as CE 660.)

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

662 Nonlinear Dynamics and Chaos
3 hrs.
Nonlinear and chaotic dynamical systems, phase plane, periodic and strange attractors, stability analysis, critical points, Pianov exponents, bifurcation points, solitons, logistic maps, Poincare and Henon iterative maps, fractals, Mandelbrot and Julia sets, chaos in complex dynamical systems. Prerequisites: MA 244, 324.

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

671 Continuum Mechanics
3 hrs.
Kinematics and kinetics, various coordinate systems, constitutive equations for continuous media; governing partial differential equations from first and second laws of thermodynamics; applications to solids, liquids, and gases. Prerequisites: MAE 352, 370. (Same as CE 671.)

672 Theory of Elasticity
3 hrs.
Review of fundamentals. Formulation of boundary-value problems of classical elasticity. Application to plane problems, prismatic members, and axisymmetric problems. Introduction to three-dimensional problems. Prerequisite: MAE 671. (Same as CE 672.)

673 Plasticity
3 hrs.
Fundamentals of mechanical behavior of metals and nonmetals for stress states greater than the yield stress state. Deformation and flow theories. Stress-strain relations and yield criteria. Solution of boundary value problems with plastic bodies. Limit analysis of structures. Prerequisite: MAE 671. (Same as CE 673.)

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

676 Viscoelasticity
3 hrs.

677 Optical Techniques in Solid Mechanics
3 hrs.
Overview of 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: MAE 477/577 or consent of instructor. (Same as CE 677.)

678 Mechanics of Composite Materials
3 hrs.
Introduction to composite materials, micro- and macro-mechanical behavior of laminae; bending, buckling and vibration of laminated plates. Prerequisites: MAE 671, 672. (Same as CE 678.)
Graduate Seminar 1 hr.
Professional activities designed to promote the skills required to organize and deliver oral technical presentations and to broaden the individual's awareness of technical issues. Registration in this course is required one time for M.S.E. and one time for Ph.D. students who make a one-hour oral presentation each time registered. Students will graded “S” (satisfactory) or “U” (unsatisfactory) based upon their performance and attendance. Students who do not receive an “S” grade must register for the course until an “S” is obtained. (Same as CHE 683.)

Graduate Engineering Analysis I 3 hrs.
Ordinary differential equations (ODEs), Green’s functions, linear algebra, simultaneous differential equations, application of ODEs to mechanical systems, Fourier series and integrals, Laplace transformations, vectors, and tensors. Prerequisite: MA 324.

Graduate Engineering Analysis II 3 hrs.
Partial differential equations (PDEs) and boundary-value problems, Bessel functions, Legend polynomials, vector analysis and integral theorems, introduction to tensor analysis, calculus of variations, analytical functions of a complex variable, Taylor and Laurent expansions, the residue theorem, and stability criteria. Prerequisites: MA 324, MAE 692 or permission of instructor.

Master’s Thesis 3, 6 or 9 hrs.
Required each semester in which a student is working and receiving direction on a master’s thesis. Minimum of two semesters and 6 hours required for M.S.E. students. A maximum of 9 hours of credit is awarded upon successful completion of master’s thesis.

Aerothermodynamics 3 hrs.
Description of the dynamic and thermal fluid flow environments associated with hypervelocity vehicles and propulsion systems with emphasis on thermochemical nonequilibrium behavior. Topics include thermostatistical basis for internal energies, specific heats and shock strengths in dissociated and ionized gases; formulation of reacting flow conservation equations; and recent experimental advances in aerothermodynamics. Prerequisite: MAE 652.

Statistical Thermodynamics 3 hrs.

Combustion II 3 hrs.
Turbulent flames, spray combustion, solid propellant combustion, combustion instability, reacting boundary layers, ignition phenomena. Prerequisite: MAE 646.

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

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

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: MAE 643, 651. (Same as CHE 749.)
750 Computational Fluid Dynamics IV 3 hrs.
Application of FDM, FEM, FVM, and SEM in acoustics, turbulence, hypersonics, reacting flow, combustion, and radiative heat transfer problems. Prerequisite: MAE 655.

751 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: MAE 651.

752 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: MAE 651. Offered upon demand.

753 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: MAE 652.

754 Hypersonic Flow 3 hrs.
Theories for treating the laminar and turbulent boundary layers of reacting fluids, mixtures, related chemical, thermodynamic, and physical phenomena in hypersonic flows. Leading edge bluntness, shock wave interactions, and vorticity effects. Prerequisite: MAE 652.

755 Advanced Aerodynamics 3 hrs.
Transonic, supersonic, and hypersonic flows. Application of compressible potential theory, similarity rules, slender body theory and Newtonian flow theory to the analysis of aerodynamics of aircraft, missiles, re-entry vehicles, and other flight vehicles. Prerequisite: MAE 557, 652, or approval of instructor.

756 Numerical Simulations of Magnetohydrodynamics 3 hrs.
Finite difference methods for simulation of MHD flows. Methods include explicit scheme, FICE methods, LBL, ADI, artificial damping and projected characteristics for multidimensional time-dependent flow. Prerequisite: MAE 753.

757 Optical Techniques in Fluid Mechanics 3 hrs.
Laser sources, diatomic spectroscopy, experimental methods, Mie, Rayleigh, and Raman scattering, laser-induced fluorescence, Brillouin scattering, four wave mixing, CARS, and applications discussed. Prerequisites: MAE/CHE 552, OSE 542. (Same as CHE 757.)

758 Turbulence 3 hrs.
Turbulence in gases and liquids; boundary layers, atmospheric phenomena. Prerequisite: MAE 651.

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: MAE 660, 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: MAE 660. (Same as CE 762.)
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: MAE 561. (Same as CE 765.)

Dynamics of Aerospace Vehicles

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 gyrostat. Prerequisite: MAE 560 or 661.

Theory of Structural Stability

Energy criterion for stability of elastic structure under conservative loading. Stability concept for general continuous systems. Rigorous and approximate methods of analysis. Buckling of structural elements under impulsive and nonconservative loading. Postbuckling behavior. Prerequisite: MAE 671. Offered upon demand. (Same as CE 772.)

Theory of Shells

Analysis of thin plates and shells including higher order approximation theories and transverse-shear deformations. Illustration of theories by selected problems. Prerequisite: MAE 671. (Same as CE 773.)

Finite Element Analysis II

Advanced topics in finite element analysis; application to nonlinear partial differential equations in continuum mechanics; theoretical studies of convergence and stability of solutions. Prerequisite: MAE 674. (Same as CE 774.)

Theory of Finite Elasticity and Finite Viscoelasticity

This course presents the theory of finite deformation analysis for elastic and viscoelastic materials. Constitutive models are developed for a functional analysis approach leading to models based on the Cauchy-Green Deformation Tensor and the Strain Energy Density Function. Models discussed include: Mooney-Rivlin and Bernstein-Kearsley-Zappas. Prerequisite: MAE 671.

Fracture Mechanics

Theory of crack propagation, stress intensity factors, series expansion, asymptotic approximations, field singularities, integral transforms, numerical solutions. Prerequisites: MAE 671, 672. (Same as CE 778.)

Theory of Acoustics

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: MAE 671.

Nonlinear Effects in Plasma

Fundamental physical concepts and methods of estimating various nonlinear interactions in plasmas. Analytical and numerical methods to deal with these problems. Prerequisite: PH 531 or permission of instructor.

Plasma Turbulence

Methodology that deals with plasma turbulence together with current numerical techniques to solve these problems approximately, via super-computing. Prerequisite: PH 531 or permission of instructor.

Doctoral Dissertation

119
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 Program of Study with faculty members who share the student's intellectual interests. Within the framework of the requirements established by the departments and the School of Graduate Studies, students design, in consultation with a faculty advisor, a graduate program fitted to their particular interests and needs.

The College of Liberal Arts offers programs of study leading to the Master of Arts degree with concentrations in English, history, psychology, and public affairs. Class A teacher certification is available with concentrations in English and history. Certification may be achieved through either traditional (including the Strengthened Subject Matter Option) or non-traditional "fifth year" approaches.

**Graduate Courses in Social Science (SS)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>532</td>
<td><strong>Space Orientation for Teachers: Social Science</strong></td>
<td>3 hrs.</td>
</tr>
<tr>
<td>632</td>
<td><strong>Space Orientation for Teachers</strong></td>
<td>3 hrs.</td>
</tr>
<tr>
<td>642</td>
<td><strong>International Aerospace Education: Soviet Union</strong></td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

- **Space Orientation for Teachers: Social Science**
  - Offers social studies teachers a unique and careful study of the historical, economic, political, and other dimensions of space-related activities, technologies, and discoveries.
- **Space Orientation for Teachers**
  - Curriculum for this program builds on that already attained by those educators who have participated in the generic program conducted at UAH, by providing experiences available in Washington, DC. 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. Prerequisites: SS 532/ED 532/ES 532. Same as ED 622/ED 632/ES 632)
- **International Aerospace Education: Soviet Union**
  - On-site seminar on the Soviet space program. Lectures deal with rocket and shuttle design, cosmonautics, Soviet science education and space policy decision-making. Locations include Space Mission Control, Star City, the Baikanur Cosmodrome, and various schools, institutes, ministries, and factories involved in aerospace education and industry in Moscow, Kiev, Leningrad, and Krasnoyarsk. (Same as ED 642/ES 642)
EDUCATION DEPARTMENT  

Degree: Master of Arts  

Chair: M. L. Piersma, Associate Professor  

Associate Professors:  
Brindley, T.A.; education theory, social change, foundations, secondary education  
Piersma, M.L.; reading and elementary education  

Assistant Professors:  
Asundi, M.: educational psychology, assessment, technology  
Carroll, C.; exceptional children, technology  
Harwell, S.; human development, supervision  

History and Objectives  
The Department of Education at the University of Alabama in Huntsville has been concerned with programs for the preparation of public school personnel since the University's inception in 1950. The earliest teacher education programs were initially connected directly to the College of Education at the University of Alabama. During the next 17 years, the Department of Education became more independent and autonomous as the demand for courses and programs expanded. Finally, by 1967 students could complete all coursework in teacher education at the University of Alabama in Huntsville. That spring the education program at UAH was officially approved, and the first independent Department of Education was established. The program has continued to prepare prospective elementary and high school teachers at the graduate and undergraduate level to assume leadership roles in public and private schools. The faculty in the Department of Education is committed to a knowledge base for these programs which reflects the view that educators are reflective decision makers who facilitate student learning.

Accreditation  
Teacher education programs in the Department of Education are approved by the Alabama State Board of Education, according to standards of the National Association of the State Directors of Teacher Education and Certification (NASDTEC), for the issuance of appropriate professional certificates for service in public schools. The Department of Education is also accredited by the Southern Association of Schools and Colleges (SACS).

Facilities  
The Department of Education utilizes the facilities and resources of the entire university, the community, and the schools. The department maintains a special partnership with the teachers and students at University Place Elementary School in Huntsville. Classrooms and faculty offices are located in Morton Hall. The department also maintains a Teacher Materials Center and a Computer Education Laboratory in Morton Hall where current teaching materials are available and where laboratory classes are held. The Institute for Science Education, a resource center for teaching and research in science and mathematics, is also located in Morton Hall.

Services  
In addition to its teaching function, the Department of Education provides inservice education for schools, agencies, and institutions of higher learning; conducts and disseminates research to solve educational problems; and provides consultative service to all types and levels of educational institutions.
Academic Advising

Students who plan to enroll in the Teacher Education Program and qualify for teacher certification should contact the chair of the Department of Education to be assigned an advisor. Students are expected to consult their advisors about curricular and degree requirements. In addition, students are expected to consult with advisors from their teaching field departments to coordinate the planning of programs of study.

Career Planning and Placement

The Office of Career Services, located in the University Center, assists all students who have completed an approved Teacher Education Program at the University of Alabama in Huntsville and who are eligible for an Alabama professional certificate, in securing teaching positions. All teacher education students are encouraged to file their credentials with the Office of Career Services during their last semester of study.

THE STATE BOARD OF EDUCATION PERIODICALLY REVISES THE REQUIREMENTS GOVERNING CERTIFICATION IN THE STATE OF ALABAMA. THEREFORE, REQUIREMENTS FOR DEGREES LEADING TO CERTIFICATION ARE SUBJECT TO CHANGE FROM THOSE PUBLISHED IN THIS CATALOG. THE STUDENT IS REQUIRED TO SEEK ADVISEMENT FROM THE EDUCATION DEPARTMENT (AS EARLY AS POSSIBLE IN THE PROGRAM OF STUDY) TO ENSURE THAT BOTH DEGREE REQUIREMENTS AND CERTIFICATION REQUIREMENTS ARE MET.
Admission and Enrollment in the Teacher Education Program

General Regulations

Student Responsibility. Education students are expected to register for appropriate courses necessary to make reasonable progress toward completing program requirements by the expected date of graduation. They must familiarize themselves with the requirements contained in this catalog and initiate the application process for a program of study. Faculty advisors are available to assist students as needed.

Local Mailing Address. Students are expected to maintain a mailing address at which communication from the department will, with reasonable certainty, reach them. The address should be recorded in the department office.

Registration and Enrollment. Education students seeking an institutional recommendation from UAH for professional certification must complete all professional education coursework at UAH. All graduate students will have their credits evaluated on an individual basis to determine course equivalency of both undergraduate and graduate courses. In cases of extreme hardship, students may petition for an exception to the policy.

Course Substitution. When a course substitution in professional studies or the teaching field is desired, permission from the State Department of Education must be obtained prior to enrolling in the course. Students should contact the Certification Officer in the UAH Department of Education to complete appropriate forms for such approval from the State Department of Education. This requirement is very crucial and must be adhered to. Courses taken without approval may prevent a student from completion as planned.

Course Repeat Policy. The UAH course repeat policy allows students to repeat courses on a limited basis in order to improve the grade in a course. Education students may take advantage of this policy in all subjects; however, grades received for courses repeated in the student's teaching fields and in professional education courses will be averaged with the original grade. The student is reminded that all coursework attempted in professional education and teaching field courses will be used to calculate the grade point average. (This is in compliance with the Alabama State Code of Education.) Both the original and the repeated grade will show on the transcript.

Program Completion. If a student does not complete requirements for the graduate degree within a period of six years from the date of admission, the Department of Education will modify the student's program to bring it into harmony with current degree and certification requirements. In addition, students in the teacher education program must complete that program's requirements within four years from the date of formal admission to the program, or they must re-apply for admission.

Degree Programs Offered

The Department of Education, in conjunction with the College of Liberal Arts and the College of Science, offers three options for graduate teacher certification. Two Class A certification programs are available for teachers already certified at the Class B level; a non-traditional program is also available for individuals without prior certification. Certification is available in the following areas:

Secondary/High School Education (7-12) with majors in biology, chemistry, English, history, mathematics, and physics
Traditional High School Program

1. **Option A - Single Teaching Field Program**, Class B Certification required.

   Teaching field 24 hrs.
   
   (English, history, biology, chemistry, mathematics, physics)

   Professional Education Requirements:
   
   ED 603 - Sources of American Educational Thought 3 hrs.
   ED 604 - Contributions of Psychology to Education 3 hrs.
   ED 620/CS 620 - Curriculum Integration of Technology 3 hrs.
   ED 630 - Modern Secondary School Programs 3 hrs.
   ED 593*- Education of Exceptional Children & Youth 3 hrs.
   ED 607 - The Educator as Evaluator 3 hrs.

   15-18 hrs.

   Electives:
   
   ED 520/CS 520 - Computer Based Instructional Technology 3 hrs.
   ED 560/CS 560 - Current & Emerging Instructional Technology 3 hrs.

2. **Option B - Strengthened Subject Matter Program**, Class B Certification required.

   Teaching Field 24 hrs.
   
   (English, history, biology, chemistry, mathematics, physics)

   Professional Education Requirements:
   
   ED 604 - Contributions of Psychology to Education 3 hrs.
   ED 607 - The Educator as Evaluator 3 hrs.
   ED 630 - Modern Secondary School Programs 3 hrs.
   ED 593*- Education of Exceptional Children and Youth 3 hrs.

   9-12 hrs.

   Optional Electives:
   
   ED 520/CS 520 - Computer Based Instructional Technology 3 hrs.
   ED 560/CS 560 - Current & Emerging Instructional Technology 3 hrs.
   ED 620/CS 620 - Curriculum Integration of Technology 3 hrs.

   *A survey course in special education (ED 593) is required if no such course has been taken at the undergraduate or graduate level prior to entering the program. Students who meet the special education requirement should elect a technology course. ED 520/CS 520 (an equivalent course or proficiency) and ED 560/CS 560 are prerequisites to ED 620.

Non-Traditional Fifth Year Program

This program is designed to be an alternative to the traditional programs and is available for students who do not have a Class B certificate. Completion of requirements leads to Class A certification in the teaching field chosen. Students may proceed directly from a degree in the subject field(s) to this program.

Teaching field 24 hrs.

(English, history, biology, chemistry, mathematics, physics)

Professional Education

ED 593 - Education of Exceptional Children & Youth 3 hrs.
ED 603 - Sources of American Educational Thought 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 608 - Reading in Content Areas 3 hrs.
ED 610 - Psychological Foundations of Evaluation 3 hrs.
ED 690 - Seminar in Teaching 1 hr.
ED 698 - Internship

Electives*

ED 520/CS 520-Computer-Based Instructional Technology 3 hrs.
ED 560/CS 560-Current & Emerging Instructional Technology 3 hrs.
ED 620/CS 620-Curriculum Integration of Technology 3 hrs.

*Students are encouraged to take at least one technology course to enhance teaching skills.

ADMISSION AND ENROLLMENT IN THE NON-TRADITIONAL FIFTH-YEAR PROGRAM*

Admission to the graduate school does not qualify a student for admission to the Teacher Education Program (TEP). Students may apply for admission to the teacher education program after they have been admitted to the graduate school. Eligibility for admission to teacher education is determined after the student has been unconditionally admitted to the graduate school. Persons who enter the program with master’s (or higher) degrees and who wish to obtain certification must complete or meet the institution’s approved program. Course equivalency must be determined following the usual procedures. An additional master’s degree at UAH is not necessarily required. The student's previous degree(s) can be recognized as long as it is deemed equivalent to UAH’s.

Criteria for unconditional admission to Teacher Education Program. Applications for admission to the Teacher Education Program are available in the department office or from the Certification Officer. Students who meet the following minimum criteria may apply for admission to the Teacher Education Program (TEP). However, meeting the minimum criteria does not guarantee admission. In addition to meeting the following criteria, all students who are admitted to the Teacher Education Program must have an approved Program of Study on file in the Department of Education. Applications for programs of study must be filed before completion of 12 semester hours.

(a) A bachelor’s (or higher) degree from an accredited institution.
(b) A major, or the equivalent (at least 27 hours), 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 science, science, and mathematics.
(d) Admissibility to the School of Graduate Studies and to subject field programs. (See Graduate School admission section.)
(e) A passing score on the Alabama Basic Skills Test.
(f) Submission of proper application forms with documentation of items (a)-(e) above to the certification officer. Completed applications will be forwarded to the appropriate departments.
(g) An appropriate GPA (B or better) on all work attempted in teaching field.
(h) A satisfactory interview(s) with faculty in the Department of Education.
(i) Individuals who are already certified (in any field) are not admissible to the Non-Traditional Fifth-Year Program.
Retention and Completion of the Teacher Education Program. Admission to the TEP implies continuous evaluation of the student's progress and qualifications for teaching. A student may be removed from the program, after due process, at any time the advisor, area head, and others in a position to judge determine that the student's potential for success as a teacher is minimal.

1. A grade of "C" or above must be earned in all professional education courses. A student who receives a grade below "C" in a required education course must repeat the course at UAH. Such a repeat is allowed only once; both grades are used to calculate the GPA. In cases of extreme hardship the student may petition the department for permission to repeat the course at another institution.

2. To remain in the program each student shall make satisfactory progress as determined by continuous evaluation. Students enrolled in the TEP at UAH must maintain at least a B average which was required for admission to the program. In addition, admitted students must maintain at least a B average in all professional education courses and at least a B average in the teaching field(s) courses. This grade point average is consistent with requirements for student teaching and certification. (Students should consult teaching field departments for minimum grade point requirements in their program.)

3. Students whose grade point average in professional education courses falls below the minimum average at any time following admission to the TEP will be placed on probation for one semester. During the probationary semester the student may enroll in only one professional education course and progress will be closely monitored. Enrollment in courses outside of the education department will not be limited. Any student who fails to raise the grade point average to at least the minimum requirement during the probationary semester will not be permitted to continue in the TEP.

4. A student who wishes to apply for readmission should submit a letter to the chair of the Department of Education. A department committee will evaluate each request for readmission. Readmitted students who subsequently earn a grade lower than a "C" in any professional education course will be permanently dismissed from the program.

INTERNSHIP REQUIREMENTS

The teaching internship (student teaching) is one of the most important experiences teacher education students have. It is generally regarded as the culminating activity of one's preparation to become a teacher. At the University of Alabama in Huntsville the internship is a full-time, full-semester assignment. Students enrolled for an internship should not expect to be enrolled in other courses while interning.

Applications for the internship are available in the department office. Students may apply for the internship according to the following deadlines.

- January 30 for fall semester internship
- June 30 for spring semester internship

Admission Criteria.

1. Acceptance into the Teacher Education Program.
2. An appropriate GPA on all work attempted in the teaching field(s).
3. An appropriate GPA on all work attempted in professional education courses, with no grade lower than a "C".
4. Satisfactory completion of all appropriate professional studies: ED 603, 606, 608, and 610. ED 593 is also recommended before student teaching.
5. Completion of at least half of teaching field courses.

Internship Placements.

All internship placements are coordinated by the Department of Education faculty. Placement sites are selected in a manner to assure the quality of the internship experience and of the supervision provided by the cooperating teacher. All internship placements are in the Huntsville-Madison County area, in order to facilitate supervision of students by UAH faculty.
The issuance of an Alabama teaching certificate is the legal responsibility of the Alabama State Department of Education. Colleges and universities cannot issue a professional certificate. However, in order to be recommended for a professional teacher's certificate, a student must complete an appropriate course of study at a college or university which has been approved by the Alabama State Board of Education. When the student has completed the course of study, the institution recommends to the State Department of Education that a certificate be awarded. It is the responsibility of the student to initiate the application for initial certification.

Programs offered by the Department of Education are designed to prepare teachers for professional certification at the Class A (master's degree) level. The Department of Education, in accordance with the Alabama State Board of Education, also provides courses for persons who hold expired certificates and wish to reinstate them.

Students who expect to teach in states other than Alabama are responsible for a knowledge of the licensure requirements in those states. Some states have reciprocity with Alabama through interstate agreements of the State Department of Education. Such students should inform their advisor or the certification officer of their intentions, as the advisor and certification officer may be of assistance in ensuring compliance with other states' requirements.

Applications for an Alabama professional teaching certificate are available in the certification office. Students should make application for a teaching certificate during the final semester of their education program.

Exit Examinations. All students seeking Class A certification must take comprehensive exit examinations in their teaching field and professional education. Exit examinations are required of all non-traditional fifth year education students. Both degree and non-degree seeking graduate students are required to complete a series of exit examinations: (1) students must successfully complete a written examination based on the professional education coursework in their program of study; (2) at the end of the internship students must also submit and present a teaching portfolio to a faculty committee; and (3) students must take a comprehensive examination over their teaching field. Students should contact their teaching field department(s) to schedule these examinations.

Students enrolled in Option A-the traditional program or Option B-the strengthened subject matter program should consult their teaching field department regarding their comprehensive examinations. They should also consult their education advisor about the education examination.

Initial Certification. Successful completion of the master's program in teacher education leads to Alabama Class A certification which is valid for eight years. This certification may be renewed upon verification of successful teaching for four of the eight years and completion of an approved professional development program.

Graduate Courses in Education (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.

520 Computer-Based Instructional Technologies 3 hrs.
Introduces prospective teachers to current state of the art in educational technology. Designed as a laboratory course with extensive hands-on experience with microcom-
puters and other emerging technology. Emphasis on enabling the student (both special and regular) to effectively integrate technology into instructional setting. Lab Fee: $40. (Same as CS 520.)

522 Space Orientation for Teachers: Elementary 3 hrs.
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. Includes a number of experiments which can be duplicated in the classroom. Offered in cooperation with the Alabama Space and Rocket Center.

532 Space Orientation for Teachers: Secondary 3 hrs.
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. Includes a number of experiments which can be duplicated in the classroom. Offered in cooperation with the Alabama Space and Rocket Center. Lab Fee: $20. (Same as ES 532.)

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

560 Current and Emerging Instructional Technologies 3 hrs.
Designed to build competency in computer technologies appropriate to instructional use. Concepts of authoring and scripting will be used to unify course materials. Lab Fee: $40. Prerequisite: ED/CS 520. (Same as CS 560.)

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

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

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

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

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

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

606 Principles of Curriculum Development 3 hrs.
Principles of curriculum construction that underlie the organization of the programs of study in schools. Origin and background of the curriculum, methods of organization, curriculum planning and development, and pertinent applications.
607 The Educator as Evaluator 3 hrs.
Procedures and techniques of evaluation and research approaches. Emphasis on teachers as evaluators; based on action research in the classroom.

608 Reading in the Content Areas 3 hrs.
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.

610 Psychological Foundations of Evaluation 3 hrs.
Foundations of educational theory and practice as related to evaluation. Factors that determine learning, motivation, and conditions of learning will be viewed as an integral part of the overall planning, instruction, and assessment in today's classrooms.

611 Principles of Guidance 3 hrs.
Sociological, psychological, and educational foundations of guidance; history and growth of the guidance movement; functions, scope, organization, and administration of guidance.

620 Curriculum Integration Technology 3 hrs.
Prepares teachers to plan curriculum integration by using computer technology and software in various curriculum areas for both regular and special students. Students will develop competency in instructional design and production skill techniques and implement instructional events using long-distance technologies. Lab Fee: $40. Prerequisites: ED/CS 520, ED/CS 560. (Same as CS 620.)

622 Space Orientation for Teachers: Elementary 3 hrs.
The curriculum for this program builds on that already attained by those educators who have participated in the generic program conducted at UAH, by providing experiences available in Washington, DC. 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 John Hopkins, National Oceanic and Atmospheric Administration, and the Office of Technology Assessment. Prerequisites: ED 532, ES 532, SS 532, or ED 522. (Equivalent to EEC 592 at UAB.)

626 Modern Middle School Programs 3 hrs.
Survey of important viewpoints and issues, reorganization trends, typical research findings by subject fields and analysis of current curriculum proposals at the national, state, and local levels.

630 Modern Secondary School Programs 3 hrs.
Survey of main foundational ideas of education in philosophic and social perspectives; survey of important trends and issues; analysis of curricula in relation to subject fields.

