2003

2003-2005 Graduate Catalog

University of Alabama in Huntsville

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CONTENTS

CAMPUS MAP ....................................................................................................................... 2
CALENDAR ............................................................................................................................ 4
GENERAL INFORMATION ............................................................................................... 6
STUDENT INFORMATION .............................................................................................. 10
FINANCIAL INFORMATION .............................................................................................. 22
ACADEMIC INFORMATION .......................................................................................... 28
SCHOOL OF GRADUATE STUDIES .............................................................................. 36
  Graduate Programs ................................................................................................. 37
  Graduate Admissions .............................................................................................. 45
  Graduate Assistantships ......................................................................................... 49
  Graduate Degree Requirements ............................................................................ 50
INTERDISCIPLINARY PROGRAMS ............................................................................ 56
COLLEGE OF ADMINISTRATIVE SCIENCE .............................................................. 76
COLLEGE OF ENGINEERING .................................................................................... 102
COLLEGE OF LIBERAL ARTS ....................................................................................... 152
COLLEGE OF NURSING .............................................................................................. 197
COLLEGE OF SCIENCE ................................................................................................. 210
DIVISION OF CONTINUING EDUCATION .................................................................. 266
BOARD OF TRUSTEES ................................................................................................. 270
ADMINISTRATION ........................................................................................................ 271
GRADUATE FACULTY .................................................................................................... 272
INDEX .............................................................................................................................. 295
ACADEMIC CALENDAR 2003-2004
(Prepared December 2002 - All dates tentative and subject to change without prior notice.)

Fall Semester 2003

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 20</td>
<td>Late Registration</td>
</tr>
<tr>
<td>August 22</td>
<td>Faculty Convocation/New Faculty Orientation</td>
</tr>
<tr>
<td>August 25</td>
<td>Classes Begin</td>
</tr>
<tr>
<td>August 30</td>
<td>First Saturday class</td>
</tr>
<tr>
<td>September 1</td>
<td>Labor Day Holiday</td>
</tr>
<tr>
<td>October 2 - 4</td>
<td>Fall Break</td>
</tr>
<tr>
<td>November 26 – 29</td>
<td>Thanksgiving Holidays - No Classes</td>
</tr>
<tr>
<td>December 2</td>
<td>Last Tuesday only class</td>
</tr>
<tr>
<td>December 3</td>
<td>Last MW class</td>
</tr>
<tr>
<td>December 4</td>
<td>Last TR class</td>
</tr>
<tr>
<td>December 5</td>
<td>Last M/W/F class</td>
</tr>
<tr>
<td>December 8</td>
<td>Last Monday only class/final exam</td>
</tr>
<tr>
<td>December 8 - 12</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>December 10</td>
<td>Last Wednesday only class/final exam</td>
</tr>
<tr>
<td>December 13</td>
<td>Last Saturday only class/final exam</td>
</tr>
<tr>
<td>December 18</td>
<td>Last Thursday only class/final exam</td>
</tr>
<tr>
<td>December 24 – 31</td>
<td>Winter break - No Classes</td>
</tr>
</tbody>
</table>

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

Spring Semester 2004

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 1-2</td>
<td>Holidays</td>
</tr>
<tr>
<td>January 7</td>
<td>Late Registration</td>
</tr>
<tr>
<td>January 12</td>
<td>Classes Begin</td>
</tr>
<tr>
<td>January 17</td>
<td>First Saturday class</td>
</tr>
<tr>
<td>January 19</td>
<td>Martin Luther King Jr. Holiday</td>
</tr>
<tr>
<td>March 22-27</td>
<td>Spring Break</td>
</tr>
<tr>
<td>April 13</td>
<td>Honors Day-No Classes</td>
</tr>
<tr>
<td>April 23</td>
<td>Last MWF class</td>
</tr>
<tr>
<td>April 26</td>
<td>Last MW class</td>
</tr>
<tr>
<td>April 27</td>
<td>Last TR class</td>
</tr>
<tr>
<td>April 28</td>
<td>Last Wednesday only class/final exam</td>
</tr>
<tr>
<td>April 29</td>
<td>Study Day/Weather Day</td>
</tr>
<tr>
<td>April 25 - May 5</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>May 1</td>
<td>Last Saturday only class/final exam</td>
</tr>
<tr>
<td>May 3</td>
<td>Last Monday only class/final exam</td>
</tr>
<tr>
<td>May 4</td>
<td>Last Tuesday only class/final exam</td>
</tr>
<tr>
<td>May 16</td>
<td>Commencement</td>
</tr>
</tbody>
</table>

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

Summer 2004

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 21</td>
<td>Registration</td>
</tr>
<tr>
<td>May 24</td>
<td>Classes begin - 10 week</td>
</tr>
<tr>
<td>May 24</td>
<td>Classes begin - 1st 5 week</td>
</tr>
<tr>
<td>May 31</td>
<td>Memorial Day Holiday</td>
</tr>
<tr>
<td>June 22</td>
<td>Last class - 1st 5 week</td>
</tr>
<tr>
<td>June 23</td>
<td>Study Day</td>
</tr>
<tr>
<td>June 24 - 25</td>
<td>Final Examinations - 1st 5 week</td>
</tr>
<tr>
<td>June 28</td>
<td>Classes begin - 2nd 5 week</td>
</tr>
<tr>
<td>July 5</td>
<td>Independence Day Holidays</td>
</tr>
<tr>
<td>July 22</td>
<td>Last TR class - 10 week</td>
</tr>
<tr>
<td>July 26*</td>
<td>Last MW class - 10 week</td>
</tr>
<tr>
<td>July 27</td>
<td>Last class - 2nd 5 week</td>
</tr>
<tr>
<td>July 27</td>
<td>Study Day - 10 week</td>
</tr>
<tr>
<td>July 28</td>
<td>Study Day - 2nd 5 week</td>
</tr>
<tr>
<td>July 28-30</td>
<td>Final Examinations - 10 week</td>
</tr>
<tr>
<td>July 29 - 30</td>
<td>Final Examinations - 2nd 5 week</td>
</tr>
</tbody>
</table>