632 Space Orientation for Teachers: Secondary 3 hrs.
Builds on material already attained by those educators who have participated in the generic program conducted at UAH, by providing experiences available in Washington, D.C., 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 John Hopkins, National Oceanic and Atmospheric Administration, and the Office of Technology Assessment. Prerequisites: ED 532, ES 532, SS 532, or ED 522. (Same as ES 632.)

641 Staff Development 3 hrs.
Principles and techniques for the continued professional development of individuals and groups who are responsible for establishing learning environments. Designed for those in instructional leadership positions who are responsible for the development (in-service) programs including conferences, workshops, single sessions, and comprehensive programs.
642 International Aerospace Education: Soviet Union 3 or 6 hrs.
On-site seminar on the Soviet space program. Lectures deal with rocket and shuttle design, cosmonautics, Soviet science education and space policy decision-making. Locations include Space Mission Control, Star City, the Baikanur Cosmodrome, and various schools, institutes, ministries, and factories involved in aerospace education and industry in Moscow, Kiev, Leningrad, and Krasnoyarsk. (Same as ES 642.)

647, 648, 649 Field Experience Practicum 1 hr. each
Student demonstration of performance competencies in school administration through field practicum. Students with committee approval may register for 647-648-649 individually or jointly. Course approval based upon committee’s evaluation of student’s readiness for field practicum. Courses individually scheduled to fit concurrently with student’s regular employment assignment.

661 Major Issues and Trends in Instructional Leadership 3 hrs.
Designed to: stimulate student participation in the analytic process of examining issues and trends in the broad field of instructional leadership; serve as a vehicle for increasing proficiency in writing skills; refine participants’ abilities to analyze, synthesize, and formulate a position relative to controversial educational issues and areas.

662 Instructional Leadership 3 hrs.
Upon completion of this course students describe themselves in terms of leadership strengths, modality strength, cognitive strength, personality type, coping procedures, time management, and other pertinent leadership variables. Designed to promote peer interaction and introspection such that students receive feedback which enables them to analyze the conflict between self perception and peer perception.

690 Seminar in Teaching 1 hr.
Provides opportunity for reflection and discussion of student teaching experiences in light of current trends and problems in education. To be taken concurrently with student teaching.

695 Supervised Teaching 1 hr.
Provides graduate teaching assistants with theoretical background, knowledge, skills, and practical strategies needed to develop, implement and assess appropriate instructional experiences which adult learners need to succeed. For graduate teaching assistants only.

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.
ENGLISH DEPARTMENT

Degree: Master of Arts

Chair: D. Schenker, Associate Professor

Professors:

Associate Professors:
Early, J.; Victorian literature
Mebane, J.S.; Renaissance literature
Moore, R.S.; American literature
Munson, W.F.; medieval literature
Neff, D.S.; Romantic period, criticism
Nelson, J.; Renaissance literature
Norman, R.; technical writing, women’s studies
Schenker, D.; modern British literature
Szilagyi, S.; Augustan and eighteenth-century literature

Assistant Professors:
Bollinger, L; American literature
Dillard, N.F.; Milton, seventeenth-century literature
Youmans, M.; linguistics, TESOL
Young, B.; rhetoric and writing, women’s studies

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. In addition, 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

Students seeking an M.A. in English may choose either Plan I (24 semester hours plus a thesis) or Plan II (33 semester hours). Both plans require a minimum of 18 semester hours in literature courses offered by the English Department. Special certificate programs require additional hours which are determined by guidelines given below and in consultation with the appropriate program advisors. Six hours of graduate work in English may be transferred with the approval of the department graduate committee. Other requirements are as follows:

1. At least half of the hours for the degree (exclusive of thesis credit hours) must be 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).
2. Six semester hours of EH 699 for students following Plan I.
3. A maximum course load of 15 semester hours per semester.
4. Oral comprehensive examination on courses taken and on the thesis. For students following Plan II, both oral and written examinations are required. The written examination must be passed before the oral examination is taken.
5. A reading knowledge of French, German, Spanish, or another language deemed by the department to be academically appropriate. Adequate reading knowledge must be demonstrated by one of the following options:
a. Four semesters or their equivalent in one language with a minimum average grade of B at an accredited institution, completed not more than five years before the student's first graduate course in the UAH program.


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.

d. In lieu of the language requirement, additional graduate course work of three semester hours of English. EH 507 (English Linguistics) or EH 508 (History of the English Language) or a designated course of a similar nature is required.

Class A Teacher Certification - Traditional Master's Program-Option B

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 a Class B Certificate before receiving the M.A. degree.
2. Take 9 hours of graduate courses in education as specified by the Education Department which 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.

Class A Teacher Certification - Non-Traditional Fifth-Year Program

Those who have a B.A. or B.S. 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 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.

Certificate Programs in TESOL and Technical Communication

Students who wish to earn the Certificate in TESOL and/or the Certificate in Technical Communication must be admitted to the Graduate School, but may pursue the certificates independent of a master's degree program.

A. Graduate Certificate in TESOL

The English Department offers an 18-credit-hour Certificate in the Teaching of English to Speakers of Other Languages (TESOL). The certificate courses in applied English linguistics prepare students for classroom instruction, testing, and material evaluation and preparation in the area of TESOL. The certificate is awarded upon completion of the following six courses: EHL 505, 507, 508, 608, 609, and 610. Students who wish to apply EHL 505, 507, and 508 to the certificate must take these courses at the graduate level. EHL 505, 507 and 508 may be applied to the M.A. degree in English. No more than six credit hours of relevant graduate level course work taken at another institution may be applied to the certificate. Students who wish to earn both the M.A. degree and the TESOL Certificate will pursue a program consisting of the prescribed 18 hours of TESOL-related courses and 18 hours of appropriate graduate-level literature courses in English.

B. Graduate Certificate in Technical Communication

The English Department offers a 15-credit-hour Certificate in Technical Communication. The certificate requires three specialty courses in technical writing and editing (EHT 501, 502, and 601 or 602) and two specialty courses in an allied field (such as linguistics, psychology, cognitive sci-
ence, or management information systems). Students wishing to apply 500-level courses toward
the certificate must take those courses at the graduate level. EH 501, 502, and 601 may be applied
to the M.A. degree in English. EH 602 may be counted only toward completion of the certificate.
No more than six credit hours taken at another institution may be applied to the certificate, and cer-
tificate courses taken at UAH must include EH 501 or 502 and EH 601 or 602.

**Graduate Courses in English (EH)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>Literary Criticism and Theory</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>510</td>
<td>Advanced Fiction Writing</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>520</td>
<td>Modern Poetry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>522</td>
<td>Modern Novel</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>525</td>
<td>Literature and Technology</td>
<td>hrs.</td>
</tr>
<tr>
<td>530</td>
<td>Special Studies in American Literature</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>532</td>
<td>Literature of the American South</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>533</td>
<td>William Faulkner</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>540</td>
<td>Special Studies in English Literature</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>571</td>
<td>Renaissance Drama</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>572</td>
<td>Seventeenth-Century Poetry</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>592</td>
<td>The Literature of the Transition</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>618</td>
<td>Studies in Women and Literature</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>629</td>
<td>Studies in Twentieth-Century Literature</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>630</td>
<td>Studies in American Literature to 1865</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>631</td>
<td>Studies in American Literature since 1865</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>
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 Criseyde, and other works especially in relation to relevant literary and religious traditions.

651 Middle English Literature 3 hrs.
Emphasis on literature of later medieval England, excluding Chaucer, chosen from the Gawain poet, Piers Plowman, romance, drama, religious meditation, the short poem, and Margery Kempe.

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.

670 Milton 3 hrs.
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 various early modern texts, with attention to interdisciplinary contexts.

690 Studies in the Romantic Period 3 hrs.
Representative writing, selected from prose, poetry, or fiction, with attention to aesthetic theory and philosophical and psychological backgrounds.

691 Studies in the Victorian Period 3 hrs.
Representative writing, selected from prose, poetry, or fiction, with emphasis on social and cultural changes that inform the literature.

699 Master’s Thesis 3 hrs.
Required each semester during which a student is working and receiving direction on a master’s thesis. No more than 6 hours credit may be applied toward the degree. Prerequisite: approval of instructor.

Graduate Courses in English Linguistics and TESOL (EHL)

Survey of the field of linguistics, including language typology, distribution of major languages of the world, cognition, topics in socio- and psycho-linguistics, theories of grammar, and introduction to writing mini-grammars. 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 texts which characterize the Anglo-Saxons.

Advanced grammar which includes traditional and contemporary analyses of major English syntactic patterns; dialect studies; analysis of style; selected socio- and psycho-linguistic topics.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>508</td>
<td>History of the English Language: Applied English Linguistics III</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>610</td>
<td>Practicum in TESOL: Applied English Linguistics VI</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

Graduate Courses in English Technical and Business Writing (EHT)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>502</td>
<td>Problems in Technical Editing</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>601</td>
<td>Writing Pedagogy</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>602</td>
<td>Practicum in Technical Communication</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

HISTORY DEPARTMENT

Degree: Master of Arts

Chair: A. J. Dunar, Professor

Professors:
Boucher, P.P.: early modern Europe, early modern European expansion
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 on the aptitude portion of the examination. Reading ability in French, German, Latin, 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 1500 on the three aptitude portions 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 History Department requirements for the Master of Arts degree are:

1. Eighteen semester hours of graduate work in history, six of which may be transfer credit approved by the departmental Graduate Committee. Equal course distribution of U.S. and European history is expected within these 18 hours. HY 605 is required.
2. Six additional hours of elective graduate courses in history or a related subject approved by the Graduate Committee.
3. At least 50 percent of the hours for a graduate degree (excluding thesis credit hours) in courses numbered 600 or above. At least nine hours must be in history courses numbered 600 or above (excluding thesis credit hours at UAH).
4. Master's thesis carrying a minimum of six hours credit. Upon petition to and approval by the departmental Graduate Committee, a student may substitute nine hours of graduate history courses for the thesis.
5. Oral comprehensive examination covering 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:

Class A Teacher Certification – Traditional Master’s Program-Option B
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.

Class A Teacher Certification – Non-Traditional Fifth-Year Program
Those who have a B.A. or B.S. 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.

Upper Level Undergraduate Courses In History
If an applicant has insufficient undergraduate hours in history for even probational admission to the graduate program, but demonstrates to the departmental Graduate Committee sufficient potential and determination to merit further consideration, 6 to 12 course hours at the 400-level (senior undergraduate) may be required. Senior undergraduate course credit cannot be transferred or used for credit toward the Master of Arts in history.

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. See undergraduate program.

513 The Old South
Southern society, economics, politics and culture concentrating on the nineteenth century South through Reconstruction.

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

524 The Atlantic World
Comparative survey of the western European colonial empires from 1450 to 1763, emphasizing the cultural interactions of African, Amerindian, and European peoples in the Americas. Meets the requirement for either American or non-American credit in the history major.

527 The Age of the American Revolution
Politics, society, economy, culture and international conflicts from 1754 through the Revolutionary War to 1815.

528 The Republic in Crisis
Political, social, and economic changes in the United States and its sections from 1815 through the Civil War and Reconstruction.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>537</td>
<td>The Rise of Modern America</td>
<td>3 hrs.</td>
<td>Economic and social changes, imperialism, and the growth of government in the United States from 1877 to the 1920s.</td>
</tr>
<tr>
<td>538</td>
<td>Modern America</td>
<td>3 hrs.</td>
<td>American society, politics, economics, and foreign affairs from the end of World War I to the origins of the Cold War.</td>
</tr>
<tr>
<td>539</td>
<td>Recent America</td>
<td>3 hrs.</td>
<td>Contemporary America from the 1950s to the present analyzing both domestic and foreign affairs.</td>
</tr>
<tr>
<td>573</td>
<td>The High Middle Ages</td>
<td>3 hrs.</td>
<td>Political, economic, and cultural features of Europe when medieval civilization was at its height.</td>
</tr>
<tr>
<td>574</td>
<td>The Renaissance and Reformation</td>
<td>3 hrs.</td>
<td>Selected topics in the Italian Renaissance and European Reformation.</td>
</tr>
<tr>
<td>575</td>
<td>Crisis in Europe, 1560-1660</td>
<td>3 hrs.</td>
<td>Europe in an age of anxiety, religious wars, political upheaval, witch hunts, and the early scientific revolution.</td>
</tr>
<tr>
<td>576</td>
<td>Absolutism and Enlightenment, 1660-1763</td>
<td>3 hrs.</td>
<td>Europe from Louis XIV to the Peace of Paris, an age of political stability and intellectual innovation.</td>
</tr>
<tr>
<td>577</td>
<td>The French Revolution and Napoleon</td>
<td>3 hrs.</td>
<td>A study of European ideas, institutions, and events from the beginning of the French Revolution to the demise of the Napoleonic Empire.</td>
</tr>
<tr>
<td>578</td>
<td>Europe in the Nineteenth Century</td>
<td>3 hrs.</td>
<td>Major political, social, economic, and intellectual developments in Europe from the Congress of Vienna to World War I.</td>
</tr>
<tr>
<td>579</td>
<td>Europe in the Twentieth Century</td>
<td>3 hrs.</td>
<td>Major developments in Europe from 1914 to the present, including the two World Wars and post-war reconstruction.</td>
</tr>
<tr>
<td>590</td>
<td>Research Seminar in History</td>
<td>3 hrs.</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>605</td>
<td>Recent Interpretations of Modern History</td>
<td>3 hrs.</td>
<td>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.</td>
</tr>
<tr>
<td>614</td>
<td>Studies in Southern History</td>
<td>3 hrs.</td>
<td>Research, writing, and critical examination of selected topics in nineteenth- and twentieth-century southern history.</td>
</tr>
<tr>
<td>618</td>
<td>Studies in Early American History</td>
<td>3 hrs.</td>
<td>Research, writing, and critical examination of selected topics in early American history from 1607 to 1800.</td>
</tr>
</tbody>
</table>
Research, writing, and critical examination of selected topics in twentieth-century American history.

637 Development of Management and Policy 3 hrs.
The evolution of modern American business management and government policy.
(Same as PSC 637)

650 Research Methods in History 3 hrs.
Exploration of contemporary research methods such as archival research, prosopography, paleography, quantitative methods, and state/local research techniques.

655 Studies in British History 3 hrs.
Research, writing, and critical examination of selected topics in British history.

656 Studies in French History 3 hrs.
Research, writing, and critical examination of selected topics in French history.

657 Studies in Russian and Soviet History 3 hrs.
Research, writing, and critical examination of selected topics on Imperial Russia and the Soviet Union.

670 Studies in Medieval History 3 hrs.
Research, writing, and critical examination of selected topics in medieval history.

680 Studies in Early Modern Europe 3 hrs.
Research, writing, and critical examination of selected topics in the field of early modern European history.

690 Studies in Modern Europe 3 hrs.
Research, writing, and critical examination of selected topics in the field of modern European history.

699 Master’s Thesis 1-3 hrs.
Required each semester 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 DEPARTMENT-Public Affairs Program

Degree: Master of Arts

Chair: Allan Spitz, Professor

Professors:
Meek, R.L.
Spitz, A.

Associate Professors:
MacDougall, J.J.
Pottenger, J.R.
Williams, T.J.

Assistant Professor:
Reeves, A.E.

Adjunct Assistant Professors:
Moorman, J.M.
Schumann, J.P.
The Master of Arts in Public Affairs is designed to provide students with the knowledge and understanding that is required to relate effectively to the American public policy process. Graduates will be prepared to make significant contributions within the private and/or public sectors of American society. The program provides the foundation for productive participation in organizations that are dedicated to the development, implementation, and evaluation of public policies in the United States. It makes accessible a set of perspectives that are valuable to persons in the private sector whose activities are substantially impacted by the public policy system. It is expected that the typical graduate will function within public organizations at the national, state, or local levels. However, the skills and expertise that are developed in the program contribute to the ability of the graduate to contribute to the success of non-profit and for-profit organizations in the private sector whose activities involve intense interactions with the public policy system.

The program emphasizes theoretical, practical, and methodological issues that are critical for the knowledgeable contributor and consumer of public policy in the American polity. Historical, empirical, and normative approaches are central to each element of the program. The norms of public service, sound governance, effective analysis, and knowledgeable evaluation are central to the design of the program. Therefore, the acquisition of relevant skills in quantitative and qualitative analyses are central expectations for all students who complete the program.

Clientele

The program is designed to serve the needs of students who hold the bachelor's degree in any field. The criteria for admission to the program are those specified for the master’s degree by the graduate school at the University of Alabama in Huntsville. Admission is not dependent upon any particular subject matter expertise. However, each student will be expected to complete AHS 300 if he or she does not have an equivalent experience in his or her background. Instruction in the program assumes the level of intellectual development and maturity expected of an above average college graduate. The goals and interests of students rather than subject matter expertise are the primary criteria for the selection of students for participation in this program of instruction.

The program is organized primarily to serve the needs and interests of the mature individual who has significant experience after completion of an undergraduate degree program. Most typically, these students will most often be employed within an organization in the public or private sector in which the principles and practices of public affairs are relevant. The successful completion of the program is expected to lead to enhanced organizational contributions and provide enhanced opportunities for career advancement. However, the program is also quite appropriate for the person who aspires to shift a career toward activities related to the public policy process. Therefore, the design and scheduling of courses in the program assumes that most students will have significant practical experience and will enroll in the program on a part-time basis. Such a part-time student should anticipate that two to three years of study will be required to complete the program.

However, the program is also appropriate for the pre-service student and every effort is made to make it possible for a student to enroll in the program on a full-time basis. Efforts are made to provide such a student with the opportunity to complete the program within one calendar year. It should be emphasized that it would be quite unusual and not typical for the student to be able to complete the program in such a limited time frame. Generally, in cases where practical experience is not present in the background of the student, a degree in one of the social sciences or a field of administrative science would be most helpful but not required for admission and successful completion of the program.
Program

The program is administered by the Department of Political Science and the bulk of the instruction is provided through that department. The focus of the program is on fundamental issues related to the problems of politics and governance in a democratic society. However, the subject matter and the objectives of the program dictate that there should be an interdisciplinary dimension to the program. Consequently, significant coursework and academic experiences outside the Department of Political Science will be required as a component of the program of study.

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 requires 36 hours of approved graduate work from the following courses:

1. A minimum of 36 credits at the 500- and 600-levels.
2. Foundation courses - 12 hours. All of the following courses are required.*
   - PSC 500 The American Polity
   - PSC 501 The Public Policy Process
   - PSC 510 Public Management Profession: Theory and Practice
   - PSC 635 Methodological Issues and Public Policy (replaces AHS 600 as program requirement)
   - Although these courses are not prerequisites for other courses in the program, it is advisable for students to complete them as early in their program as practicable.
3. Value Issues - 3 hours. One of these courses is required:
   - PSC 630 Public Values and Public Policy
   - PSC 637 Development of Management and Policy
   - PSC 639 Complex Organizations in Industrial Society
4. Structures and Processes - 6 hours. Two of the following courses are required:
   - PSC 611 Public Personnel Administration
   - PSC 612 Budgetary Process
   - PSC 615 Special Topics in Public Administration*
   - PSC 620 Intergovernmental Relations
   - PSC 651 Public Policy and the Law
   *May be repeated for credit with change in course content, subject to approval of department chair.
5. Specialized Issues - 3 hours. One of the following courses is required:
   - PSC 605 Public Policy Seminar*
   - PSC 665 American Foreign Policy
   - PSC 668 National Security Policy
   *May be repeated for credit with change in course content, subject to approval of department chair.
6. Courses in other disciplines* - 6 hours. Two of the following courses are required:
   - SOC 639 Complex Organizations in Industrial Society
   - PY 502 Industrial and Organizational Psychology
   - HY 637 Development of Management and Policy
   - AC 601 Foundations of Accounting
   - MGT 622 Human Behavior in Organizations
   - MGT 623 Organizational Theory
   - MGT 505 Contract Law
   - ECN 540 Industrial Structure and Regulation
ECN 548 Development of Economic Theory
MSC 642 Management Science

*Other courses outside the department may be substituted for these courses with the permission of the department chair.

7. Other Options - 6 hours. One of the following options:
   PSC 695 (a) Internship in Government (3 hrs. + one elective)
   PSC 699 (b) Master's Thesis (6 hours)
   (c) Free Electives (6 hours)

Graduate Courses in Political Science (PSC)

500 The American Polity 3 hrs.
Comprehensive and intensive review of the foundations, institutions, and dynamics of the American polity and the relationship of these forces to the making of public policy.

501 The Public Policy Process 3 hrs.
Economic, political, social, and institutional factors which influence the policymaking process and the impact of policy decisions made by the national, state, and local levels of government. Examination of the steps in policymaking analysis.

510 Public Management Professions 3 hrs.
Introduction to public management as a field of study and practice. Review of basic literature. Emphasis on ethics in public service.

605 Public Policy Seminar 3 hrs.
Focuses on specific policy areas of the national government such as foreign policy, science policy, or national security policy.

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

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

615 Special Topics in Public Administration 3 hrs.
Selected current issues in public administration.

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

630 Public Values and Public Policy 3 hrs.
Critical examination of the normative aspect of public policy-making. 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.

635 Methodological Issues and Public Policy 3 hrs.
Emphasis upon application of advanced quantitative techniques to public policy issues. Prerequisite: AHS 300.

637 Development of Management and Policy 3 hrs.
Evolution of modern American business management and government policy. (Same as HY 637.)
Complex Organization in Industrial Society 3 hrs.
Mainstream and critical sociological theories for understanding complex organization in industrial societies. Specific areas covered include: historical development, structure and processes, contradictions and conflict, and alternative forms. (Same as SOC 639.)

Public Policy and the Law 3 hrs.
Judicial influences on the development and application of public policy in the United States. Role of the judiciary as a political actor.

American Foreign Policy 3 hrs.
Analysis of major theories explaining foreign policy and various controversies surrounding policy processes and issues.

National Security Policy 3 hrs.
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. Prerequisite: Undergraduate course in international relations recommended.

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.

Master's Thesis 1-3 hrs.
Required every semester a student 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 DEPARTMENT

Degree: Master of Arts

Chair: Robert E. James, Associate Professor

Professors:
Kirkpatrick, S.W.; learning disabilities, facial interpretation, moral orientation, sex-role issues in adults and children
Rogers, J.G.; human factors, theory of abnormal, cognitive-behavioral therapy

Associate Professors:
Carpenter, S.L.; social psychology, personality, social cognition, the self, psychology of women
James, R.E.; learning, learning theory, nonverbal communication, experimental aesthetics

Assistant Professors:
Bliss, J. P.; human factors, virtual reality, aviation, military training, simulation, warnings
Lohmeier, J.H.; learning, memory, concepts and categorization, problem solving
Torres, A.; biological psychology, hormones and behavior, psychophysiology, stress, health psychology

The Master of Arts degree program is oriented toward providing an understanding and appreciation of the scientific basis of behavior. The focus of the program is general-experimental with areas of concentration available in human factors, industrial, cognitive, and developmental psychology. This program is primarily directed toward the student whose goal is the continuation of scholarly study, research, and writing. This program is not designed to qualify students for licensure, private practice, or for providing psychological services without further advanced education.
Admission Requirements

In addition to the general requirements for admission to the School of Graduate Studies, this program requires a minimum combined score of 1000 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 faculty 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 as well as a statement specifying intent for graduate study and at least one (preferably two) papers (preferably experimental) authored by the applicant. Recommendations should be sent to: The Graduate Committee, Department of Psychology. Applications are not reviewed until all materials are complete.

Degree Requirements

1. The student must complete at least 30 hours of graduate work, including 6 hours of thesis or supervised research. A maximum of 6 hours may be transfer courses approved by the Graduate Committee of the department.

2. The student’s Program of Study must include PY 610, PY 611, PY 615, PY 641, and 6 hours of either PY 650 or PY 699.

3. In addition, the student’s Program of Study will include other graduate level courses in psychology selected with the advice of the student’s advisor. If approved by the Graduate Committee of the department, the student’s Program of Study may include up to 6 hours of graduate credit from related departments.

4. The student must pass an oral comprehensive examination which covers both coursework and research (either thesis or supervised research).

5. The student must meet requirements for the Master of Arts degree as specified by the School of Graduate Studies.

Graduate Courses in Psychology (PY)

The 500-level courses listed below are offered at the senior/graduate level except for courses noted below. Only admitted graduate students may enroll in 600-level courses.

**500 Human Research I**

3 hrs.

Human behavior observation and/or experimentation. Students will design a study dependent upon previous coursework, will engage in data collection and analysis, and will report their findings in a research paper and an oral presentation. Lab Fee: $30. Prerequisites: PY 302, 15 hours PY 300-level or above, and senior/graduate standing. (Offered Fall)

**501 Human Research II**

3 hrs.

Continuation of PY 500. Lab Fee: $30. Prerequisites: PY 500 and approval of instructor. (Offered Spring)

**502 Industrial and Organizational Psychology**

3 hrs.

Application of basic principles of learning, motivation, and perception to typical industrial and organizational problems. Prerequisite: Senior/graduate standing.

**520 Special Topics**

3 hrs.

Pre-announced special areas in seminar discussion, laboratory work, or practicum. May be taken twice for credit.

**530 Psychometrics**

3 hrs.

History and development of psychological testing with special emphasis given to both theory and process of effective evaluation. Prerequisites: AHS 300 and PY 311 (or equivalent, depending upon program background).
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>535</td>
<td>Theory of Abnormal Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Selected disorders such as depression, anxiety disorders, and personality disorders from different theoretical orientations with emphasis on cognitive behavioral theory. Prerequisite: PY 433 or approval of instructor, and senior/graduate standing.</td>
<td></td>
</tr>
<tr>
<td>601</td>
<td>Advanced Developmental Psychology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>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 and graduate standing in psychology.</td>
<td></td>
</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 are responsible for library research, writings, and presentation of selected topics. 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 are responsible for library research, writings, and presentation of selected topics. 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. Prerequisite: Graduate standing in psychology.</td>
<td></td>
</tr>
<tr>
<td>610</td>
<td>Experimental Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Design and use of the experiment as an inferential tool. Issues pertaining to reliability, validity, manipulation of independent variables and sampling will be examined. Prerequisites: AHS 300, PY 302, and graduate standing in psychology.</td>
<td></td>
</tr>
<tr>
<td>611</td>
<td>Statistics for Experimental Methods</td>
<td>4 hrs.</td>
</tr>
<tr>
<td></td>
<td>Statistical techniques for analysis of data generated by experimental designs. Lab Fee: $60. Prerequisites: PY 610 and graduate standing in psychology.</td>
<td></td>
</tr>
<tr>
<td>613</td>
<td>Non-experimental Designs</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Methods of psychology research in areas where direct manipulation of independent variables is not feasible. Observation, questionnaires, modeling, regression analysis. Other possible topics include program evaluation and cluster analysis. Prerequisites: AHS 300, PY 302, and graduate standing in psychology.</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 in psychology. May be taken more than once for credit.</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, learned helplessness, and observational learning. Prerequisite: Graduate standing in psychology.</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. Prerequisite: Graduate standing in psychology.</td>
<td></td>
</tr>
<tr>
<td>641</td>
<td>Concentrated Readings/Research in Specialization Area</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. One requirement is a major research paper, of publishable quality, which will be reviewed by the faculty of the department. May be taken more than once for credit. Prerequisite: Permission of instructor.</td>
<td></td>
</tr>
</tbody>
</table>
650 Supervised Research 3-6 hrs.
Laboratory or applied research concerning a particular topic, approved and supervised by a PY faculty member. The student may work on an independent or group project. May be taken more than once for credit. Prerequisite: Permission of supervising faculty.

655 Symbolic Processes 3 hrs.
Psychology of processing symbolic material. Prerequisite: Graduate standing in psychology.

699 Master's Thesis 3 hrs.
Required each semester a student is working and receiving faculty direction on a 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. Prerequisite: PY 641 and graduate standing in psychology.
The College of Nursing offers the Master of Science in Nursing degree which builds upon and augments the scientific and professional base provided in baccalaureate-level study.

The Master of Science in Nursing degree provides a theoretical and clinical base which enables the graduate to engage in advanced professional practice. The program is designed for three academic year semesters and one summer session of full-time study. Part-time study is available.

Opportunities for student learning are individualized while developing advanced skills and knowledge in three majors: Acute Care Nurse Practitioner, Nursing Administration, and Family Nurse Practitioner. All graduates, upon completion of the program, are eligible to sit for national certification in selected areas.
Special Facilities

Madison County has two general hospitals with a licensed capacity of 1,013 beds, one army hospital licensed for 42 beds, a county health department, and numerous skilled nursing homes and home health care agencies. The University of Alabama Medical Clinics – Huntsville Program also serve as a clinical site for students in the College of Nursing.

Huntsville Hospital System, the largest general hospital in the northern part of the state, is the regional medical care center for north Alabama and south central Tennessee. The hospital offers comprehensive emergency treatment facilities and the only newborn intensive care unit in north Alabama. Columbia Hospital is a private general hospital fully equipped to handle most diagnostic and surgical procedures. Fox Army Community Hospital provides complete outpatient care and general medical and surgical short-term acute care. Rural health clinics across Alabama are also used for student experiences. Other hospitals, clinics, and physicians' offices are used on a selected basis.

Admission and Enrollment Requirements

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. Petitions for exceptions will be evaluated on an individual basis.
2. Overall grade point average of 3.0 on a 4.0 scale in all baccalaureate coursework or on the last 60 semester hours of coursework completed.
3. Acceptable score on either the Graduate Record Examination or the Miller Analogy Test taken within the last five years. Desired scores are 1500 on the GRE or 50 on the MAT.
4. Three recommendations from individuals familiar with applicant's academic and clinical abilities. One recommendation should be from a former nursing instructor/dean and one from an employer/supervisor. Forms will be provided by the College of Nursing.
5. Satisfactory completion of an elementary statistics course.
6. Current RN license in the State of Alabama or eligibility for an Alabama license. Alabama license must be obtained prior to enrollment in graduate courses.
7. Applicants who meet all criteria delineated in the School of Graduate Studies and College of Nursing admission requirements and have clinical experience as a registered nurse in the proposed area of study will be given preference in admission to the program.

Students who meet or exceed both the GPA requirement and the desired test score (GRE or MAT) are eligible for unconditional admission to the graduate program. Students who meet only one of these criteria are eligible for conditional admission.

Clinical sequences begin in the fall semester. Students applying for fall admission should plan to have their admission packets completed by April 15.

After admission to the graduate program in nursing and prior to enrollment in graduate nursing courses, the following requirements must be met:

Health Requirements for Enrollment:

1. Health examination by physician or a certified nurse practitioner. Reports of the results of this examination must be submitted on forms provided by the College of Nursing and must be received by the College of Nursing Office of Student Affairs by published deadlines. Individual clinical agencies may require additional documentation for specific health requirements which must be met by students.
2. Immunization for Hepatitis B. Certification that the series of injections has begun or results of a recent titer must be received by the College of Nursing Office of Student Affairs by published deadlines. Immunizations and titers are at the expense of the student.
3. Immunization for measles. Documentation of current immunization for measles or results of a recent titer must be received by the College of Nursing Office of Student Affairs by published deadlines. Immunizations and titers are at the expense of the student.

4. Documentation of current health insurance must be received by the College of Nursing Office of Student Affairs by published deadlines. Hospitals and health agencies provide emergency treatment to students for injury or illness occurring in the course of program requirements in their agencies. Such treatment shall, however, be at the expense of the student.

**Other Requirements for Enrollment:**

1. Documentation of professional liability insurance must be provided to the College of Nursing Office of Student Affairs prior to enrollment in a nursing class. Professional liability insurance must be maintained throughout the program.

2. Documentation of CPR certification must be provided to the College of Nursing Office of Student Affairs prior to enrollment in a nursing class. CPR certification must be maintained throughout the program.

3. Documentation of current licensure to practice as a registered nurse in Alabama must be provided to the College of Nursing Office of Student Affairs prior to enrollment in a nursing class. Students will not be eligible for continuation in the program if licensure is suspended or revoked. Students are required to notify the College of Nursing of any change in licensure status. If a student is permitted to meet course clinical requirements in a state other than Alabama, the student must be licensed in that state as well as in Alabama.

**Responsibility to Clinical Agencies**

Students are responsible for complying with policies and procedures required by clinical agencies. Failure to meet any requirement may lead to exclusion from required clinical educational experiences and prevent completion of the program. Additionally, should a student cause damage to property during the course of clinical experiences, liability and cost of repair shall be the responsibility of the student.

**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. Students must make application directly to the Alabama Board of Nursing. Contact Alabama Board of Nursing for deadline.

   The College of Nursing applies annually for a limited number of traineeships for graduate students. These funds are granted to admitted students enrolled for full-time study in a clinical major. Currently, only those students enrolled in the Family Nurse Practitioner Track or the Acute Care Nurse Practitioner Track are eligible for traineeships. Application forms may be obtained through the Office of Student Affairs in the College of Nursing.

3. Elizabeth M. Fisher Memorial Scholarship.

4. Graduate Teaching Assistantships.

5. Graduate Tuition Scholarships.
Degree Requirements

Requirements for completion of the graduate program are a minimum of 45 semester hours of graduate coursework for students enrolled in the Acute Care Nurse Practitioner Track, the Family Nurse Practitioner Track, and the Nursing Administration Track.

Students may follow one of two research options for their program of study: (1) Plan I: Thesis, (2) Plan II: other activities with approval of advisor.

All tracks require that students successfully complete a written comprehensive examination.

Nursing Tracks

Core Requirements: (12 semester hours)

Theoretical Perspectives for Advanced Nursing Practice (NUR 601) 3
Scholarly Inquiry for Advanced Nursing Practice (NUR 602) 3
Thesis/Other research activities (NUR 698, 699, graduate courses) 6

Acute Care Nurse Practitioner Track

In addition to the above 12 semester hours of required core courses, the student must complete the following required courses (33 semester hours):

Pathophysiology (NUR 606) ........................................ 3
Health Assessment (NUR 605) ........................................ 3
Pharmacology (NUR 607) ........................................ 3
Adult Acute Care Nurse Practitioner I (NUR 620) .............. 6
Adult Acute Care Nurse Practitioner II (NUR 621) .............. 6
Adult Acute Care Nurse Practitioner III (NUR 622) ............ 6
Acute Care Nurse Practitioner IV (NUR 623) .............. 6

A minimum of 45 semester hours is required for the Acute Care Nurse Practitioner Track.

Family Nurse Practitioner Track

In addition to the 12 semester hours of required core courses, the student must complete the following required courses (33 semester hours):

Pathophysiology (NUR 606) ........................................ 3
Health Assessment (NUR 605) ........................................ 3
Pharmacology (NUR 607) ........................................ 3
Family Nurse Practitioner I (NUR 610) .......................... 6
Family Nurse Practitioner II (NUR 611) .......................... 6
Family Nurse Practitioner III (NUR 612) .......................... 6
Family Nurse Practitioner IV (NUR 613) .......................... 6

A minimum of 45 semester hours is required for the Family Nurse Practitioner Track.

Nursing Administration Track

In addition to the 12 semester hours of required core courses, the student must complete the following required courses (33 semester hours):

Health Policy (NUR 604) ........................................ 3
Nursing Administration in Health Care Systems (NUR 630) .... 3
Resource Management in Nursing Administration (NUR 631) .... 3
Fiscal Management in Nursing Administration (NUR 632) .... 3
Nursing Administration I (NUR 633) ........................................ 6
Nursing Administration II (NUR 634) ........................................ 6
Basic Budgeting in Health Systems (NUR 636) .... 3
Graduate Electives ........................................ 6

A minimum of 45 semester hours is required for the Nursing Administration Track.

The College of Nursing offers a post-MSN Family Nurse Practitioner Certificate Program. Contact the College of Nursing’s Office of Student Affairs for more information (205-890-6742).
Graduate Courses in Nursing (NUR)

500 Special Topics 2-4 hrs.
Advanced study of selected area of interest in nursing. Elective. Prerequisite: Approval of instructor. Lab Fee: $30. Fall, Spring, Summer.

601 Theoretical Perspectives for Advanced Nursing Practice 3 hrs.
Focuses on understanding the process for developing and using different forms of nursing knowledge and the exploration of theory relevant to advanced nursing practice. Lab Fee: $30. Spring.

602 Scholarly Inquiry for Advanced Nursing Practice 3 hrs.
Includes discussion of philosophical and theoretical bases of nursing research and the application of research findings to practice. Development of a research problem, including problem identification, evaluation of current knowledge, and the selection of an appropriate research approach. Focuses on research methodologies, both quantitative and qualitative, as they relate to data collection, data analysis including both interpretive and statistical strategies, and discussion of findings. Proposal generation and research funding mechanisms. Lab Fee: $30. Summer.

604 Health Policy 3 hrs.
Local, state, and national health care policies, with emphasis on political systems, regulatory processes, and organizational issues influencing health care delivery. Lab Fee: $30. Summer.

605 Advanced Health Assessment 3 hrs.
Theory and laboratory practice to develop skills for comprehensive health assessment of individuals and families. Lab Fee: $100. Fall.

606 Pathophysiology 3 hrs.
Expands upon previous knowledge of anatomy, physiology, development, and disease processes. Anticipated physiological alterations as they affect individuals throughout the life span. Lab Fee: $30. Spring.

607 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. Lab Fee: $30. Fall.

610 Family Nurse Practitioner I 6 hrs.
Clinical course that introduces advanced nursing concepts and skills necessary for assessment, health promotion and illness prevention, and health care management of the adult client in primary health care settings. Pre/corequisites: NUR 605, 606, or 607. Lab Fee: $180. Fall.

611 Family Nurse Practitioner II 6 hrs.
Clinical course with emphasis on advanced nursing concepts and clinical practice of health promotion and management of women throughout the life span in the context of family. Prerequisite: NUR 606 or 607; 610. Lab Fee: $180. Summer.

612 Family Nurse Practitioner III 6 hrs.
Clinical course that focuses on advanced nursing concepts and clinical practice of health promotion and management of children in the context of family. Pre/corequisite: NUR 606 or 607; 610. Lab Fee: $180. Spring.

613 Family Nurse Practitioner IV 6 hrs.
A synthesis clinical course, focusing on preparation for primary care of individuals and families throughout the life span and along the health continuum. Prerequisites: NUR 610, 611, 612. Lab Fee: $180. Fall.
620 Acute Care Nurse Practitioner I  
Clinical course that introduces advanced nursing concepts and skills necessary for assessment, health promotion and illness prevention, and health care management of the adult client in primary health care settings. Pre/corequisites: NUR 605; 606 or 607. Lab Fee: $180. Fall.

621 Acute Care Nurse Practitioner II  
Clinical course focusing on assessment and management of adults with acute health problems in agency and home settings, emphasizing the clinician role. Focus is on assessment parameters and protocols of care of clients with selected acute alterations in health. Pre/corequisites: NUR 606 or 607; 620. Lab Fee: $180. Spring.

622 Acute Care Nurse Practitioner III  
Clinical course in care of adult patients with acute alterations in health in the hospital, home, or clinic setting focusing on the concept of managed care. Within a selected product line, the practitioner will develop protocols, care for and evaluate care for patients and practice consulting with client groups. Prerequisites: NUR 620, 621. Lab Fee: $180. Summer.

623 Acute Care Nurse Practitioner IV  
Culminating course in the acute care nurse practitioner track. Student will complete a clinical residency in a selected acute care area/specialty. Classroom theory will focus on the role and legal trends and issues facing the acute care nurse practitioner. Prerequisites: NUR 620, 621, 622. Lab Fee: $180. Fall.

630 Nursing Administration in Health Care Systems  
Focuses on the nurse administrator’s relationship with organizational dynamics in a variety of health care delivery systems. Theories of organizations and organizations from the perspective of structure, regulation, dynamics, trends, technology and strategic planning in health care delivery will be explored. Lab Fee: $30. Fall.

631 Resource Management in Nursing Administration  
Role of the nurse manager in resource allocation and management in health care systems, with emphasis on human resource management including recruitment, selection, retention, staff development, quality improvement and marketing. Lab Fee: $30. Fall.

632 Fiscal Management in Nursing Administration  
The role of the nurse administrator in fiscal management in a variety of health care settings, with emphasis on student understanding of finance in administrative decision making, planning, and control. Fiscal resources, processes and systems. Lab Fee: $30. Spring.

633 Nursing Administration I  
Clinical course based on the application of organizational theory and resource management in nursing, focusing on middle management functions in a variety of health care systems. Prerequisites: NUR 630, 631, 632. Lab Fee: $100. Spring.

634 Nursing Administration II  
Clinical course providing opportunity for students to apply and synthesize administrative theory at various executive levels in nursing. Prerequisite: NUR 633. Lab Fee: $180. Fall.

636 Basic Budgeting in Health Systems  
Assists nurse managers in gaining conceptual knowledge of budgeting in various health systems, targeting primarily mid-level nurse managers who have responsibility for planning and controlling unit budgets. Prerequisite: NUR 632. Lab Fee: $30. Spring.
Independent Study 2-4 hrs.
Planning, implementation, and evaluation of related phenomena of special interest observed in nursing practice. Prerequisite: Permission of instructor. Lab Fee: $30. Fall, Spring, Summer.

Plan II: Other Activities 1-6 hrs.
Application of activities appropriate to student program of study. Intended to expand student knowledge and enhance track specific content. Advisor approval required prior to enrollment. Lab Fee: $10. Fall, Spring, Summer.

Plan I: Thesis 1-6 hrs.
College of Science

Degrees: Master of Arts  
Master of Science  
Doctor of Philosophy

Dean: J. G. Duthie, Professor of Physics  
Associate Dean: F. L. Cook, Associate Professor of Mathematics

The College of Science includes the Departments of Atmospheric Science, Biological Sciences, Chemistry, Computer Science, Mathematical Sciences, and Physics. In addition, significant graduate course offerings are available in environmental sciences, biochemistry, materials science, and optical science.

The College offers programs leading to the Ph.D. degree in applied mathematics, atmospheric science, computer science, and physics. The Ph.D. degrees in materials science and in optical science and engineering are offered in cooperation with the College of Engineering. The latter two programs are described in the section on “Interdisciplinary Programs.” All departments in the College offer programs leading to the M.S. degree. A program for the M.A. degree is also 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.

In formulating a strategic mission for the College of Science, basic research continues to be emphasized while exploring every opportunity to strengthen ties with production segments in the government and private sectors. Much of the faculty’s strength lies in its 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. Because of this, unique opportunities are offered 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 SCIENCE

Degrees: Master of Science
Doctor of Philosophy

Interim Chair: A. G. Emslie, Professor

Professors:
Essenwanger, O.M. (Research); statistical climatology
McNider, R.T.; mesoscale modeling, air pollution
Perkey, D.J.; global change, mesoscale modeling
Vaughan, W.W. (Research); satellite meteorology, reference atmospheres

Associate Professors:
Christy, J.R.; climate dynamics, global change
Knupp, K.R.; severe storms, radar meteorology
Newchurch, M.J. (Research); stratospheric chemistry

Atmospheric science is the study of an increasingly important part of the earth system: the atmosphere. Research opportunities abound at UAH due largely to the nation’s concern about the environment. The National Aeronautics and Space Administration, the National Science Foundation, the National Oceanic and Atmospheric Administration, the Environmental Protection Agency, and the Tennessee Valley Authority all fund atmospheric science research at UAH. The Department is housed in the Global Hydrology and Climate Center, a unique institute in which scientists from the NASA Marshall Space Flight Center, the Universities Space Research Association, and UAH all work together on research programs of common interest. Atmospheric science students come from a variety of backgrounds including mathematics, physics, chemistry, computer science, and engineering, as well as traditional meteorology. Atmospheric science is an excellent field for students with a technical background who would like to apply their knowledge to important environmental problems. Global warming, ozone depletion, climate change, acid rain, air pollution, severe storms and weather forecasting are only some of the problems studied by atmospheric scientists. Because much of the information about the atmosphere must come from satellite-based instruments, and because the atmosphere is coupled with the other components of the atmosphere-ocean-land-biosphere system, the program emphasizes remote sensing and earth system science.

Admission Requirements

Applicants will be unconditionally admitted only if they have
(a) a minimum grade point average (GPA) of 3.0 overall or 2.75 overall and 3.0 over the last 60 semester hours of undergraduate and graduate credit;
(b) a combined score of at least 1650 on the verbal, quantitative, and analytical sections of the Graduate Record Examination (GRE);
(c) a bachelor’s degree in science or engineering from a recognized and accredited college or university; and
(d) in the case of international students, a Test of English as a Foreign Language (TOEFL) score of at least 550.

Applicants will be conditionally admitted only if they have
(a) a minimum GPA of 2.75 overall or 3.0 over the last 60 semester hours of undergraduate and graduate credit;
(b) a combined score of at least 1500 on the verbal, quantitative, and analytical sections of the Graduate Record Examination (GRE);
(c) a bachelor’s degree in science or engineering from a recognized and accredited college or university; and
(d) in the case of international students, a TOEFL score of at least 550.
To avoid remedial work in mathematics or science, the applicant must have training through a calculus sequence (including the calculus of vector-valued functions), a course in linear algebra, and a course in ordinary differential equations. He or she must also have completed at least two semesters of chemistry, two semesters of calculus-based physics, and have demonstrable computer proficiency in at least one high-level programming language.

**Master of Science**

To earn a master’s degree in atmospheric science, each student must satisfy all requirements of the School of Graduate Studies and of the Atmospheric Science Department. Students are encouraged to formulate an appropriate Program of Study, in consultation with a faculty advisor, at the earliest opportunity, and certainly by the completion of nine semester hours of credit. Two options are available.

**Plan I (Thesis)**

Degree requirements under this plan include completion of at least 24 semester hours of graduate course work including the six core courses:

- ATS 551 Atmospheric Fluid Dynamics I
- ATS 553 Atmospheric Radiation and Remote Sensing
- ATS 581 Atmospheric Thermodynamics and Chemistry
- ATS 641 Atmospheric Structure
- ATS 651 Atmospheric Fluid Dynamics II
- ATS 661 Mesoscale and Microscale Atmospheric Processes

The student must also earn at least two semester hours of credit in ATS 780 (Seminar) and six semester hours of credit in ATS 699 (Master’s Thesis). The thesis must show evidence of the student’s capability for research, independent thought, and analysis in atmospheric science and must be written in fluent, acceptable English.

**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 course work including the core courses (above), two semester hours of credit in ATS 780 (Seminar), and the passing of a written comprehensive examination. A thesis is not required.

**Final Examination**

A final comprehensive examination is required of all candidates for a master’s degree; this examination will be oral for a Plan I student and written for a Plan II student. The candidate will be examined on the course work and thesis in Plan I and on course work in Plan II. The examination is conducted by a committee of at least three faculty members appointed by the department chair and approved 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. The majority of the committee must be full-time UAH faculty members who have full membership in the graduate faculty. A written notice of the time and place of examination is sent to the Graduate Dean and the Registrar. After approval by the Graduate Dean, the department chair sends a copy of the written notice to the candidate and each member of the committee. The examination must be given at least one month before the date of graduation, and the results reported within two working days to the Graduate Dean. A student may take the final oral or written examination only twice.

**Doctor of Philosophy**

To obtain the Ph.D. degree in atmospheric science, each student must satisfy all requirements of the School of Graduate Studies as well as those of the Atmospheric Science Program. In summary, the five major requirements are the following.
1. Take the core courses and pass the preliminary examination.

Each student must complete the six common core courses (above). Students who have previously taken similar courses may be exempted from some of the core courses by the department chair.

Each student must pass a preliminary examination. This examination covers material in the three 500-level core courses plus one of the 600-level core courses (selected by the student). This examination will be designed and graded by a committee appointed by the department chair. It is anticipated that a student will take the preliminary examination during the second year of graduate study, but students with a strong background in atmospheric science may take the examination within the first year. The preliminary examination may be taken at most twice. 

After a student has passed the preliminary examination, a supervisory committee will be formed. The committee will consist of the student's academic advisor plus at least four other members, with the committee to be approved by the College and Graduate Deans. The committee will administer the qualifying examination and, with the consent of the Graduate Dean, give approval to all aspects of requirements 2-5.

2. Satisfy the residence requirement

Each student is required to spend at least one academic year or its equivalent in continuous full-time residence at UAH.

3. Complete an acceptable Program of Study

Each Program of Study will stress breadth, depth, and research competence as well as understanding of the relationship of the major area to its applications, and will be individualized to meet the student's needs and requirements of the program. Any prerequisites required for courses in the Program of Study must be fulfilled before attempting these courses. A Program of Study will consist of at least 48 semester hours of course work at the graduate level, including the core courses needed to prepare for the preliminary examination and courses required in a major area of concentration that will prepare the student to conduct original research in that area. In addition, the student must register for doctoral dissertation (ATS 799) each semester that he or she is enrolled and receiving direction on the dissertation. A minimum of 18 hours of registration is required. Students must also register for a total of three hours of ATS 780 (Seminar).

4. Pass the qualifying examination

The qualifying examination will cover the major areas of study and the student's proposal for a dissertation topic. It will have both written and oral components and will be prepared and graded by the student's advisory committee. This examination may be taken at most twice.

5. Complete and defend a research dissertation

Each student must complete and successfully defend a research dissertation, the results of which are publishable in a nationally recognized journal. The dissertation, which must comply with the regulations set forth in the School of Graduate Studies' Thesis and Dissertation Manual, must be approved by the student's supervisory committee, by the department chair, by the dean of the College of Science, and by the dean of the School of Graduate Studies.

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

The atmospheric science department does not require knowledge of a foreign language, but it does require proficiency in both spoken and written English.
**Graduate Courses in Atmospheric Science (ATS)**

**504 Survey of Atmospheric Science**
3 hrs.
General survey of the field of atmospheric science. Quantitative examination of atmospheric physical properties including atmospheric composition, structure and dynamics. Detailed inspection of evolving atmospheric structures using real-time data systems. General topics include atmospheric thermodynamics, atmospheric dynamics, cloud physics, atmospheric radiation, and related topics in atmospheric remote sensing. Prerequisites: MA 172 and PH 112 or consent of instructor. Fall. (Same as ES 504)

**510 Meteorological Analysis and Forecasting**
3 hrs.
Analysis, interpretation, and forecasting of synoptic-scale and mesoscale phenomena, including air masses, frontal systems, cyclones, anticyclones, tropical cyclones, and associated mesoscale phenomena. Emphasis is placed on the use of remotely-sensed data (e.g., from satellites, radars, and profilers) and state-of-the-art workstations. Prerequisites: ATS 551, 581. Spring, even years.

**551 Atmospheric Fluid Dynamics I**
3 hrs.
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 324 and PH 112. Fall. (Same as ES 551)

**553 Atmospheric Radiation and Remote Sensing**
3 hrs.
Introduction to solar and terrestrial radiation. Absorption and emission of radiation in the atmosphere. Experimental determination of flux emissivity. Divergence of net radiation. Applications to remote sensing. Prerequisites: MA 324 and PH 112. Spring. (Same as ES 553)

**581 Atmospheric Thermodynamics and Chemistry**
3 hrs.
Introduction to the thermodynamics and chemistry of the atmosphere and the relation to atmospheric processes such as cloud and precipitation processes. Specific topics include a review of basic thermodynamics, atmospheric thermodynamic variables, air-water systems, atmospheric statics and stability, saturation point analysis, cloud and precipitation physics, general aspects of atmospheric chemistry. Prerequisites: MA 324, CH 123, and PH 112. Fall. (Same as ES 581)

**603 Climate Dynamics**
3 hrs.
Origin and evolution of the climate system including underlying causes for past climates such as occurred during the ice ages. Statistical processing of various time series to extract climatic signals in the data. Determination of global-scale forcing mechanisms which impact climate. Prerequisite: ATS 561. Fall, odd years.

**620 Atmospheric Photochemistry**
3 hrs.
Photochemistry and kinetics of the earth’s atmosphere, including primary processes, thermodynamics, models, and measurements. Emphasis is placed on the chemistry of ozone production and loss, especially catalytic cycles, natural and anthropogenic perturbations and the ozone hole. Both stratospheric and tropospheric chemistry are discussed. Prerequisite: ATS 504 or permission of instructor. Fall, odd years.

**641 Atmospheric Structure**
3 hrs.
Detailed examination of the observed dynamic, thermodynamic and chemical structure of the atmosphere. Specifically to include examination of mid-latitude baroclinic systems, tropical systems, global-scale energy, mass, and momentum budgets and fundamental climatology of the atmosphere. Prerequisite: MA 324. Fall, even years.

**651 Atmospheric Fluid Dynamics II**
3 hrs.
Wave motions in the atmosphere; in particular, Rossby waves, Kelvin waves, and gravity waves. Systematic scaling of primitive equations to develop quasi-geostrophic and Ekman-layer theory. Shallow water theory, stratified flows, and barotropic/baroclinic instability. Prerequisite: ATS 551. Spring, even years.
661 Mesoscale and Microscale Atmospheric Processes
Theory and observations of classical mesoscale circulations; atmospheric boundary layers; atmospheric fluid instabilities and turbulence; atmospheric convection; conditional instability of the second kind; turbulent dispersion. Prerequisite: ATS 551. Spring, odd years.

671 Radar Meteorology
Basic principles of incoherent, Doppler, and multiparameter radar, profiler, lidar, and sodar devices. Propagation characteristics in the atmosphere. Application of radar sensing techniques to atmospheric structure and processes including measurement of wind, temperature, humidity, characteristics of hydrometers, rainfall estimation, utility in detection of internal cloud flows and turbulence, detection of severe storms. Applications to aviation and weather forecasting. Prerequisites: ATS 553, 581. Spring, odd years.

673 Satellite Meteorology
Theory and practice of the remote sensing of atmospheric parameters from space. Topics include satellite orbits, radiative transfer, satellite instruments, image interpretation, and retrieval techniques for temperature, trace gas concentration, winds, clouds, aerosols, precipitation, and the earth's radiation budget. Prerequisite: ATS 553. Fall, even years.

681 Numerical Atmospheric Modeling
Introduction to numerical methods applied to simulation of the atmosphere. Basic numerical solution techniques will be discussed along with filtering, radiative parameterizations, thermodynamics, turbulent parameterization, initialization, and coordinate transformation. Prerequisites: MA 415, ATS 551. Spring, odd years. (Same as ES 681)

683 Cloud Dynamics and Microphysics
Theory and observations of the microphysical composition and dynamical structure of the various cloud and fog types; precipitation formation processes in "warm" and "cold" clouds; examination of detailed models of cirrus, stratocumulus, nimbostratus, orographic, cumulus and cumulonimbus cloud systems; remote sensing applications of clouds and precipitation. Prerequisites: ATS 581, 551. Spring, even years.

690 Selected Topics in Atmospheric Science
Selected topics of interest not included under other courses. Prerequisite: Approval of instructor. All terms.

699 Master's Thesis
Required each semester a student is enrolled and receiving direction on a master's thesis. Minimum of two terms required.

780 Seminar
Speakers are invited to report on research relevant to the field of atmospheric science. Does not count toward minimum degree requirements. Fall, Spring.

790 Selected Topics in Atmospheric Science
Selected topics of interest not included under other courses. Prerequisite: Approval of instructor. All terms.

799 Doctoral Dissertation
Required each semester student is enrolled and receiving direction on a doctoral dissertation. Minimum of 18 hours required.
BIOLOGICAL SCIENCES

Degree: Master of Science

Chair: P. S. Campbell, Professor

Professors:
Campbell, P.S.; reproductive physiology, sex steroid hormone action
Dimopoullos, G.T.; pathogenesis of infectious diseases, Lyme disease, biosynthesis of bacterial lipids
Eley, M.H.; chemical and biological conversions of biomass
Lawton, R.O.; structure and composition of forest communities
Modlin, R.F.; biology of crustacea, ecology of marine and freshwater ecosystems
Moirarity, D.M.; regulation of eucaryotic gene expression, natural products biology
Young, R.B.; gene expression in skeletal muscle, recombinant DNA

Associate Professors:
Garstka, W.R.; reproduction and chemical communication in vertebrates
Johnson, A.D.; nutritional physiology

Assistant Professor:
Ross, S.E.; immunology and bacterial pathogenesis, molecular biology

The Department of Biological Sciences provides instruction, learning, and creative scholarly activities in the life sciences. Scholarly investigations are directed by scientists and undertaken by those who as graduate students (and sometimes advanced undergraduate students) are preparing to become future scholars. The department does not offer courses in all areas of biological science; rather, it has chosen to emphasize instruction in the following general areas:
1. cell biology
2. environmental biology
3. genetics and molecular biology
4. microbiology
5. physiology

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 that small programs can accommodate.

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 semester of organic chemistry and biochemistry;
3) have a minimum GPA of 3.0 in the major area of concentration;
4) a course in statistics is also recommended.

Applicants demonstrating potential for graduate study in the biological sciences, but having some deficiencies in their previous academic work, may be admitted on a conditional basis.

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 biology, environmental biology,
genetics and molecular biology, microbiology, and physiology. 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 sciences 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 teacher’s certificate**

Those who have a B.A. or B.S. 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 (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 for more details.

**Graduate Courses in Biological Sciences (BYS)**

501 **Gravitational Biology** 3 hrs.
Basic studies of responses of plants and animals to microgravity. Emphasis on effects of low-gravity at the cellular level, including cell physiology, metabolism, structure, signal transduction mechanisms of gravity sensing, and issues of human gravitational physiology. Description of organisms and summary of biological space flight experiments. Prerequisites: BYS 119, 120, 214 or 221, 301 or 361, and 543 recommended, or permission of instructor.

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 219 and BYS/CH 361.

521 **Medical Mycology** 4 hrs.
Basic studies of fungi and applied studies of various classes of fungi pathogenic to humans; reproduction, morphology, classification of disease states, pathogenesis, laboratory diagnosis, chemotherapy. Two 2-hour labs per week. Lab Fee: Level 4. Prerequisite: BYS 421, 430, or approval of instructor.
525 Medical Parasitology  
Basic and applied studies of various classes of parasites pathogenic 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 3. Prerequisite: BYS 221.

528 Immunopathology  
Pathological mechanisms of the immune response in allergy, auto-immune disease, chronic inflammation, immunodeficiency, transplantation, and cancer. Therapeutic interventions related to the immune response. One 3-hour lab per week. Lab Fee: Level 5. Prerequisite: BYS 430.

531 Plant Physiology  
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 per week. Lab Fee: Level 3. Prerequisites: BYS 119, 120, 371, or 372, CH 113 or 331.

532 Animal Physiology  
Basic organismal function. Membrane physiology and transport phenomena, muscle, nerve, synapse, and sensory receptor physiology. Physiology of respiration, heart, circulation, kidney, and endocrine system. Emphasis on regulation. One lab per week illustrating physiological principles discussed in lecture. Lab Fee: Level 4. Prerequisites: Senior standing with a major or minor in biological science; BYS 317 and 16 hours completed in POS, CH 113 or 331 or graduate standing.

533 Endocrinology  
Anatomy, physiology, and biochemistry of endocrine glands. Emphasis on regulation of hormone secretion, hormonal integration of physiological function, and mechanism of hormone action. Prerequisites: BYS 313 and 314 or 532, BYS/CH 361.

543 Cellular and Developmental Biology  
Cellular structure and function including mitosis, meiosis, cell cycle, and cell signaling. Discussion of biological techniques such as tissue culture, hybridoma and monoclonal antibody production, gene cloning and recombinant DNA, radiotracer methodology, and specialized microscopy. Prerequisites: BYS 119, 120, 219, and 331.

544 Cellular and Developmental Biology  
Gametogenesis and regulation of reproductive cycles, fertilization, cleavage, gastrulation and developmental mechanisms such as nuclear-cytoplasmic interactions and oocyte polarity in regulating gene expression during development, selective cell affinities, contact guidance, and embryonic inductions and fields. Selected morphogenesis of germ-layer derivatives discussed. Prerequisite: BYS 543.

545 Cellular and Developmental Biology Laboratory  

547 Biochemistry I  
Structural chemistry and function of biomolecules, mechanisms of biochemical reactions, enzyme kinetics, and energy transfer. Prerequisite: CH 333 or BYS/CH 361, 363. (Same as CH 561.)

548 Biochemistry II  
Metabolism, biosynthesis of macromolecular precursors, storage, transmission, expression of genetic information, and molecular physiology. Prerequisite: CH 561 or BYS 547. (Same as CH 562.)
561 Physiological Ecology 4 hrs.
Physiological and behavioral responses of organisms to natural changes in their chemical and physical environment. Lab Fee: Level 3. Prerequisite: BYS 312 or approval of instructor. BYS 361 or 532 recommended.

562 Community Ecology 4 hrs.
Detailed consideration of ecological principles and concepts, as well as biotic and abiotic factors relative to development of plant communities and ecosystems. One 4-hour lab per week. Lab Fee: Level 3. Field trips required. Prerequisites: BYS 312.

563 Population Ecology 4 hrs.
Distribution, population dynamics and behavior of animal populations in relation to environmental factors. One 4-hour lab per week. Lab Fee: Level 3. Field trips required. Prerequisites: BYS 312.

564 Limnology 4 hrs.
Fresh-water environments and organisms exemplified by lakes, ponds, and streams in North Alabama. Laboratory and required field trips. Occasional Saturday field trips required instead of week's laboratory session. One 4-hour lab per week. Lab Fee: Level 4. Prerequisites: BYS 312, 378.

578 Aquatic Arthropod Biology 4 hrs.
Systematics, physiology, ecology and importance of the crustacea, insecta and arachnida that inhabit freshwater and estuarine ecosystems. Particular attention will be given to those arthropods common to the aquatic systems in and around Alabama. Since all field trips are required, prospective students should consult with the instructor prior to registration. Lab Fee: Level 4. Prerequisite: BYS 378.

621 Pathogenic Bacteriology 4 hrs.
Survey of bacterial diseases in humans. Mechanisms of pathogenicity and host-parasite interactions. Includes laboratory. Lab Fee: Level 5. Prerequisites: BYS 361, 421, 430, or approval of instructor.

624 Molecular Immunology 3 hrs.
Molecular mechanisms of the mammalian immune response, including the genetic basis of antigen recognition and antigen specificity, lymphocyte and macrophage activation, receptor modulation and signal transduction, and cytokine regulation. Prerequisite: BYS 430.

626 Advanced Immunological Technique 3 hrs.
Principles and performance of techniques currently utilized to assess the immune response as well as immunologically based assays. Includes separation of cells of the immune system and their characterization, cell culture, immunocytchemistry, immunofluorescence and ELISA. One lecture, two 3-hour labs per week. Lab Fee: Level 7. Prerequisite: BYS 430.

641 Advanced Cell Biology (also at A&MU) 4 hrs.
Integrated approach to fine structure and function of various cellular processes. Particular aspects of cellular processes each semester, e.g. motility in cells and cellular differentiation. Laboratory included. Lab Fee: Level 5. Prerequisite: Cellular and Developmental Biology or approval of instructor.

643 Microscopy 4 hrs.
Introduction to the various methods of preparation for transmission electron microscopy and analysis of electronmicrographs. Supporting techniques such as phase microscopy, autoradiography, scanning electron microscopy, negative staining, and cytochemistry. Lab Fee: Level 7. Prerequisites: Graduate standing and approval of instructor.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>644</td>
<td>Topics in Cell and Developmental Biology and Biological Fine Structure</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>
</tr>
<tr>
<td>646</td>
<td>Molecular Genetics (also at A&amp;MU)</td>
<td>3 hrs.</td>
<td>Advanced study of molecular mechanisms underlying genetic principles. Current molecular biology techniques. Structure of genes and chromosomes; primary, secondary, and tertiary structure of DNA; DNA replication; genetic recombination; RNA transcription; translation and genetic code; regulation of gene function; evolution at molecular level. Prerequisites: BYS 219 and BYS/CH 361.</td>
</tr>
<tr>
<td>647</td>
<td>Enzymology</td>
<td>3 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>
</tr>
<tr>
<td>660</td>
<td>Ecosystem Dynamics</td>
<td>3 hrs.</td>
<td>An analytical approach (including simulation and modeling) to the interactions of organisms in terrestrial, aquatic, and marine ecosystems. Prerequisites: BYS 564, 562.</td>
</tr>
<tr>
<td>661</td>
<td>Advanced Population Ecology</td>
<td>4 hrs.</td>
<td>Interaction of population structure, genetic properties, and ecology factors in controlling dynamics and evolutionary character of natural population. One 4-hour lab per week. Lab Fee: Level 4. Prerequisites: BYS 312, BYS 564 or 565, or approval of instructor.</td>
</tr>
<tr>
<td>690</td>
<td>Seminar (also at A&amp;MU)</td>
<td>1 hr.</td>
<td>Student reports on current journal articles, research, or assigned readings. Graduate students should attend whether enrolled for credit or not. May be taken up to three times for credit.</td>
</tr>
<tr>
<td>691</td>
<td>Special Topics (also at A&amp;MU)</td>
<td>1-4 hrs.</td>
<td>Directed readings and/or written reports on topics of individual student interest carried out under the supervision of an instructor. Permission of instructor required before registration.</td>
</tr>
<tr>
<td>692</td>
<td>Research (also at A&amp;MU)</td>
<td>2-4 hrs.</td>
<td>Individual investigations of biological problems under supervision of graduate faculty member. Permission of instructor required before registration. 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.</td>
</tr>
<tr>
<td>699</td>
<td>Master’s Thesis (also at A&amp;MU)</td>
<td>1-4 hrs.</td>
<td>Required each semester student is working and receiving direction on master’s thesis. Minimum of six hours required for M.S. students. Maximum of nine hours credit upon successful completion of master’s thesis.</td>
</tr>
</tbody>
</table>

Graduate Courses Offered at Alabama A&M University (A&MU)

Courses offered jointly by Alabama A&M University and UAH but which are taught on the A&M campus are listed below for ready reference.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>510</td>
<td>Radiation Biology</td>
<td>4 hrs.</td>
<td>Characteristics of radioisotopes, detection and counting techniques and instrumentation, tracer techniques, health and safety system. Prerequisite: Consultation with instructor.</td>
</tr>
<tr>
<td>Course</td>
<td>Title</td>
<td>Credits</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>511</td>
<td>Biological Control</td>
<td>4 hrs.</td>
<td>Components of resistance, use of parasites, predators and microorganisms, foreign exploration, shipment, release and establishment of imported parasites and predators.</td>
</tr>
<tr>
<td>512</td>
<td>Histotechniques</td>
<td>3 hrs.</td>
<td>Microscopic study of the various tissues and organs of the animal systems.</td>
</tr>
<tr>
<td>522</td>
<td>Microbial Physiology</td>
<td>3 hrs.</td>
<td>Relationship between structure and biochemical functions in microorganisms. Lab Fee: Level 4. Prerequisite: Microbiology, organic chemistry, and biochemistry.</td>
</tr>
<tr>
<td>523</td>
<td>Principles of Virology</td>
<td>4 hrs.</td>
<td>Principles of viral infectivity, multiplication, and chemical constitution; laboratory techniques for their isolation, cultivation, identification, and enumeration. Prerequisite: BYS 221.</td>
</tr>
<tr>
<td>524</td>
<td>Mycology</td>
<td>4 hrs.</td>
<td>Lines of phycomycetes using representative species; various series of actinomycetes; representative pathogenic (crop and vegetative pathogens) and nonpathogenic heterobasidiomycetideae organisms; order and families of homobasidiomycetideae. Ontogenetics, cellular, and structural study applied to all divisions, classes, series, orders and families. Lab Fee: Level 4.</td>
</tr>
<tr>
<td>526</td>
<td>Microbial Ecology</td>
<td>4 hrs.</td>
<td>Relationship of soil and aquatic microorganisms and their importance in ammonification, nitrification, and other biological processes. Prerequisite: BYS 221.</td>
</tr>
<tr>
<td>533</td>
<td>Medical Physiology I</td>
<td>4 hrs.</td>
<td>Nerve and muscle cell function, fluid and electrolyte environment of body tissues, blood, heart, circulatory, and nervous systems. Prerequisite: Organic chemistry, preferably biochemistry.</td>
</tr>
<tr>
<td>534</td>
<td>Medical Physiology</td>
<td>4 hrs.</td>
<td>Continuation of mammalian physiology with consideration of kidney function, respiratory, digestive, reproductive, and endocrine systems. Prerequisite: Medical Physiology I.</td>
</tr>
<tr>
<td>535</td>
<td>Endocrinology (also at UAH)</td>
<td>4 hrs.</td>
<td>Current developments on anatomy, physiology, chemistry, and regulations of major endocrine glands. Laboratory sessions in biological and chemical assays of hormones. Prerequisite: ZOO 409.</td>
</tr>
<tr>
<td>546</td>
<td>Cytogenetics</td>
<td>4 hrs.</td>
<td>Analysis of composition, morphology, and behavior of genes, especially as they relate to function, development, and heredity. Prerequisite: BIO 406.</td>
</tr>
<tr>
<td>551</td>
<td>Insect Physiology</td>
<td>4 hrs.</td>
<td>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, advanced biochemistry.</td>
</tr>
<tr>
<td>552</td>
<td>Insect-Pest Management</td>
<td>4 hrs.</td>
<td>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.</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------------</td>
<td>---------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>560</td>
<td>Environmental Biology</td>
<td>3 hrs.</td>
<td>Principles of interaction between living systems and their resources. Current problems in management of natural resources including new approaches in management of pest populations.</td>
</tr>
<tr>
<td>570</td>
<td>Plant Pathology</td>
<td>4 hrs.</td>
<td>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.</td>
</tr>
<tr>
<td>571</td>
<td>Plant Anatomy</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 per week. Lab Fee: Level 4. Prerequisite: BYS 372 or approval of instructor.</td>
</tr>
<tr>
<td>572</td>
<td>Plant Taxonomy</td>
<td>4 hrs.</td>
<td>Principles of classifying, naming, and identifying vascular plants with emphasis on flowering plants. Ecologic factors influencing vegetational distribution.</td>
</tr>
<tr>
<td>590</td>
<td>Problems in Biological Sciences</td>
<td>4 hrs.</td>
<td>(Plan III only) 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.</td>
</tr>
<tr>
<td>622</td>
<td>Applied and Industrial Microbiology</td>
<td>4 hrs.</td>
<td>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.</td>
</tr>
<tr>
<td>623</td>
<td>Advanced Virology</td>
<td>4 hrs.</td>
<td>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.</td>
</tr>
<tr>
<td>631</td>
<td>Medical Pharmacology</td>
<td>5 hrs.</td>
<td>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. Laboratory included. Prerequisites: Medical Physiology I and II.</td>
</tr>
<tr>
<td>632</td>
<td>Cardiovascular Physiology</td>
<td>3 hrs.</td>
<td>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.</td>
</tr>
<tr>
<td>642</td>
<td>Advanced Cell Physiology</td>
<td>4 hrs.</td>
<td>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. Laboratory included. Prerequisites: molecular biology, physics, cytology, biochemistry.</td>
</tr>
<tr>
<td>645</td>
<td>Human Cytogenetics and Its Clinical Application</td>
<td>3 hrs.</td>
<td>Review of normal human chromosome structure and normal chromosome segregation and morphology with clinical consideration.</td>
</tr>
</tbody>
</table>
Advanced Applied Entomology 4 hrs.
Economic thresholds, economic injury levels, population dynamics, residues in food crops, chemical control, insect transmission of plant disease, and livestock. Prerequisite: General entomology.

Taxonomy of the Immature Insect 4 hrs.
Literature, comparative morphology and techniques of identification of immature stages of the insect, methods of collecting and preserving the immatures. Lab Fee: $40. Prerequisite: BYS 455 or approval of instructor.

Advanced Systematic Botany 4 hrs.
Classification, nomenclature, and taxonomic theory of vascular plants. Prerequisite: Plant taxonomy.

CHEMISTRY

Degree: Master of Science
Chair: C. Riley, Professor

Professors:
Baird, J.K.; theoretical radiation chemistry and crystal growth, critical phenomena in solution
Clunie, J.C. (Adjunct); solution thermodynamics, diffusion
Gregory, J.C.; cosmic ray astronomy, interaction of atomic oxygen with surfaces
Harris, J.M.; polymers, organic reaction mechanisms, hydrophilic polymer surfaces
Loo, B.H.; surface enhanced Raman spectroscopy, electrochemistry, superconductivity
McManus, S.P.; functionalized polymers, nucleophilic displacement reactions and nonlinear optical materials
Motiarty, D.M. (Adjunct); protein metabolism and eucaryotic gene expression
Riley, C.; electrodeposited materials, biocompatible surfaces

Associate Professors:
Coble, H.D.; coordination compounds
Leslie, T.; organic nonlinear optical materials, liquid crystals and polymer composites
Lumpkin, R.; solar energy conversion and inorganic nonlinear optical materials
Meehan, E.J., Jr.; x-ray crystallography of proteins
Setzer, W.N.; biomedical aspects of biologically active phytochemicals
Van Alstine, J. (Research); separation technology of macromolecules and bioparticles
Weimer, J.; surface kinetics and surface bonding studies

Assistant Professor:
George, Michael (Adjunct); surface science
Kaukler, W. (Research); x-ray microscopy, materials processing

Research
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 testing on sounding rocket flights and 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, Auger electron spectrometer, GC/MS, fluorescence spectrometer, X-ray photoelectron spectrometer, plasma chemistry apparatus, Perkin-Elmer spectrometer, Jarrell-Ash 2 meter spectrometer, Varian Drls-90 ultraviolet-visible spectrometer with kinetics apparatus, HP 353 Pentium Controlled visible-ultraviolet spectrometer, Raman spectrometer with laser exciter, Picker x-ray diffractometer, atomic absorption spectrometers, SEM, EDS, scanning tunneling microscope, surface x-ray diffractometer, FTIR with small angle and microscope attachments, molecular modelling system, Waters binary gradient liquid chromatography system, Perkin-Elmer high pressure liquid chromatograph, gas chromatographs and various CW and pulsed lasers. The University has a DEC AXP 7000 computer and has access to a Cray-XMP supercomputer at the Alabama Supercomputer Center located in Huntsville. The Chemistry Department has numerous IBM compatible and Macintosh personal computers and Silicon Graphics work stations 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 or 632; two courses from 640 or 646, 642, 643, 644; 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 semester in which they are in residence at UAH. 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 or her 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 or 632; two courses from 640 or 646, 642, 643, 644; 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 semester 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 Teacher's Certificate

Those who have a B.A. or B.S. 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 for more details.

Doctor of Philosophy

The Ph.D. degree with a chemistry specialty is possible within the guidelines and requirements of the materials science program (See "Interdisciplinary Programs").

Graduate Courses in Chemistry (CH)

521 Chemical Instrumentation 4 hrs.
Use of basic instrumentation in electrochemical, chromatographic, and spectrophotometric analysis. 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 223; EE 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 332, 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 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, MA 244, 324. (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.
Examines both theoretical and practical aspects of molecular structure determination by x-ray diffraction methods. 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. Lab Fee: Level 6. Prerequisites: Senior standing in chemistry or physics and approval of the instructor.
561 Biochemistry I  3 hrs.
Structural chemistry and function of biomolecules, mechanisms of biochemical reactions, enzyme kinetics, and energy transfer. Prerequisite: CH 332 or CH 361. (Same as BYS 547.)

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

565 Molecular Biochemistry Laboratory  2 hrs.
Practical experience in isolation and characterization of biomolecules. Lab Fee: Level 6. Prerequisite: CH 562.

600 Advanced Inorganic Chemistry  3 hrs.
Survey with emphasis on structure and reactivity of inorganic compounds. Prerequisite: CH 401.

601 Structural Methods in Inorganic Chemistry  3 hrs.
Physical methods applied to determination of structure of inorganic compounds. Prerequisite: CH 600.

602 Chemistry of Coordination Compounds  3 hrs.
Modern bonding theory and stereochemistry of coordination compounds. Prerequisite: CH 600.

603 Chemistry of Nonmetal Compounds  3 hrs.
Chemistry of selected nonmetal compounds. Prerequisite: CH 601.

621 Methods of Chemical Analysis  3 hrs.
Literature, seminar course. Theory and methodology of various techniques of chemical analysis. Prerequisite: CH 521 or CH 421.

631 Advanced Organic Chemistry I  3 hrs.
Organic synthetic reactions. Survey of certain reactions that enjoy widespread application to the synthesis of organic compounds. Prerequisites: CH 333, 342, or approval of instructor.

632 Advanced Organic Chemistry II  3 hrs.
Physical organic chemistry. Reactive intermediates, structure-activity relationships, reaction mechanisms and techniques used to determine them. Prerequisite: CH 531 or approval of instructor.

640 Advanced Chemical Thermodynamics  3 hrs.
First, second, and third laws of thermodynamics and applications. Brief introduction to statistical thermodynamics. Prerequisites: CH 343, MA 324, or approval of instructor.

641 Statistical Thermodynamics  3 hrs.
Principles leading to the development of Maxwell-Boltzmann, Bose-Einstein, and Ferm-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.
646 Thermodynamics of Materials  
Fundamental thermodynamic review, phase equilibrium, chemical reaction equilibrium, free energy, binary and ternary phase transformations, solution models and selected topics. Prerequisite: CH 342 or equivalent. (Same as CHE 646.)

647 Polymer Physical Chemistry  
Introduction to structure, properties and processing of polymers. 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, 540.

650 Principles of Liquid & Solid Interfaces  
Applies basic principles in thermodynamics and kinetics to characterize surfaces and surface phenomena. Fundamental properties of gas-liquid, liquid-liquid, solid-liquid and solid-gas interfaces and phenomena occurring at these interfaces. Prerequisite: CH 341. (Same as MTS 650 and CHE 650.)

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

699 Master’s Thesis  
Required each semester a student is enrolled and receiving direction on a master’s thesis. Minimum of two terms required.

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

721 Selected Topics in Analytical Chemistry  
Prerequisite: CH 621 and approval of instructor.

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

745 Selected Topics in Physical Chemistry  
Prerequisite: CH 643 and approval of instructor.

746 Solid State Chemistry  
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 324.

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

780 Chemistry Seminar  
Required during each semester of residence.

799 Doctoral Dissertation  
Required each semester student is enrolled and receiving direction on a doctoral dissertation.

COMPUTER SCIENCE

Degrees: Master of Science  
Doctor of Philosophy

Chair: C. G. Davis, Professor
Professors:
Amin, A.T.; algorithms, graphs and networks, software testing
Davis, C.G.; software engineering, software requirements definition techniques
Graves, S.J.; distributed computing, data and information systems, software engineering
Hooper, J.W. (Adjunct); languages, simulation and prototyping, software engineering
Johannes J.D.; artificial intelligence, distributed operating systems, software engineering
Richards, P.G.; numerical analysis, modeling of ionosphere and plasmasphere
Shiva, S.G.; artificial intelligence, software engineering, parallel and distributed processing, VLSI design methodologies

Associate Professors:
Delugach, H.S.; software requirements development, knowledge based systems
Hinke, T.H.; data and information systems, computer security, distributed artificial intelligence
Ranganath, H.S.; image processing, pattern recognition, neural networks
Rochowiak, D.M.; cognitive science, artificial intelligence, computer ethics

Assistant Professors:
Li, W.; object oriented software design, real time software engineering
Newman, T.S.; visualization, graphics, and computer vision
Reed, T.; compatibility, programming languages
Wang, H.; parallel algorithms, parallel computing models and architectures, systolic array computing
Weisskopf, M.E.; modern operating systems, artificial intelligence, planning systems

Computer science is a key ingredient in almost all significant technical endeavors undertaken today. The modern computer scientist must be trained to tackle a wide variety of tasks relating to the development of hardware and software computing systems and their application to complex problems. The graduate program in computer science teaches practical application of knowledge as well as theoretical fundamentals to prepare the graduate to contribute to effective problem solving in a university, industrial or government environment.

The UAH campus is fully networked with a fiber optics backbone interconnecting all computing facilities and providing easy access to the Internet. The department has several file servers, providing support to the networked Sun and PC labs within the department. Adequate time is available on the departmental machines, other campus computing resources, as well as the nearby State of Alabama owned CRAY C94 and a 128 processor nCUBE-2 machine. The department also has a microcomputing laboratory used for instruction in logic design and computer architecture. Additional information may be obtained from the Computer Science Department's homepage at http://www.cs.uah.edu on the World Wide Web.

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, computer graphics, image processing, computer architecture, and data and information technology.

Theoretical Computer Science
These courses develop and explore some of 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.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 603</td>
<td>Formal Languages and Automata Theory</td>
</tr>
<tr>
<td>CS 617</td>
<td>Design and Analysis of Algorithms</td>
</tr>
<tr>
<td>CS 703</td>
<td>Theory of Programming Languages</td>
</tr>
<tr>
<td>CS 717</td>
<td>Advanced Algorithm Design and Analysis</td>
</tr>
</tbody>
</table>
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 690 Operating 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 this very complex software development process. The requirements for a certificate in software engineering are described in the Master of Science degree requirements section. Courses in this area include the following:

- CS 550 Ada Program Support Environments
- CS 551 Object Oriented Methodologies
- CS 552 Object-oriented Design
- CS 555 Theory of Program Development
- CS 650 The Software Engineering Process
- CS 652 System and Software Requirements Methods
- CS 654 Software Design Techniques and Tools
- CS 656 Software Testing and Reliability
- CS 658 Software Project Management and Quality Assurance
- CS 750 Advanced Software Engineering Topics

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; can adapt to environmental variations; and can describe their own operations and justify their solutions, decisions and advice. The courses listed below cover the fundamentals of artificial intelligence.

- CS 530 Expert Systems and Heuristic Programming
- CS 537 Neural Networks I
- CS 630 Artificial Intelligence I
- CS 635 Computational Models of Cognition
- CS 637 Neural Networks II
- CS 730 Artificial Intelligence II

Computer Graphics and Image Processing

The creation of computer-generated graphic animations and photo-realistic images has a growing number of exciting and important applications. The inverse problem—the processing and extraction of information from visual and other patterns—also has many industrial, military, and space applications. Courses in this emphasis area include a sequence in computer graphics and a sequence in the theory, computational algorithms, and architecture for the design and development of pattern recognition and vision systems.

- CS 545 Introduction to Computer Graphics
- CS 640 Automatic Pattern Recognition
- CS 642 Computer Processing of Digital Images
- CS 645 Computer Graphics
- CS 646 Computer Geometry Modeling
- CS 742 Image Processing Algorithms and Architectures
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 main concentration areas are: logic design and digital computer hardware design; parallel computer architectures; distributed processing; and networks. Courses in this area include:

- CS 586 Microprocessor Architecture
- CS 613 Computer Architectures
- CS 670 Computer Networks
- CS 713 Distributed Processing Systems
- CS 714 Parallel Processing Architectures
- CS 716 Computer System Performance Analysis
- CS 780 Fault Tolerant Computing

Data and Information Technology

As the amount of information and data used by organizations rapidly increases, the need for techniques to manage, retrieve, process, and protect this geographically distributed data becomes critical. For very large data collections, these techniques must include methods to help users discover and select relevant data from the mass of available data. The data and information technology area focuses on the technology required to utilize effectively this rapidly growing volume of data and information. The courses in this area include the following:

- CS 685 Computer Security
- CS 687 Database Systems
- CS 660 Large Scale Scientific Computing
- CS 787 Advanced Database Systems

Admission Requirements

Requirements for admission to the computer science graduate degree program are in addition to those of the School of Graduate Studies. Scores from the GRE basic test and the subject test in computer science are required for admission to the program. For unconditional admission a student should have a 70th percentile average for the verbal, quantitative, and analytical scores and scores on the subject test in computer science should be at least in the 60th percentile. The MAT or GMAT is not an acceptable substitute for the GRE.

Breadth Requirements

Applicants to graduate programs in computer science must satisfy the following breadth requirements before admission to the program.

Mathematics:
- MA 171 Calculus A (4 hrs.)
- MA 172 Calculus B (4 hrs.)
- MA 244 Introduction to Linear Algebra
- MA 385 Introduction to Probability

Computer Science:
- CS 107 Computer Science I
- CS 207 Computer Science II-Data Structures
- CS 214 Introduction to Discrete Structures
- CS 317 Introduction to Design and Analysis of Algorithms
- CS 424 Introduction to Programming Languages
- CS 490 Systems Software
- CS 513 Introduction to Computer Architecture or CS 309 and 413
The breadth requirements can be satisfied in one of the following ways:
1. Completion of the course at UAH with a grade of B or better
2. Completion of an equivalent course at another institution with a grade of B or better
3. Testing out of the course, where permitted by departmental policy.
Consult a departmental advisor for additional information.

Transfer to Computer Science from other UAH Graduate Programs
Students enrolled in other graduate programs at UAH who wish to obtain a degree in computer science should see a computer science advisor for evaluation. Such a student must fulfill the computer science breadth requirements. Taking CS graduate courses without first checking with a departmental advisor will not eliminate the need for completing the breadth requirements.

Master of Science
Students applying for the master’s program are expected to have an undergraduate background in CS. Those students who do not have such a background must satisfy the breadth requirements described above.

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 the breadth requirements listed above.

Conditional Admission
Conditional admission will be recommended for 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 and Restrictions
The Master of Science degree is conferred under Plan I or Plan II. The following list of requirements and restrictions applies to students in either plan. Specific requirements for Plan I and Plan II follow.
• All students must take the following four core courses:
  CS 613 Computer Architecture
  CS 617 Design and Analysis of Algorithms
  CS 650 The Software Engineering Process
  CS 690 Operating Systems
• A grade of B or better must be earned in each core course. A grade of B- or lower will require that the course be retaken.
• All M.S. students must pass a comprehensive written examination over the core courses after completing 18 hours. The examination may only be taken twice.
• The Plan of Study must include six hours in an approved minor. The minor may be within the computer science department or from another area such as engineering, science, or mathematics.
• A grade of B or better must be made in any 500-level course which is to be counted toward the degree.
• A 3.0 average must be maintained in all graduate work at UAH and in all work to be counted toward the degree.
• No more than 50% of the hours in the Plan of Study may be 500-level courses.
• No more than three hours of special topics courses may be included in the Plan of Study. Exceptions must be approved by the department chair.
• The degree must be completed within six years. Courses older than six years may be validated according to graduate school policy. Courses older than ten years may not be applied to the degree.
Graduate work may be transferred from another institution according to graduate school rules.

Plan I students must register for CS 699 each term they receive supervision from their thesis advisor.

**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 (CS 699) must be earned. In addition to the written comprehensive examination, students must pass an oral examination covering the thesis.

**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 hours in an approved minor area. The written comprehensive examination must be taken successfully.

**The Program of Study**

A program of study should 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 chair as an advisor. 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. A Petition for Change in Graduate Program (Form 3-A) must be submitted with appropriate signatures for any changes in the program of study.

**Software Engineering Concentration**

The Software Engineering Concentration leading to a Software Engineering Certificate requires the completion of 18 hours of graduate software engineering courses as a part of the Plan II M.S. program. This would include CS 650, and 15 hours from the following: CS 652, 654 or 552, 551, 656, 658, 555, 550, 750, or 695.

**Doctor of Philosophy**

**Admission Requirements**

The admission policies for the Ph.D. program in computer science follow the general 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 semester. Applicants are required to submit supporting recommendation letters and an indication of research interests and study plans. Specific requirements are available from the Computer Science Department office. 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. Students showing exceptional promise who desire to pursue the Ph.D. full-time may be admitted to the program after completing a bachelor’s degree in computer science.

**Conditional Admission**

Conditional admission will be recommended for 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 a preliminary examination, completion of coursework, a qualifying examination, completion of significant research documented in a dissertation and the dissertation defense.

Major/Minor Subjects

A minimum of 60 hours of graduate course credit plus a minimum of 18 dissertation credit hours are required for the Ph.D. in computer science. The program of study (approved by the student's supervisory committee) will consist of 36 hours in the major and 24 hours in a minor. Coursework grade requirements are the same as for the M.S. degree. Coursework taken as part of a graduate degree program at another institution may be applied to the degree with permission of the student's supervisory committee.

The program must include CS 603, CS 613, CS 617, CS 624, CS 650 and CS 690 and must have a coherent area of emphasis, of which at least 6 semester hours must be at the 700 level. At least 9 semester hours of graduate level mathematics must also be included as part of the minor.

Preliminary Examination

Students will be required to take a preliminary examination over the following core areas: formal languages, computer architecture, algorithms, programming languages, operating systems and software engineering. The examination should be taken at the earliest opportunity upon completion of the core coursework. Successful completion of the examination will provide evidence of the student's ability to continue in pursuit of the Ph.D. degree. The examination can be taken no more than twice.

Admission to Candidacy

To be admitted to candidacy for the Ph.D. degree, students must first pass the qualifying examination. The qualifying examination 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. It is designed to test students' fitness for pursuing research projects in their chosen areas and to test their general knowledge of computer science. After completion of the qualifying examination, each student will present a research proposal to the supervisory committee.

Residency Requirements

In order to meet the residency requirements, a student must complete 9 or more graduate hours per semester for two consecutive semesters at UAH. The Summer Term may be ignored, if desired, in establishing two consecutive semesters. No more than 9 hours taken as part of the residency requirements may be dissertation credit.

Other Requirements

The program must be completed within five years after admission to candidacy.

The qualifying examination may be taken no more than twice.

CS 799 is required each semester a student is receiving direction on the doctoral dissertation.

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 COMPUTER SCIENCE COURSES (CS)

The following courses serve as prerequisites for students entering the computer science graduate program. They are not open to computer science undergraduates and can not be taken for credit by computer science undergraduate or 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.

517 Data Structures 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. Basic 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 207.

Graduate Courses in Computer Science (CS)

Courses numbered between 530 and 599 (inclusive) may be taken for undergraduate or graduate credit with prior approval of the student's advisor, except as otherwise noted. Courses at 600-level or above are reserved for graduate students. They may be taken by other students only by approval of the department chair.

520 Computer-Based Instructional Technologies 3 hrs.
Introduces prospective teachers to current state of the art in educational technology. Extensive hands-on experiences with microcomputers and other emerging technology. Emphasis on effectively integrating technology into instructional setting for both special and regular students. Lab Fee: Level 4. (Same as ED 520.) May not be applied to CS major or minor.

530 Expert Systems and Heuristic Programming 3 hrs.
Expert systems 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 4. Prerequisites: CS 317, 424.

537 Neural Networks I 3 hrs.
Introduction to neural networks, covering the most prominent neural network models. Hands-on experience with neural networks is gained through an individual or group project. Lab Fee: Level 4. Prerequisite: CS 317.

545 Introduction to Computer Graphics 3 hrs.
Introduction to the underlying theory and mechanics of computer graphics. Brief historical perspective, progressing through extended discussion on topics such as display hardware technology, 2D raster scan conversion algorithms, 2D and 3D geometric transformations, and 3D projection and viewing techniques. A significant number of programming projects are assigned. Lab Fee: Level 4. Prerequisites: CS 312 (or proficiency with the C programming language), MA 244.

550 Ada Program Support Environments 3 hrs.
A study of advanced development concepts and support tools centered around Ada as the implementation language. Design and implementation concepts as part of the software life cycle. Lab Fee: Level 4. Prerequisite: CS 350 or equivalent introductory course in Ada.
551 Object Oriented Software Methodologies 3 hrs
Object oriented methods and design concepts, languages and systems for object orient­
ed development, object oriented programming environments, application of object ori­
ented techniques. Lab Fee: Level 4. Prerequisite: CS 207.

552 Object Oriented Design 3 hrs.
Introduces “design patterns” as elements of reusable object-oriented software develop­
ment, advanced C++ programming and techniques, concepts, and styles to realize and
make object-oriented designs more reusable, extendible, and simple. Lab Fee: Level 4. Prerequisite: CS 307.

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.

560 Current and Emerging Instructional Technologies 3 hrs.
Designed to build competency in computer technologies appropriate to instructional use.
Concepts of authoring and scripting will be used to unify course materials. Lab Fee:
Level 4. Prerequisite: ED/CS 520. (Same as ED 560.) May not be applied to CS major
or minor.

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 cur­
rent microprocessor technology. Lab Fee: Level 5. Prerequisites: CS 413 or 513.

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 expe­
rience in UNIX.

595 Selected Topics in Computer Science 3 hrs.
Special topics requested by students. Prerequisites: Approval and consent of instructor.

603 Formal Languages and Automata Theory 3 hrs.
Formal definition of programming languages. Definition of formal grammars: regular,
context-free, context sensitive, and phrase-structure. Definition of automata: finite-state,
pushdown, linear-bounded automata, Turing Machines. Relationship between formal
languages and automata. Lab Fee: Level 4. Prerequisite: CS 424 or CS 624; CS 403 re­
commended.

612 Compiler Design 3 hrs.
Compilation of expressions and statements; organization of a compiler including com­
pile-time and run-time symbol tables, lexical analysis, syntax analysis, optimization,
object-code generation and error diagnostics. Compiler writing tools. Lab Fee: Level 4. Prerequisites: CS 424 or CS 624; CS 403 recommended.

613 Computer Architectures 3 hrs.
Array, 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 413 or 513.
617  Design and Analysis of Algorithms 3 hrs.
Strategies of algorithm synthesis and analysis. Design methodologies of classical algorithm categories such as: divide-and-conquer, greedy method, dynamic programming, search and traversal, back-tracking, and branch-and-bound. Computational complexity and important theoretical results from lower-and upper-bound studies, NP-hard, and NP-complete problems. Lab Fee: Level 4. Prerequisite: CS 317 or 517.

620  Curriculum Integration Technology 3 hrs.
Prepares teachers to plan curriculum integration by using computer technology and software in various curriculum areas for both regular and special students. Also develops competency in instructional design and production techniques. Implementing instructional events using long-distance technologies. Lab Fee: Level 4. Prerequisites: ED/CS 520, 560. (Same as ED 620.) May not be applied to CS major or minor.

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 or 517.

630  Artificial Intelligence I 3 hrs.
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, 424.

635  Computational Models of Cognition 3 hrs.
Computational models of human 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.

637  Neural Networks 3 hrs.

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, 385.

645  Computer Graphics 3 hrs.
Hierarchical modeling paradigm and 3D solid modeling. High resolution 3D graphics including topics in curve and surface representation, solid modeling, visible surface determination, color theory, illumination and shading, texture mapping, and antialiasing. A significant number of programming projects are involved. Lab Fee: Level 4. Prerequisite: CS 545.
**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 robotics, animation, image processing and computer graphics, CAD/CAM/CAE. Lab Fee: Level 4. Prerequisite: CS 545.

**The Software Engineering Process** 3 hrs.
The process of developing complex software products. Includes software life cycles, phases of development and disciplines such as CM, QA, V&V, and T&E. Software standards, rapid prototyping, and a significant group project are used to illustrate concepts. Lab Fee: Level 4. Prerequisite: Completion of breadth requirements or permission of instructor.

**System and Software Requirements Methods** 3 hrs.
Emphasis upon the requirements phases of software development. Formal and informal methods, computer aided software engineering tools, tool and technique evaluation, requirements specification characteristics. Includes experience with CASE tools on a variety of problems. Lab Fee: Level 4. Prerequisite: CS 650.

**Software Design Techniques and Tools** 3 hrs.
Alternative approaches for the design of software products. Includes design specification, characteristics of a good design, design verification and validation. Includes a design project. Lab Fee: Level 4. Prerequisite: CS 650.

**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 5. Prerequisite: CS 650.

**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 5. Prerequisite: CS 650.

**Large Scale Scientific Computing** 3 hrs.
Advanced techniques for processing data for large scientific and engineering applications. Application of parallel processing to scientific data processing. Lab Fee: Level 4. Prerequisite: MA 515.

**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.

**Computer Security** 3 hrs.
Security policies, models, and mechanisms applicable to providing security for computer-based systems, including operating systems, database management systems, and networks. Lab Fee: Level 4. Prerequisite: CS 690.

**Data Base Systems** 3 hrs.
Basic concepts of data base systems. Use of semantic models in database design. Data models with a major focus on the relational and object-oriented models. Relational query languages and normal forms. Database management system design issues. Security and integrity issues. Lab Fee: Level 4. Prerequisites: CS 624, 690.
690  Operating Systems 3 hrs.
Techniques of operating systems control programs, including management of systems, processes, and data; issues in concurrency, synchronization, scheduling, memory management, multiprogramming, multiprocessing, and timesharing systems. Lab Fee: Level 4. Prerequisites: CS 490 and either CS 413 or 513.

695-698 Selected Topics in Computer Science 3 hrs.
Special topics requested by students. Prerequisite: Approval of instructor.

699  Master's Thesis 3 hrs.
Required each semester 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. Lab Fee: Level 4. Prerequisites: CS 670, 690.

714  Parallel Processing Architectures 3 hrs.
Coarse and fine grain parallelism and its effect on architecture, vector, array and multiprocessor structures. Process creation, communication and synchronization techniques, mapping algorithms to architectures, vectorization, data dependence and optimization, case studies of contemporary parallel architectures. Lab Fee: Level 4. Prerequisites: CS 613, 690.

716  Computer System Performance Analysis 3 hrs.
Performance evaluation: criteria for selecting techniques, performance metrics, and the establishment of performance requirements. Measurement techniques and tools: workload selection and characterization, monitors, capacity planning and data presentation. Specialized supporting theory; techniques and tools developed from the areas of probability and statistics; experimental analysis and design; simulation and queuing models. Lab Fee: Level 4. Prerequisites: CS 613, 624, 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  Artificial Intelligence II 3 hrs.
Rigorous treatment of special topics in artificial intelligence. Topics may include knowledge representation, automated deduction, search control, machine learning, or metalevel architectures. Lab Fee: Level 4. Prerequisite: CS 617.

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 613, 642.
Advanced Software Engineering Topics
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. Lab Fee: Level 4. Prerequisite: CS 650.

Fault Tolerant Computing
3 hrs.
Hardware and software system reliability; diagnosable digital systems; fault tolerant architectures; software techniques for fault tolerance; fault tolerant algorithms and data structures; system reliability; fault tolerant systems. Lab Fee: Level 4. Prerequisites: CS 613, 617.

Advanced Database Systems
3 hrs.
Advanced topics in data bases. Introduction to distributed data bases and current research in coupling artificial intelligence techniques to databases. Query optimization, concurrency control, security and recovery issues in both centralized and distributed databases. Lab Fee: Level 4. Prerequisite: CS 687.

Advanced Operating Systems
3 hrs.
Advanced issues in concurrency, synchronization, multilevel memory allocation and paging, algorithms, file structures and I/O scheduling. Recent trends in operating system design for multiprocessor and distributed systems. Distribution queuing models, models of program behavior, measurement, techniques and analysis. Lab Fee: Level 5. Prerequisite: CS 690.

Advanced Selected Topics
3 hrs.
Special topics requested by students. Prerequisite: Approval of instructor.

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

ENVIRONMENTAL SCIENCE PROGRAM

Coordinator: R.O. Lawton, Professor, Biological Sciences

Faculty: Faculty members for this program have academic appointments in established University departments (primarily atmospheric science and biological sciences) and in local industry.

The environmental science graduate program provides 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. 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 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 and the environmental science program coordinator who will tailor programs to meet the student’s educational needs.

Graduate Courses in Environmental Science (ES)

Survey of Atmospheric Science
3 hrs.
General survey of the field of atmospheric science. Quantitative examination of atmospheric physical properties including atmospheric composition, structure and dynamics. Detailed inspection of evolving atmospheric structures using real-time data systems.
Atmospheric thermodynamics, atmospheric dynamics, cloud physics, atmospheric radiation, and related topics in atmospheric remote sensing. Prerequisites: MA 172 and PH 112 or consent of instructor. (Same as ATS 504)

512 Environmental Transport 3 hrs.

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

525 Environmental Chemistry 3 hrs.
Principles of quantitative analyses related to minor components of a sample. Applications selected from principal analyses necessary to maintain environmental quality of air, water, and soil. Selection of conditions for collecting reliable samples, concentration of components with techniques for increasing concentration of selected component, relationships between physical and chemical changes in sample and signal output of predominant transducers, and translation of chemical analysis into meaningful specifications. Lecture only. Prerequisite: CH 521 or 223; EE 311, 342. (Same as CH 525)

532 Space Orientation for Teachers: Science 3 hrs.
Introduces the teacher to a variety of space-related subjects and techniques which may be used in the classroom. Curriculum is designed to reflect current research and technological development in a hands-on experience with the space program. Includes a number of experiments which can be duplicated in the classroom. Offered in cooperation with the Alabama Space and Rocket Center. Lab Fee: Level 2. (Same as ED 532.)

551 Atmospheric Fluid Dynamics I 3 hrs.
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 324, PH 112. (Same as ATS 551.)

553 Atmospheric Radiation and Remote Sensing 3 hrs.
Introduction to solar and terrestrial radiation. Absorption and emission of radiation in the atmosphere. Experimental determination of flux emissivity. Divergence of net radiation. Applications to remote sensing. Prerequisites: MA 324, PH 112. (Same as ATS 553.)

581 Atmospheric Thermodynamics and Chemistry 3 hrs.
Introduction to thermodynamics and chemistry of the atmosphere and relation to atmospheric processes such as cloud and precipitation processes. Specific topics include a review of basic thermodynamics, atmospheric thermodynamic variables, air-water systems, atmospheric statics and stability, saturation point analysis, cloud and precipitation physics, general aspects of atmospheric chemistry. Prerequisites: MA 324, CH 123, and PH 112. (Same as ATS 581.)

590 Environmental Laws and Regulations 2 or 3 hrs.
Air pollution control laws and water pollution control laws including air and water pollution standards and variances, congressional and judicial developments in control laws, economic and technological difficulties encountered in meeting standards, relation to state and federal agencies in the enforcement of pollution control laws, and methods of monitoring violations and legal penalties. (Offered through Continuing Education.)

591 Environmental Quality Planning 2 or 3 hrs.
Provides field planners with in-depth understanding of the Water Resource Council's Principles and Guidelines and the Environmental Quality Evaluation Procedures
Manual; their relationship to environmental planning and evaluation; and their application to water resources set forth in P&G planning, including incremental analyses for justification of mitigation measures being recommended. Pays particular attention to the needs of the environmental member of a plan formulation team in planning and scheduling the geophysical, ecological, cultural and aesthetic investigations. Covers the location and use of available environmental information, the integration of new studies, the appraisal of environmental elements of alternative plans (determining significance for both non-monetary and monetary values), trade-off considerations, the environmental basis for selecting a recommended plan, and the presentation of net environmental quality effects for decision making. (Offered through Continuing Education.)

592 Ecological Systems Survey Techniques 2 or 3 hrs.
Improves student competency in the methods and rationale behind the various field survey techniques, which depend on both the purpose of the study and the kind of ecosystem being investigated. (Offered through Continuing Education.)

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

594 Cultural Resources 2 or 3 hrs.
Provides field personnel with an in-depth working knowledge of current policies, procedures, and acceptable methods for assessment, inventory, and evaluation of the impact water resources projects may have on cultural resources, historic and prehistoric properties. Covers the statutory base for historic preservation, with emphasis on the National Historic Preservation Act (NHPA), the Archaeological Resources Protection Act, and the Reservoir Salvage Act. Procedures for complying with Section 106 of NHPA and for nominating properties for inclusion in the National Register of Historic Places. Not less than 4 hours of lecture are provided to cover social impact assessment and the relation of cultural heritage and historic (and prehistoric) properties to present-day communication construction and cohesion. (Offered through Continuing Education.)

595 Aesthetic Resources 2 or 3 hrs.
Provides field personnel with in-depth working knowledge of current policies, procedures, and acceptable methods for assessment and evaluation of the impact water resources projects may have on the aesthetic quality of urban and rural environments. Stresses visual impacts, but covers other perceptual impacts. Considers the definition of the study area as described in the Principles and Guidelines. Not less than 4 hours of lecture are given on the description of present land use in the study area and methods for predicting future land use for both the with-project and the without-project conditions. (Offered through Continuing Education.)

597 Environmental Impact Assessment of Projects 2 or 3 hrs.
Detailed consideration is given to factors involved in evaluating the effects of proposed projects upon the environment. Data and information required for environmental evaluation of major federal projects are examined. Particular emphasis is placed on physical and chemical factors which can impact biological and cultural resources. Procedures to be followed in complying with the National Environmental Protection Act (NEPA) and with the Procedures and Guidelines for Water Resources Implementation Studies (P&G) are analyzed to assist in the preparation and critiquing of an assessment. Coordination with other agencies, public involvement, and points to be considered in legal challenges are examined. (Offered through Continuing Education.)
600 Physical Activities for Learning Science 3 hrs.
In-service for elementary teachers. Emphasis is given to hands-on activities that relate
to concepts of energy, force, work, motion, machines, heat, light, and sound. Teachers
participate together in hands-on activities that can be returned to the classroom, playground, and gymnasium.

632 Space Orientation for Teachers: Science 3 hrs.
Builds on material already attained by those educators who have participated in the
generic program conducted at UAH, by providing educational experiences available in
Washington, D.C., 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, ED 532, or SS 532. (Same as ED 632.)

642 International Aerospace Education: Russia 3 or 6 hrs.
On-site seminar on the Russian space program. Lectures deal with rocket and shuttle
design, cosmonautics, Russian science education and space policy decision-making.
Locations include Space Mission Control, Star City, the Baikanur Cosmodrome, and
various schools, institutes, ministries, and factories involved in aerospace education and
industry in Moscow, Kiev, Leningrad, and Krasnoyarski. (Same as ED 642.)

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 interfer­
ence of smoke and dust is dependent upon both absolute and relative turbulent dis­
perion of the aerosols. 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: ES 551.

652 Space Science 3 hrs.
Provides teachers in-depth experience with the science associated with the space pro­
gram. Topics include: astrophysics, materials processing, plasma physics, life sciences,
orbital mechanics, propulsion, weather, and remote sensing. Lab Fee: Level 2.
Prerequisite: ES 532.

653 Atmospheric Optics 3 hrs.
Operational characteristics of optical or other radiative devices depend upon the radi­
ative 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, Mc
scattering, visibility, air mass optical characteristics. Prerequisites: ES 553, PH 541.

681 Numerical Atmospheric Modeling 3 hrs.
Introduction to numerical methods applied to simulation of the atmosphere. Basic
numerical solution techniques, along with filtering, radiative parameterizations, thermo­
dynamics, turbulent parameterization, initialization, and coordinate transformation.
Prerequisites: MA 415, ES 551. (Same as ATS 681.)

691 Special Topics: Environmental Science for Teachers 3 hrs.
MATHEMATICAL SCIENCES

Degrees: Master of Arts
Master of Science
Doctor of Philosophy

Chair: M. H. Chang, Professor

Professors:
Chang, M.H.; stochastic differential equations, stochastic control
Gibson, P.M.; linear algebra, combinatorics
McNider, R.T.; numerical modeling, boundary layer dynamics
Morales, C.H.; functional analysis, operator theory
Slater, P.J.; graph theory, combinatorics

Associate Professors:
Ames, K.A.; partial differential equations, singular perturbation theory
Epperson, J.F.; numerical analysis, partial differential equations
Friedman, M.J.; numerical analysis, differential equations
Howell, K.B.; elasticity theory, partial differential equations, Fourier analysis
Li, J.; differential equations, mathematical modeling in epidemiology
Siegrist, K.T.; probability, stochastic processes, reliability theory

Assistant Professors:
Cobb, S.S.; partial differential equations, computational mathematics
Huang, W.; differential equations, dynamical systems
Janik, T.J.; numerical analysis
Kunin, B.I.; fracture mechanics, differential geometry
Zhang, G.H.; graph theory, combinatorics

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 statistics, 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.

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 442, MA 452, 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.

Master 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 the department 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. MA 538 and MA 544 should be included in every program of study.

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 538, 544, 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, 538, 544, 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.

Master 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 in mathematics that leads to a Master of Arts degree with Alabama Class A certification. The coursework for such a Program of Study might be MA 538, 542, 544, 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 than 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.

Master's Degree Final Examination

A final comprehensive examination is required of all candidates for a master's degree. The candidate will be examined on the coursework and thesis in Plan I and on the coursework in Plan II. In the Mathematical Sciences Department this examination is oral, except that Plan II students who have passed a joint program examination for the Ph.D. degree in applied mathematics may use that examination as their master's degree final examination.

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.

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, 654) and linear and numerical linear algebra (MA 544, 614). 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. The examination 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 them in cogent, well-written exposition. It must include mathematical results suitable for publication in a nationally recognized journal.

All candidates for the Ph.D. degree must demonstrate competency in an approved foreign language such as French, German, Japanese, or Russian. Other languages may be approved at the department's discretion. This requirement may be satisfied by the completion of a 12 hour semester hour sequence in the language with an average grade over the 12 hours of B or better. It may also be satisfied by the acceptable performance on the ETS Graduate School Foreign Language Test in the approved language. At the department's discretion, other evidence of competency in an approved foreign language may be accepted.

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.

**Undergraduate/Graduate Mathematics Courses (MA)**

The following 500-level courses may, at the discretion of the student's advisor and department, be used to partially fulfill the mathematics requirement in a Program of Study for a graduate degree.

**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. (No credit allowed toward a graduate degree in mathematics or applied mathematics.) Prerequisite: MA 330 or 442 or approval of instructor.

With departmental approval, only one of the following three MA 500-level courses may be applied toward a graduate degree in mathematics or applied mathematics.
503 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.

504 Intermediate Differential Equations 3 hrs.
Elementary introduction to more advanced topics in differential equations: linear systems of differential equations, nonlinear autonomous systems, critical points, Liapunov’s method, limit cycles, Poincare-Bendixon theorem and strange attractors, power series solutions, Frobenius series solutions. Prerequisites: MA 244, 324.

506 Methods of Partial Differential Equations 3 hrs.
Survey of theory and methods for solving elementary partial differential equations. No credit given to students who have successfully completed MA 526. Topics include first-order equations and the method of characteristics; second-order equations, reduction to canonical form, the wave equation, the heat equation, Laplace’s equation, separation of variables, and Fourier series. Prerequisites: MA 324, 244.

508 Applied Linear Algebra 3 hrs.
Solving systems of equations, finding inverses of matrices, determinants, vector spaces, linear transformations, eigenvalues and eigenvectors, normal matrices, canonical forms for matrices, applications to systems of linear differential equations, use of computer software such as MATLAB. No credit given to students who have successfully completed MA 544. Prerequisites: MA 244, 324.

Graduate Courses in Mathematics (MA)

515 Introduction to Numerical Analysis 3 hrs.
Analysis and derivation of numerical methods for: the approximate solution of nonlinear equations; interpolation and integration of functions; approximating solutions of ordinary differential equations. Lab Fee: Level 4. Prerequisites: MA 244, 201, 324, CS 107 or equivalent, plus one 500-level (or higher) MA.

524 Dynamical Systems I 3 hrs.
Scalar autonomous equations; existence, uniqueness, stability, elementary bifurcations; planar autonomous equations; general properties and geometry, conservative systems, elementary bifurcations, linear systems, reduction to canonical forms, stability and instability from linearization. Liapunov functions, center manifolds, Hopf bifurcation. Prerequisite: MA 244, 324, and 452.

526 Partial Differential Equations I 3 hrs.
Introduction to the theory for solving partial differential equations. No graduate credit given to students who have completed MA 506 for graduate credit. Topics include second-order equations, reduction to canonical form, well-posedness, the classical equations (wave, heat, and Laplace’s) in one and several dimensions, separation of variables, Fourier series, general eigenfunction expansions, Sturm-Liouville theory, first-order linear and quasilinear equations, and shocks. Prerequisites: MA 502, one other 500-level MA course. (MA 506 is NOT a prerequisite.)

538 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. Prerequisites: MA 502 and at least one other MA course at the 500-level or above.
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 442 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 442 or approval of instructor.

544 Linear Algebra 3 hrs.
Vector spaces, bases, linear transformations, matrices, determinants, eigenvalues, similarity, Jordan canonical forms, dual spaces, bilinear forms, quadratic forms, orthogonal and unitary transformations. Prerequisites: MA 244 and at least one MA course at 300-level or above.

560 Intermediate Fourier Analysis 3 hrs.
Brief review of classical Fourier analysis, Parseval’s equality, Gaussian test functions. Introduction to generalized functions, the generalized transform, the generalized derivative, sequences and series of generalized functions, regular periodic arrays of delta functions, sampling, the discrete transform, the fast Fourier transform. (Other topics as time and interest permit.) Prerequisites: MA 244, 324, acquaintance with classical Fourier analysis (such as covered in MA 460).

565 Intermediate Mathematical Modeling 3 hrs.
Designed for beginning graduate students. No prior experience in a formal mathematical modeling course is required. In-depth discussion of some types of models from physics, the life sciences, and/or the social sciences, with formulation, analysis, and criticism of the models. Process of and factors involved in formulating a model will be of prime importance. Content will be divided into approximately one-half deterministic modeling and one-half stochastic modeling. Prerequisites: MA 244, 324, 385, one MA course at 400-level or above, and CS 107 or equivalent.

585 Probability 3 hrs.
Probability theory and its applications. Independent trials, discrete and continuous random variables, law of large numbers, basic distributions, sums of independent random variables, sequences of random variables, central limit theorem, and convergence in distribution. Prerequisites: MA 201 and one of MA 385, ISE 390, MA/ST 487, or approval of instructor.

590 Selected Topics in Mathematics 3 hrs.
Requested selected topics.

607 Mathematical Methods I 3 hrs.
Review vector calculus and coordinate systems, introduction to tensors, matrices, infinite series, complex variables with applications to calculus of residues, partial differential equations, Sturm-Liouville theory, Orthogonal functions, Gamma functions, Bessel functions, Legendre functions, special functions, Fourier series, integral transform and equations. Prerequisite: MA 503. (Same as PH 607.)

609 Mathematical Methods II 3 hrs.
Continuation of MA 607. Prerequisite: MA 607. (Same as PH 609.)

614 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 107 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 506 or 526, MA 544 or 614, CS 107 or equivalent.

Dynamical Systems II 3 hrs.
Brief review of linear systems; local theory for nonlinear systems; existence, uniqueness, differentiability, asymptotic behavior, the stable manifold theorem, Hartman-Grobman theorem, Hamiltonian systems; global theory for nonlinear systems; limit sets and attractors, the Poincare map, the Poincare-Bendixson theorem; some aspects of bifurcation theory and chaos; bifurcations at nonhyperbolic fixed points and periodic orbits, homoclinic bifurcations, Melnikov's method, chaos. Prerequisites: MA 524, 538, 544.

Partial Differential Equations II 3 hrs.
Continuation of MA 526. Qualitative results for solutions to the classical equations (energy inequalities, propagation of discontinuities, maximum principles, smoothness of solutions, existence and uniqueness, etc.), non-homogeneous equations, Poisson's equation, Green's functions, and the Cauchy-Kowalewski theorem. Prerequisite: MA 526.

Geometry 3 hrs.
Axioms of incidence and order, affine and metric properties, isometries, similarities, transformation groups, projective planes. Prerequisites: MA 442, 544 or approval of instructor.

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 538.

Graph Theory 3 hrs.
Graphs, subgraphs, trees, connectivity, Euler tours, Hamilton cycles, matchings, edge colorings, independent sets, vertex colorings, planar graphs, Kuratowski's theorem, four color theorem, directed graphs, networks, cycle and bond spaces. Prerequisite: MA 540 or 542.

Group Theory 3 hrs.
Isomorphism theorems, permutation groups, basis theorem and fundamental theorem for finite abelian groups, the Remak-Krull-Schmidt theorem, Sylow theorems, normal series, solvable groups, extensions, and selected topics in representation theory. Prerequisite: MA 542.

Matrix Theory 3 hrs.
Functions of matrices, invariant polynomials, elementary divisors, similarity of matrices, normal forms of a matrix, matrix equations, generalized inverses, non-negative matrices, localization of eigenvalues. Prerequisite: MA 544. MA 503 or 656 recommended.

Combinatorial Design 3 hrs.
Systems of distinct representatives, difference sets, coding theory, block designs, finite geometries, orthogonal latin squares, and Hadamard matrices. Prerequisites: MA 540, 544.

Real Analysis I 3 hrs.
Countable sets, characterization of open and closed sets, Heine-Borel theorem, Riemann integral, Lebesgue measure and outer measure, measurable functions, Lebesgue integral, Fatou's lemma, and Lebesgue-dominated convergence theorem. Prerequisites: MA 538 and one MA course at the 540 level or above.
654 Real Analysis II
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.

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 502 or approval of instructor.

658 Introduction to Functional Analysis
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 538.

661 Special Functions
Gamma and beta functions, probability integral and applications, orthogonal polynomials, Bessel functions, and their applications, spherical harmonics and their applications, hypergeometric functions. Prerequisite: MA 503 or 656.

662 Asymptotics and Perturbation Methods
Asymptotic series, regular and singular perturbation theory, asymptotic matching, Laplace's method, stationary phase, steepest descents, WKB theory. Prerequisites: MA 502, 504 or 624. MA 503 or 656 recommended.

667 The Calculus of Variations and Optimal Control
Euler necessary condition for local extremum, Euler-Lagrange equation, Weierstrass necessary condition, Jacobi's necessary condition, corner conditions, problems of optimal control, Pontryagin maximum principles, transversality conditions, applications. Prerequisites: MA 324, 502.

685 Stochastic Processes with Applications I
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
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
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
Required each semester a student is receiving direction on a master's thesis. A minimum of two terms is required. Maximum of nine hours credit awarded upon successful completion of the master's thesis.

715 Numerical Methods for Partial Differential Equations II
Finite element methods for parabolic, elliptic, and hyperbolic partial differential equations; error analysis, stability, and convergence. Lab Fee: Level 5. Prerequisites: MA 538, 615.

726 Theory of Partial Differential Equations
Hilbert space theory of existence, uniqueness, and regularity for partial differential equations. Prerequisites: MA 526, 538.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Prerequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>740</td>
<td>Combinatorial Algorithms</td>
<td>3 hrs.</td>
<td>Linear, polynomial and exponential graph theoretic algorithms, generating combinatorial objects, and NP-completeness. Prerequisite: MA 640.</td>
<td></td>
</tr>
<tr>
<td>756</td>
<td>Complex Analysis II</td>
<td>3 hrs.</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>785</td>
<td>Advanced Probability Theory</td>
<td>3 hrs.</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>790</td>
<td>Graduate Seminar</td>
<td>3 hrs.</td>
<td>Similar to MA 690 but conducted in a seminar format. Work is based largely on original memoirs and journal articles.</td>
<td></td>
</tr>
<tr>
<td>799</td>
<td>Doctoral Dissertation</td>
<td>3, 6, or 9 hrs.</td>
<td>Required each semester a student is receiving direction on a Ph.D. dissertation.</td>
<td></td>
</tr>
</tbody>
</table>

### Graduate Courses in Statistics (ST)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Prerequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>690</td>
<td>Special Topics in Statistics</td>
<td>3 hrs.</td>
<td>Courses in requested special topics. Prerequisite: Approval of instructor.</td>
<td></td>
</tr>
<tr>
<td>787</td>
<td>Theory of Statistics II</td>
<td>3 hrs.</td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>
The physics graduate program provides a smooth transition to a more comprehensive and rigorous treatment of physical principles learned in undergraduate studies. The 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, solar-terrestrial physics, astrophysics, relativity, plasma physics and microgravity effects.
2. Optics/quantum electronics including studies of laser physics, propagation, laser media and materials, optical properties of matter, electromagnetic scattering and optical bistability and instability.
3. Solid state/materials including studies of critical phenomena, crystal growth, electromagnetic properties of matter, thermal properties of materials, solid state theory, solid state physics and superconductivity.
Master of Science

Refer to the appropriate section of the catalog for general admission and degree requirements. There are two M.S. plans in physics. Plan I is for an M.S. degree with a thesis. Plan II does not require a thesis but does require a passing grade on the final examination. The final examination is the Physics Department Comprehensive Examination which is offered once every year, early in the spring semester, and also serves as the preliminary examination for the Ph.D. degree program. Details of the examination are available in the department office. Students opting for Plan I do not need to take the comprehensive exam. Students with a Graduate Research Assistantship may be required to file an M.S. Plan I Program of Study. Plan I is required for students seeking a degree through the Optics and Photonics Technology Curriculum.

Course work during the first one and a half years should be taken with the Comprehensive Examination in mind. A recommended schedule of courses for students entering UAH without previous graduate studies is given in the table below. M.S. Plan I students are required to take PH 551, 552, 601, 621, and 631, except for students pursuing a degree through the Optics and Photonics Technology Curriculum, who should consult the appropriate brochure for detailed requirements. A total of 24 credit hours in graduate courses plus a thesis (including at least 6 hours of PH 699) 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 complete two semesters of PH 792 (Physics Seminar) with a grade of “S”; seminar hours do not, however, count toward minimum degree requirements.

Typical Program Leading to Comprehensive Exam

<table>
<thead>
<tr>
<th>First Year</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH 551</td>
<td>PH 552</td>
<td>PH 621</td>
</tr>
<tr>
<td>PH 607</td>
<td>PH 609</td>
<td>Special Topic*</td>
</tr>
<tr>
<td>Special Topic*</td>
<td>Special Topic*</td>
<td></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 Examination. For example: students wishing to be examined in optics should take PH 541, PH 542, and PH 645; those wishing to be examined in solid state physics should take PH 560, PH 561; those wishing to be examined in space plasma physics should take PH 531 and PH 636; and those wishing to be examined in astrophysics should take PH 571 and PH 572 or PH 573. 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 Teacher’s Certificate.

Those who have a B.A. or B.S. 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 (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 for more details.

Doctor of Philosophy

Students are strongly advised to consult the appropriate section of this catalog for general degree requirements, such as residence, etc.

Admission to the Ph.D. program in physics is dependent on performance on the Department’s Comprehensive Examination. This examination is offered once per year (early in the spring semester) and consists of four sections: classical/statistical mechanics, electromagnetism and relativity, quantum mechanics, and a special topics section reflecting the research interests of the student (e.g. optics, solid-state physics, plasma physics, astrophysics). 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, 621, 622, 631, 732, 751, 745 or 752 and a minimum of 9 additional credit hours in courses numbered 600 or above must be taken. Students in the Ph.D. program are required to complete three semesters of PH 792 (Physics Seminar) with a grade of “S”; seminar hours do not, however, count toward the 48-hour minimum degree requirements. In addition, 18 hours of PH 799 (Doctoral Dissertation) are required; no more than 9 of these hours may be taken prior to passing the qualifying examination (see below). Courses in addition to those enumerated above are selected in consultation with the student’s advisory committee. Transfer of credit from other institutions requires approval of the advisory committee as well as the Dean of the College of Science and the Graduate Dean. Although a minor subject is not required, students are encouraged to develop an interdisciplinary program of study.

After completing the Ph.D. program of study, 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.

**Graduate Courses in Physics (PH)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>531</td>
<td>Introduction to Plasma Dynamics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>541</td>
<td>Geometrical Optics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>542</td>
<td>Physical Optics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>544</td>
<td>Optoelectronics</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

- **531 Introduction to Plasma Dynamics**
  Plasma kinetic theory including charged-particle and neutral collisions, ionization, electronic excitation and recombination, motion of charged particles, macroscopic equations. Transport coefficients, gas discharges, instabilities, sheaths, electromagnetic waves and radiation. Prerequisites: PH 421, 432. Fall.

- **541 Geometrical Optics**
  Foundations and physics of geometrical optics, Fermat’s principles and Huygen wavelets, refraction and reflection. The many forms of Snell’s Law. Optical path lengths, geometrical wavefronts and rays. Ray tracing, ynu-chart and matrix methods. Gaussian imagery and paraxial optics, conjugate elements, cardinal points, and image-object relations. Stops and pupils, chief and marginal rays, vignetting, and the optical or Lagrange invariant. The y-y bar diagram, design of common systems: objectives, magnifiers, microscopes, collimators and detectors. Optical glasses and chromatic aberrations, wavefront and transverse aberrations, spot diagrams and ray fan plots. (Same as OSE 541 and EE 541.) Fall.

- **542 Physical Optics**
  Propagation of light, polarization, plane-waves, Fresnel-Kirchoff and Rayleigh-Sommerfeld integral formulation of diffraction and radiation from apertures and scattering objects. Optical systems as linear-shift invariant systems, Fourier analysis, optical filtering, MTF, and holography. Interferometry and multi-beam interference. (Same as OSE 542 and EE 542.) Fall, Spring.

- **544 Optoelectronics**
  Review of polarized light, the Jones and Mueller calculi. Propagation of light in birefringent material. Modulation of light using electro-optic effect, Kerr effect, acoustooptic effect, and Faraday effect. Elements of photodetection and detectors, signal processing, and signal-to-noise. Design and analysis of beam scanners, optical rf-spectrum analyzer, optical sensors, and optical communication systems. Prerequisite: PH 342. (Same as OPT 444 and OPE 451.) Fall.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>546</td>
<td>Radiometry</td>
<td>3 hrs.</td>
<td>Theory and practice of radiometry and photometry. Blackbody radiation and Lambertian sources. The propagation of radiant energy in free space and through optical systems. Detector classes, responsivity, bandwidth, and noise. Fluctuations and statistics of electromagnetic field. Prerequisite: PH 342. (Same as OPT 446.) Spring.</td>
</tr>
<tr>
<td>551</td>
<td>Introductory Quantum Mechanics I</td>
<td>3 hrs.</td>
<td>Waves and particles; Bohr’s model of the atom; de Broglie waves, wave-packets and the uncertainty principle; postulates of quantum mechanics; Schroedinger’s equation; simple systems in one, two and three dimensions; the hydrogen atom. Prerequisites: PH 113, 301, MA 244, 324. (Same as PH 451, CH 553, MTS 651.) Fall.</td>
</tr>
<tr>
<td>552</td>
<td>Introductory Quantum Mechanics II</td>
<td>3 hrs.</td>
<td>Angular momentum and spin; atomic structure and spectrum; time-independent perturbation theory, variational methods; time-dependent perturbation theory and interactions of light with matter; scattering theory; electronic structure of solids; relativistic quantum mechanics. Prerequisite: PH 551. (Same as PH 452, CH 554, MTS 652.) Spring.</td>
</tr>
<tr>
<td>561</td>
<td>Introduction to Solid State Physics II</td>
<td>3 hrs.</td>
<td>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. (Same as MTS 661.) Spring.</td>
</tr>
<tr>
<td>570</td>
<td>Optical and Photonic Systems Design</td>
<td>3 hrs.</td>
<td>Review of paraxial optics, ray tracing codes, aberration and diffraction calculations; acousto- and electro-optic modulators, spatial light modulators; fibers, fiber splicers and connectors; gratings and diffractive optical elements; laser and light emitting diodes, photodetectors and CCD arrays; correlator systems; optical communication networks; signal processing systems design. Prerequisite: EE 541. Fall.</td>
</tr>
<tr>
<td>571</td>
<td>Stellar Atmospheres and Interiors</td>
<td>3 hrs.</td>
<td>Classification of stellar spectra; radiative transfer, stellar atmospheres; spectral line profiles; curve of growth. Equations of stellar structure; hydrostatic equilibrium and stability; theory of polytropes, structure of “real” main-sequence stars; stellar evolution; compact stellar objects (white dwarves, neutron stars, black holes). Prerequisite: PH 371. Spring, odd years.</td>
</tr>
<tr>
<td>572</td>
<td>Galactic Structure and Cosmology</td>
<td>3 hrs.</td>
<td>Galactic structure; Oort’s constants and rotation curve; clustering and superclustering; special and general relativity; Friedmann cosmologies; observational tests; physics of the early Universe-Grand Unified Theories; symmetry breaking; inflationary models; relation to particle physics. Fall, odd years.</td>
</tr>
<tr>
<td>573</td>
<td>High Energy Astrophysics</td>
<td>3 hrs.</td>
<td>Observational techniques; radiation processes; physics of X-ray and gamma-ray sources; low-mass and high-mass X-ray binaries; cataclysmic variables; high-energy aspects of solar flares; gamma-ray bursts; origin and composition of cosmic rays; neutrino emission and detection. Spring, even years.</td>
</tr>
</tbody>
</table>
607 Mathematical Methods I
3 hrs.
Review vector calculus and coordinate systems, introduction to tensors, matrices, infinite series, complex variables with applications to calculus of residues, partial differential equations, and Sturm-Liouville theory. Orthogonal functions, Gamma functions, Bessel functions, Legendre functions, special functions, Fourier series, integral transforms and equations. Prerequisite: MA 324. (Same as MA 607.) Fall.

609 Mathematical Methods II
3 hrs.
Continuation of PH 607. Prerequisite: PH 607. (Same as MA 609.) Spring.

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. Prerequisite: PH 552. 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. Spring.

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

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. Spring, even years.

645 Lasers
3 hrs.
Incoherent light sources; atomic and molecular energy levels; equation or motion for probability amplitudes using first-order time dependent perturbation theory; electric dipole interaction. Einstein rate equations and the Planck radiation law; induced dipole moments and frequency-dependent susceptibility. Homogeneous and inhomogeneous line broadening mechanisms; laser cavities and modes, elementary laser theory, practical lasers; frequency stabilization techniques and laser linewidth; Q-switching and mode locking; photon statistics and noise; physical origins of noise; light modulation and detection. Prerequisites: PH 432, 551. (Same as OSE 645.) Summer.

670 Optomechanical Design and Manufacturing
3 hrs.
Optomechanical design fundamentals and principles; material selection, mirror and lens mounts, adjustment mechanisms, thermal issues, metal optics, diamond machining, finishing and plating methods; quality issues. Prerequisites: EE 541, 570. Spring.

671 Optical Fabrication and Testing
3 hrs.
Fabrication and testing techniques of optical components and systems. Component measurements: refractive index, curvature, focal lengths, cardinal points and field curvature. Wavefront aberration and transverse aberration function measurements; geometric tests, interferometric tests, null tests. Basics of grinding, figuring, polishing and optical coating. Laboratory experience in manufacturing, polishing, testing, and coating reflective or transmissive optics. Prerequisite: PH 670. Fall.

673 Fourier Optics
3 hrs.
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. Fall.
680-689 Selected Topics 3 hrs.
Offered upon demand. Topics include: optical surface characterization, superconductivity, aeronomy, properties of solids, laser propagation, collision theory, magnetohydrodynamics. Fall, Spring, Summer.

699 Master's Thesis 3 or 6 hrs.
Minimum of 6 credit hours required for Plan I M.S. students. Maximum of nine hours credit toward Ph.D. course requirements awarded upon successful completion of master's thesis. Fall, Spring, Summer.

702 Classical Dynamics II 3 hrs.
Continuation of PH 601. Review Lagrangian and Hamiltonian dynamics, canonical transformations, Hamilton-Jacobi theory, Lagrangian field theory, selected topics. Prerequisite: PH 601. Spring.

705 Relativity 3 hrs.
Special and general theory. A covariant formulation of electrodynamics. Prerequisites: PH 601, 631. Offered upon demand.

706 Solar Flare Physics 3 hrs.
Overview of the flare phenomenon; magnetic field structure and stability. Radiation mechanisms; energy transport by particles, hydrodynamic motions and radiation, empirical and theoretical atmosphere models; energy release mechanisms; solar terrestrial effects. Prerequisites: PH 531, 631. Offered upon demand.

711 Problems in Physics 3 hrs.
Application of theoretical principles of physics to an intensive analysis and solution of representative problems. Does not count toward minimum degree requirements. Prerequisites: PH 552, 601, 621, 631. Fall.

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. Prerequisite: PH 531. Spring, odd years.

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. Spring.

733 Nonlinear Optics and Devices 3 hrs.
Wave propagation in nonlinear media; modeling of optical nonlinearities; Kerr, thermal and photorefractive effects; nonlinearity-induced beam distortion; phase conjugation; applications of nonlinearities in crystals and fibers; quantum well and SEED devices; soliton-based communication systems; nonlinear optical switches, deflectors, limiters and bistability; measurements of nonlinearities. Prerequisites: PH 542, 551, 631. Spring.

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. Fall.

751 Quantum Mechanics I 3 hrs.
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. Fall.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>752</td>
<td>Quantum Mechanics II</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Continuation of PH 751. Prerequisite: PH 751. Spring.</td>
<td></td>
</tr>
<tr>
<td>753</td>
<td>Quantum Mechanics III</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Continuation of PH 752. Relativistic wave equations, second quantization, interacting fields, Feynman techniques. Prerequisite: PH 752. Offered upon demand.</td>
<td></td>
</tr>
<tr>
<td>760</td>
<td>Quantum Theory of Solids</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>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, optical absorption and excitations. Prerequisites: PH 552, 561, 631. Fall.</td>
<td></td>
</tr>
<tr>
<td>780-789</td>
<td>Selected Topics</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Topics include superconductivity, advanced plasma theory, properties of solids, laser propagation, collision theory, quantum electronics, gravitational theories. Fall, Spring, Summer.</td>
<td></td>
</tr>
<tr>
<td>792</td>
<td>Physics Seminar</td>
<td>1 hr.</td>
</tr>
<tr>
<td></td>
<td>Speakers are invited to report on individual research or on journal articles. Two terms are required for all M.S. students and three terms for Ph.D. students. Does not count toward minimum degree requirements. Fall, Spring.</td>
<td></td>
</tr>
<tr>
<td>795</td>
<td>Advanced Physics Project Laboratory</td>
<td>3 or 6 hrs.</td>
</tr>
<tr>
<td></td>
<td>Advanced laboratory research in one of the departmental research groups. Student works on an independent or group project. Completion of the course requires a written report that becomes part of the student's record. Prerequisite: Approval of advisor. Approval of Department Chair and an oral presentation of results is required for more than 3 credit hours. Fall, Spring, Summer.</td>
<td></td>
</tr>
<tr>
<td>799</td>
<td>Doctoral Dissertation</td>
<td>3, 6, 9 hrs.</td>
</tr>
<tr>
<td></td>
<td>Prerequisites: Students must have passed the comprehensive examination at Ph.D. level and have Ph.D. advisor's approval. No more than 9 hours may be taken prior to passing the qualifying examination. Fall, Spring. Summer.</td>
<td></td>
</tr>
</tbody>
</table>
The mission of the Division of Continuing Education is to administer special activities which respond to the University’s internal and external needs by providing the highest quality opportunities for credit and non-credit program development. Such programs are designed to assist attendees to become more effective in their personal and professional lives by building on the strengths and expertise of the University’s faculty, departments, and colleges. The Division serves to stimulate lifelong learning through identifying educational needs in the region and providing access to such curricula at different times and locations. This accountability is carried out through the departments of Distance Learning; Science and Engineering; Business and Management; Personal Development; Sports and Fitness; and Teaching the Future.

Distance Learning

Distance Learning at UAH meets the changing environment’s demand for more convenient educational delivery. UAH offers courses to distant locations using both interactive telecommunications and video tape.

The Intercampus Interactive Telecommunication System (IITS) is a full-service video-conferencing network within the University of Alabama System. Currently the IITS comprises more than 20 video-conferencing rooms across Alabama, with sites in Auburn, Atmore, Birmingham, Brewton, Eufaula, Gadsden, Huntsville, Jasper, Montgomery, Phil Campbell, Tuscaloosa, Tuscumbia, and other locations. The IITS also offers connectivity to other video-conferencing rooms within Alabama, other states, and other countries.

Participants at UAH see, hear, and speak to individuals at other locations as if they were all sharing one classroom. One of the room’s two video monitors continuously shows the UAH room, while the other monitor switches by voice activation between distant rooms.

The IITS facility at UAH is located in Room 205 of the Administrative Science Building. All cameras, monitors, fax machines and other items necessary for video-conferencing are installed in the room. Room coordinators manage equipment for all activities, and also assist in planning courses and meetings.

IITS courses are listed in the UAH semester Timetable of Classes and are also advertised internally by host departments. For more information, call 1-800-239-6013 or (205) 890-6015.

Science and Engineering

This department develops and presents professional training and educational activities in the areas of science, engineering, engineering management, computer applications, and technical
programming languages. Using University faculty and top industry personnel as instructors guarantees high quality seminars and customized training for organizational clients in business, industry, and government. Science and Engineering strives to increase the productivity and effectiveness of its clients by offering courses on current trends and latest technological breakthroughs in industry. This department is a supplier of training with specific emphasis focused in the following categories: programming languages, databases, and operating systems; advanced technology; space and missile systems technology; systems engineering and quality assurance/control; network engineering certification and training; professional engineering certification and training; computing for business applications; multimedia certification and training; software engineering; simulation technology; information technology, and environmental technology and compliance. For more information, call (205) 890-6015 or 1-800-239-6015.

Business and Management

The department of Business and Management offers public and in-house courses and certificate programs in the areas of business, management, and staff development. Seminars and customized training activities are provided for individual or organizational clients in business, industry, and government. Certificate programs and professional review series are offered in areas such as contract management, project management, supervisory development, ISO9000, and secretarial and administrative skills.

The department is also responsible for the development and coordination of University conferences and workshops in cooperation with industry, professional associations, government agencies, and UAH colleges and research centers. Programs primarily highlight the specialized interests and research thrusts of the University and the north Alabama region. Conferences include Aerospace Environmental Technology, Information Currents, and the Wernher von Braun Exploration Forum.

For more information on Business and Management programs or UAH conferences, call (205) 890-6372 or 1-800-448-4035.

Personal Development

The Personal Development Department offers non-credit and credit courses designed to enhance and improve the quality of life for people of all ages in the area. Courses are developed to respond to the special interests and scheduling needs of non-traditional students. Courses meet on the UAH campus and at convenient off-campus centers.

Non-credit programs include Elderhostel and the Academy for Lifetime Learning (the Academy) for mature adults, academic Kids' College for ages 5-17, self-enrichment courses in a variety of academic areas, certificate programs in photography and interior design, certificate series in horticulture, gerontology, computer graphics, and antiques and collectibles. In cooperation with academic departments of the University, credit courses are scheduled both on and off campus, late night, early morning, and weekends. For more information, call (205) 890-6355 or 890-6007.

Personal Development also coordinates the Listener's License program, which allows participants who have or have not been previously admitted to the University to attend regular credit classes. Listeners are not required to take tests or satisfy attendance requirements. The Listener's License fee is $59 per course for undergraduate courses and $89 per course for graduate courses. Some courses have associated laboratory fees. Listeners have UAH Library privileges while participating in the program, but must purchase a UAH parking decal. Only select courses are available through the Listener's License program, and no academic or CEU credit is awarded. Students under disciplinary or academic suspension from any college or university are ineligible to register as listeners. A course taken as a Listener's License participant may not be petitioned for credit by examination. To determine which courses are available for Listener's License, call (205) 890-6355.
Sports and Fitness

Fitness, active participation, and good health habits are essential in today's society. Through health and physical education course offerings, one can improve one's fitness level, learn lifetime leisure skills, and participate in a wide variety of sports and fitness activities. Some of these courses provide professional training and/or meet certification standards. A variety of sports camps and programs are offered for youth, ages 6 months through 17 years.

Domestic and foreign travel programs are also offered. These programs are based on an educational theme and study in such areas as art, music, history, and sports. The study of local culture is emphasized. Professional training courses in travel are also offered. For additional information, call (205) 890-6077.

Teaching the Future

Teaching the Future develops and conducts in-service, graduate credit programs that provide hands-on experience for elementary and secondary professional educators in the fields of science, mathematics, and social studies. In an effort to improve science education in the nation's schools, several of the programs acquaint educators with all dimensions of current developments in space science, including social and international implications. Programs include Space Orientation for Professional Educators (SOPE), Capital-Area Space Orientation (CASO), and International Aerospace Education: Russian Space Studies. For more information, call (205) 890-6835 or 1-800-448-4032.

Marketing

A Continuing Education catalog (published each term) and brochures of complete course descriptions are available by calling the Division of Continuing Education's Marketing Department at (205) 890-6274. The Marketing Department provides the creation and production of promotional material, in addition to functioning in a market research capacity for the Division. This support group has the responsibility for working with each programming department to create the best strategy, message, delivery method, and follow-up analysis to facilitate the Division's mission.

Registration and Course Information

Registration for Continuing Education is handled by the Division of Continuing Education's Business Office located in Wilson Hall, Room 124, or by calling (205) 890-6010 or 1-800-448-4031. Registration in non-credit courses does not require admission to UAH as a regular student; however, admission may be required in order to register for certain credit courses. Policies governing credit and non-credit courses taken through the Division are as follows:

Credit Courses

If a student wishes to apply a continuing education credit course towards a degree, the student must first be admitted to UAH as a degree candidate; and second, the credit must be approved by the appropriate academic department chair.

If a student does not wish to receive academic credit for a credit course, he or she may choose to audit the course. The audit option has no grading, testing, or attendance requirements. This request must be made at the time of registration.

Non-Credit Courses

Continuing Education Units (CEUs) are awarded to students who satisfactorily complete non-credit courses. One CEU is equal to 10 contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction. The number of CEUs awarded for each class is designated in each course description. A record of CEUs is kept by the Division of Continuing Education, and an official transcript may be obtained upon written request to the Business Office. A $3 fee is charged per transcript.
Training and Meeting Facilities

The Division of Continuing Education utilizes the auditoriums, training facilities, classrooms, and residential accommodations located on the UAH campus. In addition, the division has its own computer training facilities equipped with three PC laboratories. Sports and fitness activities are centrally located in Spragins Hall, an on-campus facility that contains an indoor pool, racquetball courts, gymnasium, weight room, and aerobic area. Other continuing education activities are held at various locations throughout the community.

The Division of Continuing Education’s central offices are located in Wilson Hall.

The University of Alabama in Huntsville

The Board of Trustees of The University of Alabama

The Honorable Fob James, Governor of Alabama, President, Ex Officio

Dr. Ed Richardson, State Superintendent of Education, Member, Ex Officio

Congressional District

Second  Joseph L. Fine, Montgomery, 1998
        Maury D. Smith, Montgomery, 1995
Third   John Russell Thomas, Alexander City, 1996
        Cleophus Thomas, Jr., Anniston, 1999
Fourth  Sidney L. McDonald, Union Grove, 1998
        John T. Oliver, Jr., Jasper, 1995
Fifth   Peter H. Lowe, Huntsville, 1996
        Martha Simms Rambo, Huntsville, 1999
Sixth   Frank H. Bromberg, Jr., Birmingham, 1998
        Garry Neil Drummond, Birmingham, 1995
        George S. Shirley, Tuscaloosa, 1998
Seventh Sandral Hullett, M.D., Eutaw, 1995
       Cordell Wynn, Tuscaloosa, 1997

Trustees Emeriti

T. Massey Bedsole, Mobile
Winton M. Blount, Montgomery
John A. Caddell, Decatur
Thomas S. Lawson, Montgomery
James D. Loftin, Dothan
Daniel T. McCull, Jr., Mobile
William H. Mitchell, Florence
Thomas E. Rast, Birmingham
Yetta G. Samford, Opelika
Ernest G. Williams, Tuscaloosa
The University of Alabama System Staff
Philip E. Austin, Chancellor
Charles R. Nash, Vice Chancellor for Academic Affairs
Malcom Portera, Vice Chancellor for External Affairs
Linda Flaherty-Goldsmith, Vice Chancellor for Financial Affairs
John B. Hicks, Executive Assistant to the Chancellor and
Secretary of the Board of Trustees
C. Glenn Powell, General Counsel
Warren H. Spruill, General Auditor

Executive Administration
Frank A. Franz, B.S., M.S., Ph.D. .............................................................. President
Samuel P. McManus, B.S., M.S., Ph.D. ........................................ Provost and Vice President
for Academic Affairs
Kenneth Harwell, B.S., M.S., Ph.D. ....................................................... Associate Provost and
Senior Vice President for Research
B. Jeanne Fisher, B.A., M.A., Ph.D. ....................................................... Vice President for Student Affairs
Jerry Quick, B.S., M.S. ............................................................. Vice President for Finance
and Administration
Barrett Carson, B.S., M.S. ................................................................. Vice President for University
Advancement

Academic Administration
Carolyn W. White, A.B., M.A., Ph.D. ........................................ Associate Provost
C. David Billings, B.S., Ph.D. ................................................................. Dean, College of
Administrative Science
Lynn D. Russell, B.S., M.S., Ph.D. ....................................................... Dean, College of Engineering
Sue W. Kirkpatrick, B.Sc., M.Sc., Ph.D. ........................................ Dean, College of Liberal Arts
Wilson Luquire, B.A., M.L.S., Ph.D. ..................................................... Dean of the Library
C. Fay Raines, B.S.N., M.S.N., Ph.D. .................................................. Dean, College of Nursing
J. Graeme Duthie, B.Sc., Ph.D. ............................................................. Dean, College of Science
James D. Johannes, B.S., M.S., Ph.D. ............................................... Dean, School of Graduate Studies
Ron R. Koger, B.S.Ed., M.Ed., Ed.D. .................................................. Assistant Vice President
for Enrollment Services
C. Michael Oliver, B.S., M.S., Ed.D. ............................................... Director, Continuing Education
Suzanne H. Norris, B.S., M.Ed. ............................................................ Director, Cooperative Education
Jerry W. Davis, B.S., M.A. ............................................................... Director, Financial Aid
Joyce O. Pettis, B.S., M.A., Ph.D. ......................................................... Interim Director, Honors Program
Richard H. Comfort, A.B., M.S., Ph.D. ............................................ Director, Institute for
Science Education
Lee E. Williams, II, B.A., M.A., Ph.D. .............................................. Director, Multicultural Affairs
John C. Gregory, B.Sc., Ph.D. ............................................................... Director, Space Grant Consortium
Adriel D. Johnson, A.B., M.S., Ph.D. .................................................. Campus Director, Alabama Alliance
for Minority Participation
GRADUATE FACULTY


ACOSTA, PATRICK, B.S.E. (Catholic University, Ecuador), M.S.E. (University of Virginia), P.E. Lecturer in Civil and Environmental Engineering, 1995.

ADHAM, REZA, B.S.E., M.S.E., Ph.D. (University of Alabama, Huntsville). Associate Chair and Associate Professor of Electrical Engineering, 1984.

AHMED, ANEES, B.Sc. (University of Engineering and Technology, Bangalore, Pakistan), M.Sc. (University of New Brunswick, Canada), Ph.D. (University of Houston). Associate Research Professor of Optical Science and Engineering, 1989.

AHMED, NESAR U., B.S.E., M.S.E. (Bangladesh University of Engineering and Technology), Ph.D. (Vanderbilt University). Lecturer in Civil and Environmental Engineering, 1993.

AMES, KAREN K. B.S. (Stanford University), Ph.D. (Cornell University). Associate Professor of Mathematical Sciences, 1990.

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


ANDERSON, GLORIA J., R.N. (Mobile General Hospital School of Nursing), B.S.N. (Indiana University), M.S.N. (University of Alabama, Birmingham). Associate Professor of Nursing, 1972.


ASUNDI, MANEESHA, B.S., M.S. (S.N.D.T. University), M.S., Ph.D. (University of Oklahoma). Assistant Professor of Education, 1995.

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

BAILEY, CARMINE, B.A. (Rutgers University), M.S. (University of Dayton), Ph.D. (Lehigh University). Lecturer in Mathematical Sciences, 1991.


BARR, THOMAS A., B.S. (University of Chattanooga), M.S., Ph.D. (Vanderbilt University). Research Professor of Physics, 1982.
BIGGS, ALBERT W., B.S. (Southwest Missouri State University), M.S. (Stanford University), Ph.D. (University of Washington), P.E. Professor Emeritus, 1984.

BILLINGS, C. DAVID, B.S. (Southwest Missouri State University), Ph.D. (University of Missouri, Columbia). Dean of the College of Administrative Science and Professor of Finance, 1981.


BOYKIN, TIMOTHY B., B.S.E.E. (Rice University), M.S.E.E., Ph.D. (Stanford University). Assistant Professor of Electrical and Computer Engineering, 1992.


BRINKHURST, RALPH O., B.Sc., Ph.D., D.Sc. (Kings College, University of London). Adjunct Professor of Biological Sciences, 1993.


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.


BURNETT, JOHN E., B.S. (University of New Mexico), M.A. (Claremont Graduate School), Ph.D. (University of Alabama, Tuscaloosa). Assistant Professor of Finance, 1992.

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

CAMPBELL, WARREN C., B.S. (University of Alabama, Tuscaloosa), M.S. (University of Alabama, Huntsville), Ph.D. (Colorado State University). Associate Professor of Civil Engineering, 1991.

CARPENTER, SANDRA L., B.A. (California State University), Ph.D. (University of California). Associate Professor of Psychology, 1989.


CHANG, MOU-HSIUNG, B.S. (Chung-Hsing University), M.S., Ph.D. (University of Rhode Island). Chair and Professor of Mathematical Sciences, 1974.

CHEN, CHIEN P., B.S. (National Taiwan University), M.S., Ph.D. (Michigan State University). Associate Professor of Chemical Engineering, 1986.

CHIPMAN, RUSSELL A., B.S. (Massachusetts Institute of Technology), B.S. (California Institute of Technology), M.S., Ph.D. (University of Arizona). Associate Professor of Physics, 1988.

CHITTUR, K. K., B.Tech. (Indian Institute of Technology, Bombay, India), Ph.D. (Rice University). Associate Professor of Chemical Engineering, 1991.

CHRISTENSEN, ERIC R., B.S. (University of Maryland), M.S. (California Institute of Technology), Ph.D. (University of Maryland). Lecturer in Mechanical and Aerospace Engineering, 1993.

CHRISTY, JOHN R., B.A. (California State University), M.Div. (Golden Gate Baptist Theological Seminary), M.S., Ph.D. (University of Illinois). Associate Professor of Atmospheric Science, 1991.

CHUNG, T. J., Engineering Diploma (Seoul National University), M.S., Ph.D. (Oklahoma State University). Distinguished Professor of Mechanical Engineering, 1970.

COBB, SHANNON S., B.S. (Florida State University), M.S., Ph.D. (University of Southwestern Louisiana). Assistant Professor of Mathematical Sciences, 1990.

COBLE, HAROLD DWAIN, B.S., (Kearney State College), M.S., Ph.D. (University of Nebraska). Associate Professor of Chemistry, 1966.

COHEN, WILLIAM E., B.S. (University of Kansas), M.D., Ph.D. (Purdue University). Assistant Professor of Electrical and Computer Engineering, 1994.

COLCLOUGH, GLENNIA, B.A., M.A. (Kent State University), Ph.D. (University of Georgia). Chair and Associate Professor of Sociology, 1984.

COLEMAN, HUGH W., B.S. (Mississippi State University), M.S., Ph.D. (Stanford University). Eminent Scholar in Propulsion and Professor of Mechanical Engineering, 1991.

COMFORT, RICHARD H., A.B. (Harvard University), M.S., Ph.D. (University of Alabama, Huntsville). Director of the Institute for Science Education and Research Professor of Physics, 1977.


DAVIS, CARL G., B.A. (Georgia Institute of Technology), M.S., Ph.D. (University of Alabama, Tuscaloosa). Chair and Professor of Computer Science, 1986.

DELUGACH, HARRY S., B.A. (Carleton College), M.S. (University of Tennessee), Ph.D. (University of Virginia). Associate Professor of Computer Science, 1990.

DILLARD, NANCY F., B.A., M.A., (University of South Carolina), Ph.D. (University of Tennessee). Assistant Professor of English, 1972.

DIMMOCK, JOHN O., B.S., Ph.D. (Yale University). Director, Center for Applied Optics and Professor of Physics, 1993.
DIMOPOULLOS, GEORGE T., B.S., M.S. (Pennsylvania State University), Ph.D. (Michigan State University). Professor of Biological Sciences, 1980.

DORSETT, MICHAEL J., B.S. (University of Georgia), M.S.E., Ph.D. (University of Alabama, Huntsville). Adjunct Associate Professor of Industrial and Systems Engineering, 1980.

DUNAR, ANDREW J., B.A. (Northwestern University), M.A. (University of California, Los Angeles), Ph.D. (University of Southern California). Chair and Professor of History, 1984.

DUTHIE, J. GRAEME, B.Sc. (University of Aberdeen, Scotland), Ph.D. (University of Bristol, England). Dean, College of Science, and Professor of Physics, 1985.


ELEY, MICHAEL H., B.A. (West Georgia College), M.S., Ph.D. (University of Georgia). Professor of Biological Sciences, 1974.


ELROD, DAVID A., B.S. (Louisiana State University), M.S., Ph.D. (Texas A&M University). Assistant Professor of Mechanical and Aerospace Engineering, 1992.

ELSHAMY, MAGED A., B.S. (Ain Shams University, Cairo, Egypt), B.S. (Al-Azhar University, Cairo, Egypt), M.S. (Washington University), Ph.D. (University of Georgia). Associate Professor of Mathematical Sciences, 1990.

EMSLIE, A. GORDON, B.Sc., Ph.D. (University of Glasgow, Scotland). Chair and Professor of Physics, 1981.


ESSENWANGER, OSKAR M., B.S. (Technical University of Danzig), M.S. (University of Vienna), Ph.D. (University of Wuerzburg). Research Professor of Atmospheric Science, 1989.

ETZKORN, LETHA M., B.S., M.S. (Georgia Institute of Technology), M.S. (University of Alabama, Huntsville). Lecturer in Computer Science, 1993.


EVANS, JOHN L., B.E.E. (Auburn University), M.S.E., Ph.D. (University of Alabama, Huntsville). Lecturer in Finance and Adjunct Assistant Professor in Industrial and Systems Engineering, 1991.


FEIKEMA, DOUGLAS A., B.S. (Calvin College and Seminary), B.S.E., M.S., Ph.D. (University of Michigan). Assistant Professor of Mechanical and Aerospace Engineering, 1992.
FINLEY, NANCY, J., B.A., M.A., Ph.D. (University of Oklahoma). Associate Professor of Sociology, 1982.

FLOYD, STEPHEN A., B.A. (Northeastern University), M.S.B.A. (University of Massachusetts), Ph.D. (University of Georgia). Assistant Professor of Management Information Systems, 1985.


FORTE, ALDO, D.Sc. (University of Havana, Cuba). Associate Professor Emeritus, 1966.


FREDERICK, ROBERT A., B.S., M.S., Ph.D. (Purdue University). Assistant Professor of Mechanical Engineering, 1991.


GADE, RHONDA K., B.S.E.E. (Southern Methodist University), M.S.E.E., Ph.D. (University of Texas, Austin). Assistant Professor of Electrical and Computer Engineering, 1992.

GARSTKA, WILLIAM R., B.A. (University of California), Ph.D. (Harvard University). Associate Professor of Biological Sciences, 1982.

GERBERDING, RICHARD A., B.A. (University of Minnesota), M.A. (University of Manitoba), D.Phil. (Oxford University, England). Professor of History, Adjunct Professor of Latin, 1984.


GRAVES, SARA J., B.S., M.A. (University of Alabama, Tuscaloosa), Ph.D., (University of Alabama, Huntsville). Director of the Information Science and Technology Laboratory and Professor of Computer Science, 1978.

GREGORY, DON A., B.S., M.S., Ph.D. (University of Alabama, Huntsville). Associate Professor of Physics, 1992.


GUINN, GERALD R., B.S. (Auburn University), M.S. (Purdue University), Ph.D. (University of Alabama, Huntsville). Professor Emeritus, 1990.

HARRIS, J. MILTON, B.S. (Auburn University), Ph.D. (University of Texas, Austin). Distinguished Professor of Chemistry and Adjunct Professor of Biological Sciences, 1973.


HAWK, CLARK W., B.S. (Pennsylvania State University), M.S., Ph.D. (Purdue University). Professor of Mechanical Engineering and Director of Propulsion Center, 1991.

HAYES, DOUGLAS, G., B.S. (Iowa State University), Ph.D. (University of Michigan). Assistant Professor of Chemical Engineering, 1994.

HEAMAN, DORIS, R.N. (Deaconess Hospital, Missouri School of Nursing), B.S.N. (University of Alabama, Huntsville), M.S.N., D.S.N. (University of Alabama, Birmingham). Associate Professor of Nursing, 1975.

HENZE, REET L., B.S.N. (Gustavus Adolphus College), M.S.N. (University of Colorado), D.S.N. (University of Alabama, Birmingham). Associate Professor of Nursing, 1973.

HERRIN, DONNA M., B.S.N. (University of the State of New York), M.S.N. (Vanderbilt University). Clinical Assistant Professor of Nursing, 1996.

HILLMAN, LLOYD W., B.S. (University of Arizona), Ph.D. (The Institute of Optics, University of Rochester). Associate Professor of Physics, 1989.

HINKE, THOMAS H., B.S. (University of California, Berkeley), M.B.A. (Oklahoma City University), M.S. (University of California, Los Angeles), Ph.D. (University of Southern California). Associate Professor of Computer Science, 1989.

HO, FAT DUEN, B.S.E.E. (South China Technological Institute, China), B.A. (Chu Hai College, Hong Kong), M.S.E.E., Ph.D. (Southern Illinois University, Carbondale). Professor of Electrical Engineering, 1980.


HOUGH, GARY R., B.S. (Queen’s University, Canada), M.S. (Cornell University), Ph.D. (University of Michigan). Lecturer in Mechanical and Aerospace Engineering, 1995.

HOWELL, KENNETH B., B.S. (Rose-Hulman Institute of Technology), M.A., Ph.D. (Indiana University). Associate Professor of Mathematical Sciences, 1981.

HUANG, WENZHANG, B.A. (Fu Yang Teachers College), M.S. (Anhui University), Ph.D. (Claremont Graduate School). Assistant Professor of Mathematical Sciences, 1994.

HUNG, RU J., B.S. (National Taiwan University), M.S. (University of Osaka), Ph.D. (University of Michigan), P.E. Professor of Mechanical Engineering, 1972.

JAMES, ROBERT E., B.S. (Carnegie Institute of Technology), M.A. (Hollins College), Ph.D. (University of Tennessee). Associate Professor of Psychology and Communication Arts and Acting Chair of Communication Arts, 1971.

JAMSHIDI, HOSSEIN, B.S. (North Carolina State University), M.S. (North Carolina A&T State University), M.S. (Clemson), Ph.D. (University of Alabama, Huntsville). Lecturer in Industrial and Systems Engineering, 1990.*
JANIK, TADEUSZ J., B.Sc., M.Sc., Ph.D. (Technical University of Warsaw, Poland). Assistant Professor of Mathematical Sciences, 1992.

JAREM, JOHN M., B.S., M.S., Ph.D. (Drexel University), Professor of Electrical and Computer Engineering, 1987.

JEDLOVEC, GARY J., B.S., M.S. (St. Louis University), Ph.D. University of Wisconsin, Madison). Adjunct Associate Professor of Atmospheric Science, 1991.

JOHANNES, JAMES D., B.S. (Arizona State University), M.S. (University of Alabama, Huntsville), Ph.D. (Vanderbilt University). Dean of Graduate Studies and Professor of Computer Science, 1974.

JOHNSON, ADRIEL D., A.B. (Washington University in St. Louis), M.S. (Tennessee Technological University), M.S. (University of Alabama in Huntsville), Ph.D (North Carolina State University). Associate Professor of Biological Sciences and Campus Director, Alabama Alliance for Minority Participation, 1989.

JOHNSON, CARROLL D., B.S., M.S. (University of Tennessee), Ph.D. (Purdue University). Distinguished Professor of Electrical Engineering, 1963.


KATSINIS, CONSTANTINE, B.S. (National Technical University of Athens, Greece), M.S., Ph.D. (University of Rhode Island). Associate Professor of Electrical Engineering, 1985.


KHAZANOV, GEORGE V., M.Sc., Ph.D. (Irkutsk State University). Adjunct Professor of Mathematical Sciences, 1996.*

KIRKPATRICK, SUE W., B.Sc., M.Sc., Ph.D. (Ohio State University). Dean, College of Liberal Arts, and Professor of Psychology, 1972.

KNUPP, KEVIN R., B.S. (Iowa State University), M.S., Ph.D. (Colorado State University). Associate Professor of Atmospheric Science, 1991.


KUNIN, BORIS I., B.S., M.S. (Leningrad University, USSR), M.S. (Yale University), Ph.D. (University of Illinois, Chicago). Assistant Professor of Mathematical Sciences, 1992.

LAJ, VINCENT S., B.S.S. (Chinese University of Hong Kong), M.B.A. (Ohio University), Ph.D. (University of Texas, Arlington). Assistant Professor of Management Information Systems, 1993.
LANDRUM, BRIAN D. B.S., M.S. (Texas A&M University), Ph.D. (North Carolina State University). Assistant Professor of Mechanical and Aerospace Engineering, 1992.

LAPENTA, WILLIAM M., B.S. (State University of New York, Oneonta), Ph.D. (Pennsylvania State University). Adjunct Assistant Professor of Atmospheric Science, 1993.

LAWLER, PATRICK B., B.S.I.E. (Mississippi State University), M.S.E. (Texas A&M University), P.E. Adjunct Assistant Professor of Industrial and Systems Engineering, 1974.

LAWTON, MARCY, B.A. (Chatham College), Ph.D. (University of Chicago). Adjunct Assistant Professor of Biological Sciences, 1989.

LAWTON, ROBERT O., B.S. (Duke University), Ph.D. (University of Chicago). Professor of Biological Sciences, 1980.

LEONARD, KATHLEEN M., B.S., M.S. (University of Wisconsin), Ph.D. (University of Alabama, Huntsville). Assistant Professor of Civil Engineering, 1991.

LESLIE, THOMAS M., B.S. (Rider College), Ph.D. (University of Notre Dame). Associate Professor of Chemistry, 1990.

LETHBRIDGE, DONA J., Diploma (Royal Columbia Hospital School of Nursing, Canada), B.Sc.N. (University of British Columbia), M.A., Ph.D. (New York University). Associate Professor of Psychology, 1992.

LEWIS, MARIAN, B.A. (Georgia State College for Women), M.S. (University of Arizona), Ph.D. (University of Houston). Adjunct Assistant Professor of Biological Sciences, 1993.

LI, JIA, B.S. (Hunan University), M.S. (Huazhong University of Science and Technology), Ph.D. (University of Tennessee). Associate Professor of Mathematical Sciences, 1990.


LOHMEIER, JILL H., B.A. (University of Kansas), M.S., Ph.D. (University of Massachusetts). Assistant Professor of Psychology, 1995.


LORSBACH, ANTHONY W., B.A., M.S. (University of Missouri, St. Louis), Ph.D. (Florida State University). Assistant Director, Institute for Science Education and Assistant Professor of Education, 1993.


LUMPKIN, RICHARD S., B.S. (University of Texas, Austin), Ph.D. (University of North Carolina). Associate Professor of Chemistry, 1990.

LUNDQUIST, CHARLES, B.S. (South Dakota State University), Ph.D. (University of Kansas). Lecturer in Management, 1984.

MAC DOUGALL, JOHN J., B.A. (Boston College), B.S. (Georgetown School of Foreign Service), M.S. (Massachusetts State College), M.A., Ph.D. (University of Michigan). Associate Professor of Political Science, 1975.

MADDONCS, P. MERLE, B.S. (State University of New York, Albany), M.S. (University of New Orleans), Ph.D. (University of Florida). Assistant Professor of Accounting, 1993.


MAIER, MARK W., B.S., M.S. (California Institute of Technology), Ph.D. (University of Southern California). Assistant Professor of Electrical and Computer Engineering, 1992.


MC ELROY, ELLEN C. (University of Alabama, Huntsville), M.S.N., D.S.N. (University of Alabama, Birmingham). Assistant Professor of Nursing, 1993.

MC KNIGHT, WILLIAM B. (Purdue University), Ph.D. (Oxford University). Research Professor Emeritus, 1974.

MC MANUS, SAMUEL P., B.S. (The Citadel), M.S., Ph.D. (Clemson University). Provost and Vice President for Academic Affairs and Professor of Chemistry, 1966.

MC NIDER, RICHARD T., B.S. (University of Alabama, Tuscaloosa), M.S. (Florida State University), Ph.D. (University of Virginia). Professor of Mathematical Sciences, Adjunct Professor of Atmospheric and Environmental Science, and Director, Earth System Science Laboratory, 1985.


MEBANE, JOHN S., B.A. (Presbyterian College), M.A., Ph.D. (Emory University). Associate Dean, College of Liberal Arts, and Associate Professor of English, 1984.

MEEHAN, EDWARD J., JR., B.S. (Birmingham Southern College), Ph.D. (University of Alabama, Birmingham). Associate Professor of Chemistry and Adjunct Associate Professor of Biological Sciences, 1978.


MESSIMER, SHERRI L., B.S., M.S. (University of Texas, Arlington), Ph.D. (Texas A & M). Associate Professor of Industrial and Systems Engineering, 1989.

MILLER, JAMES A., B.S. (Gannon University), M.S., Ph.D. (University of Maryland, College Park), Assistant Professor of Physics, 1994.

MILLER, TIMOTHY L., A.B. (Case Western Reserve University), M.S., Ph.D. (University of Arizona). Adjunct Assistant Professor of Mathematical Sciences, 1986.
MODLIN, RICHARD F., B.S., M.S. (University of Wisconsin, Milwaukee), Ph.D. (University of Connecticut). Professor of Biological Sciences, 1976.

MOG, ROBERT ALAN, B.S. (University of Illinois, Urbana), M.S., M.S.E., Ph.D. (University of Alabama, Huntsville). Adjunct Assistant Professor in Industrial and Systems Engineering, 1990.

MOHLERE, DOLORES, B.S., M.S.M. (University of Alabama, Huntsville). Lecturer in Accounting, 1993.

MOORMAN, JO ANN, B.A. (Vanderbilt University), M.A.S. (University of Alabama, Huntsville), Ph.D. (Vanderbilt University). Adjunct Assistant Professor of Political Science, 1989.*

MORALES, CLAUDIO, B.A., (University of Chile), M.S., Ph.D. (University of Iowa). Professor of Mathematical Sciences, 1982.

MORIARITY, DEBRA M., B.S. (Pennsylvania State University), Ph.D. (Temple University School of Medicine). Professor of Biological Sciences and Adjunct Professor of Chemistry, 1984.

MUNSON, WILLIAM F., B.A. (Oberlin College), M.A., Ph.D. (Yale University). Associate Professor of English, 1974.

MUSIELAK, ZDZISLAW E., M.S. M.S. (A. Mickiewicz University, Poland), Ph.D. (University of Gdansk, Poland), Professor of Astronautics, 1989.

NADARAJAH, ARUNAN, B. Tech. (Indian Institute of Technology), M.S., Ph.D. (University of Florida), Associate Professor of Chemical Engineering and Adjunct Assistant Professor of Materials Science, 1990.


NEWCHURCH, MICHAEL J., B.S. (Colorado State University), Ph.D. (Georgia Institute of Technology). Associate Research Professor of Atmospheric Science, 1988.


NORDIN, GREGORY P., B.S. (Brigham Young University), M.S. (University of California, Los Angeles), Ph.D. (University of Southern California). Associate Professor of Electrical and Computer Engineering, 1992.

NORMAN, ROSE L., B.A. (Judson College), M.A. (University of Alabama, Tuscaloosa), Ph.D. (University of Tennessee). Associate Professor of English, 1983.


PACIESAS, WILLIAM S., B.S. (Seton Hall University), M.S., Ph.D. (University of California, San Diego). Research Professor of Physics, 1982.


PEARSON, BONNIE C., R.N. (St. Joseph's Hospital School of Nursing), B.S., M.Ed. (University of Minnesota). Associate Professor of Nursing, 1974.


PETTIS, JOYCE OWENS, B.S. (Winston Salem State University), M.A. (East Carolina University), Ph.D. (University of North Carolina, Chapel Hill). Interim Director, Honors Program and Associate Professor of English, 1994.


POULTOCK, DAVID B., B.S., M.S. (University of Louisville), M.S. (University of Arizona). Associate Research Professor of Electrical and Computer Engineering, 1994.


PORTER, GROVER L., B.S. (University of Tennessee), M.S. (University of North Carolina), Ph.D. (Louisiana State University), C.P.A. Professor of Accounting, 1985.


RAINES, C. FAY, B.S.N., M.S.N. (University of Virginia), Ph.D. (University of Maryland). Dean of the College of Nursing and Professor of Nursing, 1991.

RANGANATH, HEGGERE S., B.S.E. (Bangalore University, India), M.S. (University of Louisville), M.S.E. (Birla Institute of Technology and Science), Ph.D. (Auburn University). Associate Professor of Computer Science, 1982.


REEVES, ANDRÉE, A.B. (University of North Carolina), M.A., Ph.D. (Rice University). Assistant Professor of Political Science, 1992.

REYNOLDS, NATHANIEL D., B.A. (University of Kansas), M.S. (University of Wisconsin), Ph.D. (Florida State University). Adjunct Assistant Professor of Atmospheric Science, 1993.
RICHARDS, PHILIP G., Trained Secondary Teachers Certificate (Melbourne Secondary Teachers College), B.S., Ph.D. (La Trobe University). Professor of Computer Science, 1986.

RILEY, CLYDE, B.S. (University of Rochester), Ph.D. (Florida State University). Chair and Professor of Chemistry, Campus Program Director of Materials Science, 1967.


ROGERS, JON G., A.B. (Kansas State Teachers College), M.A. (University of Arkansas), Ph.D. (University of New Mexico). Professor of Psychology, 1968.


ROSENBERGER, FRANZ E., B.S., Diploma (University of Stuttgart, Germany), Ph.D. (University of Utah). Professor of Physics and Director, Center for Microgravity Research, 1986.

ROSS, SUZANNE E., B.S., M.S., Ph.D. (University of Alabama, Birmingham). Assistant Professor of Biological Sciences, 1992.

ROUTNREE, J. CLARKE III, B.A. (University of Alabama, Huntsville), M.A., Ph.D. (University of Iowa). Associate Professor of Communication Arts, 1993.


RUSSELL, LYNN D., B.S., M.S. (Mississippi State University), Ph.D. (Rice University). Dean, College of Engineering, and Professor of Mechanical Engineering, 1987.

SAFIE, FAYSSAL, B.S. (Ohio University), M.S., Ph.D. (Cleveland State University). Adjunct Associate Professor of Industrial and Systems Engineering, 1986.

SCHENKER, DANIEL, B.A. (Brandeis University), M.A., Ph.D. (Johns Hopkins University). Chair and Associate Professor of English, 1984.


SCHOENING, NILES C., B.A. (Columbia University), M.C.P. (Ohio State University), Ph.D. (University of Tennessee). Professor of Economics, 1983.

SCHONBERG, WILLIAM P., B.S.E. (Princeton University), M.S., Ph.D. (Northwestern University), P.E. Chair and Professor of Civil Engineering, 1986.

SCHROER, BERNARD J., B.S. (Western Michigan University), M.S. (University of Alabama, Tuscaloosa), Ph.D. (Oklahoma State University) P.E. Associate Vice President for Research and Professor of Industrial and Systems Engineering, 1985.

SCHUMANN, J. PAUL, B.A., M.A. (University of Mississippi), Ph.D. (University of Oklahoma). Adjunct Assistant Professor of Political Science, 1981.

SETZER, WILLIAM N., B.S. (Harvey Mudd College), Ph.D. (University of Arizona, Tucson). Associate Professor of Chemistry and Adjunct Associate Professor of Biological Sciences, 1985.

SEVERN, JOHN K., B.A. (University of Minnesota), M.A., Ph.D. (Florida State University). Associate Professor of History, 1991.
SHEA, DANIEL, B.S., B.S.E., M.S. (University of Alabama, Huntsville). Lecturer in Civil and Environmental Engineering, 1995.*

SHEN, DASHEN, B.S. (Shanghai University), M.S., Ph.D. (Princeton University). Associate Professor of Electrical and Computer Engineering, 1991.

SHERMAN, J. DANIEL, B.S. (University of Iowa), M.A. (Yale University), Ph.D. (University of Alabama, Tuscaloosa). Chair of Management and Marketing and Professor of Management, 1981.


SHIVA, SAJJAN G., B.E. (Bangalore University, India), M.S.E.E., Ph.D. (Auburn University). Professor of Computer Science, 1978.

SHTESSEL, YURI B., M.S.E.E., Ph.D. (Chelyabinsk Polytechnical Institute, Russia). Associate Professor of Electrical and Computer Engineering, 1993.

SIEGRIST, KYLE T., B.S., M.S., Ph.D. (Georgia Institute of Technology). Associate Professor of Mathematical Sciences, 1980.

SIMPSON, JAMES T., B.S., M.B.A. (University of Southern Mississippi), Ph.D. (University of Alabama, Tuscaloosa). Associate Professor of Marketing, 1990.


SITARAMAN, BHAVANI, B.A. (Stella Maris College), M.A. (Ohio University), Ph.D. (University of Massachusetts, Amherst). Assistant Professor of Sociology, 1993.

SLATER, PETER J., B.S. (Iona College), M.S., Ph.D. (University of Iowa). Professor of Mathematical Sciences, 1981.

SMALLEY, LARRY L., B.S., M.S., Ph.D. (University of Nebraska). Professor of Physics, 1967.

SMITH, JAMES E. JR., B.S.E., Ph.D. (University of South Carolina). Chair and Professor of Chemical Engineering, 1982.

SOUDER, WILLIAM E., B.S. (Purdue University), M.B.A., Ph.D. (St. Louis University), Eminent Scholar in Management, Professor of Management Science and Professor of Engineering, 1990.

SPITZ, ALLAN, B.A. (University of New Mexico), M.A., Ph.D. (Michigan State University). Chair and Professor of Political Science, 1985.


SUNG, CHI-CHING, B.A. (National Taiwan University), Ph.D. (University of California, Berkeley). Professor of Physics, 1972.

SWAIN, JAMES J., B.A., B.S., M.S. (University of Notre Dame), Ph.D. (Purdue University). Associate Professor of Industrial and Systems Engineering, 1992.

TAKAHASHI, YOSHIYUKI, B.S. (Saitama University, Japan), M.S. (Kanazawa University, Japan), Ph.D. (Osaka University, Japan). Research Professor of Physics, 1986.

TANNER, ELIZABETH K.W., B.S., M.S. (University of Maryland, Baltimore), Ph.D. (University of Maryland, College Park). Assistant Professor of Nursing, 1993.

THOMAS, LAWRENCE DALE, B.S.E. (University of Alabama, Huntsville), M.S.E. (North Carolina State University), Ph.D. (University of Alabama, Huntsville), P.E. Adjunct Assistant Professor of Industrial and Systems Engineering, 1984.


TORRES, AURORA, B.S. (University of Oklahoma), M.S., Ph.D. (University of Oklahoma Health Sciences Center). Assistant Professor of Psychology and Lecturer in Biological Sciences, 1995.*

TRUEBLOOD, ROBERT P., B.S. (Auburn University), M.S. (University of Tennessee), Ph.D. (Virginia Polytechnic Institute & State University), Associate Professor of Management Information Systems, 1991.

TSENG, FAN-TSONG, B.S. (National Chiao Tung University), M.S., Ph.D. (University of Texas, Dallas). Associate Professor of Management Science, 1984.

UTLEY, DAWN R., B.S. (Tennessee Technological University), M.S. (University of Tennessee), Ph.D. (University of Alabama, Huntsville). P.E., Assistant Professor of Industrial and Systems Engineering, 1992.


VAN PARADIJS, JOHANNES A., Ph.D. (University of Amsterdam). Pei-Ling Chan Chair in Physics and Professor of Physics, 1994.

VIKRAM, CHANDRA S., B.Sc. (Agra University, India), M.Tech. (Kampur Institute, India), M.Sc., Ph.D. (Indian Institute of Technology, Delhi, India). Research Professor of Optical Science and Engineering, 1989.

WALKER, JACK R., B.S. (Mississippi State University), M.S. (Georgia Institute of Technology), Ph.D. (Oklahoma State University), P.E. Associate Professor of Industrial and Systems Engineering, 1982.

WALLACE, DONALD B., B.S., M.S., Ph.D. (University of Wisconsin) P.E. Professor of Mechanical Engineering, 1974.

WAMPLER, BRUCE M., B.S. (Louisiana Technological University), M.B.A. (University of Texas, Austin), D.B.A. (Louisiana Technological University). Assistant Professor of Accounting, 1994.

WANG, HUI, B.S., M.S. (Bucharest Polytechnic Institute), M.S. (University of Minnesota), Ph.D. (University of California, Santa Barbara). Assistant Professor of Computer Science, 1992.

WEIMER, JEFFERY J., B.S. (Pennsylvania State University), Ph.D. (Massachusetts Institute of Technology). Associate Professor of Chemistry and Chemical Engineering, 1990.

WEISSKOPF, MARY E., B.A. (Vanderbilt University), M.S., Ph.D. (University of Alabama, Huntsville). Assistant Professor of Computer Science, 1983.


WELSTEA, STEPHEN T., B.S. (University of Notre Dame), M.S. (State University of New York, Stonybrook), Ph.D. (Purdue University). Adjunct Assistant Professor of Mathematical Sciences, 1987.

WENDT, RICHARD L., B.S. (Florida State University), M.S., Ph.D. (University of Houston), Lecturer in Electrical and Computer Engineering, 1993.

WESSLING, FRANCIS C., B.S. (Washington University), M.S. (University of New Mexico), Ph.D. (University of Minnesota). Professor of Mechanical Engineering, 1988.

WESTBROOK, JERRY D., B.E. (Vanderbilt University), M.S. (University of Tennessee), Ph.D. (Virginia Polytechnic Institute and State University). P.E., Professor, Director of Engineering Management Programs and Interim Chair of Industrial and Systems Engineering, 1991.


WILLIAMS, LEE E., II, B.A. (Knoxville College), M.A. (East Tennessee State University), Ph.D. (Mississippi State University). Professor of History and Director of Multicultural Affairs, 1972.


WILLIAMSEN, JOEL, B.S. (University of Nebraska), M.S.E., Ph.D. (University of Alabama, Huntsville). Lecturer in Industrial and Systems Engineering, 1994.

WILLIAMSON, JOAN, R.N. (Birmingham Baptist Hospital), B.S.N. (University of Alabama, University), M.S.N., D.S.N. (University of Alabama, Birmingham). Associate Professor of Nursing, 1973.


WOODWARD, WILLIAM B., JR., B.A. (University of North Alabama), J.D. (Cumberland School of Law at Samford University), LL.M. (New York University). Assistant Professor of Business Legal Studies, 1989.


WU, SHI TSAN, B.S. (National Taiwan University), M.S. (Illinois Institute of Technology), Ph.D. (University of Colorado). Distinguished Professor of Mechanical Engineering, Adjunct Professor of Chemical and Materials Engineering, and Director of Center for Space Plasma and Aeronomic Research, 1967.
WYSKIDA, RICHARD M., B.S.E.E. (Tri-State College), M.S.I.E. (University of Alabama Tuscaloosa), Ph.D. (Oklahoma State University) P.E. Professor of Industrial and Systems Engineering, 1968.

YOUNG, RONALD B., B.S. (University of Tennessee), Ph.D. (Iowa State University) Professor of Biological Sciences, 1981.

ZEHRT, WILLIAM, B.S.E., M.S.E. (University of Illinois, Urbana-Champaign), P.E. Lecturer in Civil and Environmental Engineering, 1994.

ZHANG, GUO-HUI, B.S. (Northeast Normal University, P.R. China), M.S., Ph.D. (Southern Illinois University, Carbondale), Assistant Professor of Mathematical Sciences, 1993.
## Index

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Appeals Process</td>
<td>35</td>
</tr>
<tr>
<td>Academic Calendar</td>
<td>3</td>
</tr>
<tr>
<td>Academic Honesty</td>
<td>35</td>
</tr>
<tr>
<td>Academic Honor Societies</td>
<td>16</td>
</tr>
<tr>
<td>Academic Information</td>
<td>32</td>
</tr>
<tr>
<td>Academic Probation and Dismissal</td>
<td>43</td>
</tr>
<tr>
<td>Academic Responsibility</td>
<td>34</td>
</tr>
<tr>
<td>Accounting (ACC) Graduate Courses</td>
<td>71</td>
</tr>
<tr>
<td>Accreditation</td>
<td>7</td>
</tr>
<tr>
<td>Activities, Student</td>
<td>14</td>
</tr>
<tr>
<td>Administration, UAH</td>
<td>206</td>
</tr>
<tr>
<td>Administrative Science, College of</td>
<td>61</td>
</tr>
<tr>
<td>Admission Information, Graduate</td>
<td>22</td>
</tr>
<tr>
<td>Admission of International Students</td>
<td>23</td>
</tr>
<tr>
<td>Admission Requirements</td>
<td>23</td>
</tr>
<tr>
<td>Aerospace Engineering</td>
<td>111</td>
</tr>
<tr>
<td>Art Programs and Exhibitions</td>
<td>19</td>
</tr>
<tr>
<td>Assistantships</td>
<td>29</td>
</tr>
<tr>
<td>Athletics, Intercollegiate</td>
<td>20</td>
</tr>
<tr>
<td>Atmospheric Science (ATS) Graduate Courses</td>
<td>158</td>
</tr>
<tr>
<td>Atmospheric Science Program</td>
<td>155</td>
</tr>
<tr>
<td>Attendance, Class</td>
<td>37</td>
</tr>
<tr>
<td>Billing and Payment Procedure</td>
<td>27</td>
</tr>
<tr>
<td>Biological Sciences Department</td>
<td>160</td>
</tr>
<tr>
<td>Biological Sciences (BYS) Graduate Courses</td>
<td>161</td>
</tr>
<tr>
<td>Biological Sciences (BYS) Graduate Courses at AA&amp;MU</td>
<td>164</td>
</tr>
<tr>
<td>Board of Trustees</td>
<td>205</td>
</tr>
<tr>
<td>Bookstore</td>
<td>14</td>
</tr>
<tr>
<td>Business Legal Studies (BLS) Graduate Courses</td>
<td>73</td>
</tr>
<tr>
<td>Calendar</td>
<td>3</td>
</tr>
<tr>
<td>Campus Map</td>
<td>Back Cover</td>
</tr>
<tr>
<td>Career Services</td>
<td>11</td>
</tr>
<tr>
<td>Center for Management of Science &amp; Technology (CMOST)</td>
<td>63</td>
</tr>
<tr>
<td>Center for Management &amp; Economic Research (CMER)</td>
<td>63</td>
</tr>
<tr>
<td>Certificate Programs</td>
<td>43</td>
</tr>
<tr>
<td>Chemical &amp; Materials Engineering, Graduate</td>
<td>84</td>
</tr>
</tbody>
</table>

223
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>English, Technical &amp; Business Writing (EHT) Graduate Courses</td>
<td>135</td>
</tr>
<tr>
<td>Environmental Science (ES) Graduate Courses</td>
<td>183</td>
</tr>
<tr>
<td>Environmental Science Program</td>
<td>183</td>
</tr>
<tr>
<td>Examinations</td>
<td>37</td>
</tr>
<tr>
<td>Executive Education Program</td>
<td>63</td>
</tr>
<tr>
<td>Facilities</td>
<td>7</td>
</tr>
<tr>
<td>Faculty, Graduate</td>
<td>207</td>
</tr>
<tr>
<td>Fifth Year Programs</td>
<td>43</td>
</tr>
<tr>
<td>Finance (FIN) Graduate Courses</td>
<td>73</td>
</tr>
<tr>
<td>Financial Aid</td>
<td>28</td>
</tr>
<tr>
<td>Financial Information</td>
<td>26</td>
</tr>
<tr>
<td>Food Service</td>
<td>14</td>
</tr>
<tr>
<td>Foreign Language Requirement</td>
<td>46</td>
</tr>
<tr>
<td>Grade Change</td>
<td>38</td>
</tr>
<tr>
<td>Grade-Point Average</td>
<td>38</td>
</tr>
<tr>
<td>Grade Reports</td>
<td>38</td>
</tr>
<tr>
<td>Grading System</td>
<td>37</td>
</tr>
<tr>
<td>Graduate Admission Information</td>
<td>22</td>
</tr>
<tr>
<td>Graduate Application Procedure</td>
<td>22</td>
</tr>
<tr>
<td>Graduate Assistantships</td>
<td>29</td>
</tr>
<tr>
<td>Graduate Dean's List</td>
<td>38</td>
</tr>
<tr>
<td>Graduate Degree Programs</td>
<td>41</td>
</tr>
<tr>
<td>Graduate Programs, Cooperative</td>
<td>48, 83</td>
</tr>
<tr>
<td>Graduate Record Examination Fee Waiver</td>
<td>30</td>
</tr>
<tr>
<td>Graduate Studies, School of</td>
<td>40</td>
</tr>
<tr>
<td>Graduation Time Limit</td>
<td>45, 48</td>
</tr>
<tr>
<td>Greeks</td>
<td>16</td>
</tr>
<tr>
<td>History Department</td>
<td>135</td>
</tr>
<tr>
<td>History (HY) Graduate Courses</td>
<td>137</td>
</tr>
<tr>
<td>History of UAH</td>
<td>6</td>
</tr>
<tr>
<td>Housing, University</td>
<td>12</td>
</tr>
<tr>
<td>Identification Cards</td>
<td>14</td>
</tr>
<tr>
<td>Industrial &amp; Systems Engineering Department</td>
<td>104</td>
</tr>
<tr>
<td>Industrial &amp; Systems Engineering (ISE) Graduate Courses</td>
<td>107</td>
</tr>
<tr>
<td>Information Desk</td>
<td>14</td>
</tr>
<tr>
<td>Information, General</td>
<td>6</td>
</tr>
<tr>
<td>Intercollegiate Athletics</td>
<td>20</td>
</tr>
</tbody>
</table>
Ph.D. Degree ........................................ 46
Physics Department .................................. 195
Physics (PH) Graduate Courses .................... 197
Plagiarism ............................................. 35
Political Science Department .......................... 139
Political Science (PSC) Graduate Courses .......... 142
Preschool Learning Center ............................ 13
Probation and Dismissal, Academic .................. 43
Psychology Department ................................ 143
Psychology (PY) Graduate Courses ................. 144
Public Affairs Program ................................ 139
Publications, Student ................................ 21

Refunds .............................................. 28
Registration .......................................... 35
Repeating a Course .................................... 37
Residency Status ...................................... 25

Schedule Adjustments ................................ 35
Scholarships .......................................... 28,31
School of Graduate Studies ........................... 40
Science, College of ................................... 154
Second Master's Degree ................................ 45
Small Business Development Center ................. 63
Social Science (SS) Graduate Courses .............. 120
Statistics (ST) Graduate Courses .................. 194
Student Affairs ....................................... 10
Student Course Load ................................... 35
Student Government Association (SGA) ............ 15
Student Organizations ................................ 16

Testing Service ....................................... 35
Time Limit ............................................ 45,48
Transcripts ............................................ 39
Transfer Credit, Master's Degree .................... 44
Transfer Credit, Ph.D. Degree ......................... 46
Tuition, Graduate ..................................... 26
Tuition, Undergraduate ................................ 26
Tutoring Services ..................................... 10

University Center .................................... 13