*Due to Monday holidays in the semester, MW classes must schedule one additional class.
PROPOSED ACADEMIC CALENDAR 2004-2005

(Prepared December 2002 - All dates tentative and subject to change without prior notice.)

Fall Semester 2004

August 23
August 27
August 30
August 28
September 6
October 7 – 9
November 24
November 25 – 27
December 7
December 8
December 9
December 10
December 11 – 16
December 11
December 13
December 16
December 22 – 31

Late Registration
Faculty Convocation/New Faculty Orientation
Classes Begin
First Saturday class
Labor Day Holiday
Fall Break
No Classes
Thanksgiving Holidays - No Classes
Last Tuesday only class/final exam
Last MWF class
Last MW class
Last Wednesday only class/final exam
Last TR class
Study Day/Weather Day
Final Examinations
Last Saturday class/final exam
Last Monday only class/final exam
Last Thursday only class/final exam
Winter break - No Classes

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

Spring Semester 2005

January 5
January 10
January 15
January 17
March 21-26
April 12
April 22
April 25
April 26
April 27
April 27
April 28 - May 4
April 28
April 30
May 2
May 3
May 15

Late Registration
Classes Begin
First Saturday class
Martin Luther King Jr. Holiday
Spring Break
Honors Day-No Classes
Last MWF class
Last MW class
Last TR class
Last Wednesday only class/final exam
Study Day/Weather Day
Final Examinations
Last Thursday only class/final exam
Last Saturday only class/final exam
Last Monday only class/final exam
Last Tuesday only class/final exam
Commencement

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

Summer 2005

May 27
May 30
May 31
June 28
June 29
June 30 - July 1
July 4
July 5
July 28
July 29
August 1**
August 2
August 2
August 3
August 3 – 5
August 4 – 5

Registration
Memorial Day Holiday
Classes Begin - 10 week
Classes begin - 1st 5 week
Last class - 1st 5 week
Study day - 1st 5 week
Final examinations - 1st 5 week
Independence Day Holiday
Classes begin - 2nd 5 week
Last TH class - 10 week
Last MWF class - 10 week
Last MW class - 10 week
Study Day - 10 week
Last class - 2nd 5 week
Study Day 2nd 5 week
Final Examinations - 10 week
Final Examinations - 2nd 5 week

**Note: MW classes short 1 class
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). All programs, both undergraduate and graduate, in the College of
Administrative Science are accredited by the American Assembly of Collegiate Schools of Business (AACSB) - the International Association for Management Education.

Facilities

The 376-acre UAH campus is situated in Cummings Research Park, which is located in northwest Huntsville. The University has 34 major buildings, including the Central Campus Residence Hall, the nine-building Southeast Campus Housing Complex, and the new North Campus Residence Hall that opened Fall Semester 2002-2003, 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, International Education, and the Writing Center.

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, the Propulsion Research Center, and the Office of Environmental Health and Safety.

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

Von Braun Research Hall contains offices for Research Administration, and offices and research laboratories for the Center for Microgravity & Materials Research, and the Center for Automation and Robotics. Additionally, it houses the University’s mainframe computer facility and the Computer & Network Services Department.

The Engineering Building contains classrooms, computer laboratories, and instructional and research laboratories as well as offices for the Dean and some of the engineering departments of the College of Engineering. It also houses the Career Services Office and Cooperative Education.

The Materials Science Building contains offices for Chemistry and Materials Science, 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, classrooms, meeting rooms, and offices for the Center for Applied Optics and the Department of Physics.

The University Center houses the Division of Student Affairs, Office of Admissions and Records, Student Financial Services, Academic Advisement and Information Center, 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 and Art Gallery.

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 Nursing Building is a contemporary triangular structure that houses the College of Nursing. Its four levels contain administration and faculty offices, classrooms, an 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.

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, a gymnasium with a seating capacity of 2800, racquetball courts, and other physical education, recreational, and athletic training facilities.

The Central Receiving and Shipping Building houses the shipping and receiving office and storage facility, and the central mailroom.

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 management 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 Business Services Building houses administrative offices of the Business Services Department including Purchasing Services, Telephone Services, and the Copy Center.

Technology Hall is located across Sparkman Drive and contains offices, classrooms, specially equipped distance learning classrooms, a 119 fixed seating seminar room, computer classrooms and laboratories, and instructional and research laboratories for several of the departments in the College of Engineering as well as the Computer Science Department. It also houses the Center for Space Plasma and Aeronomic Research (CSPAR), the Propulsion Research Center, and the Information Technology & Systems Center.

The National Space Science & Technology Center (NSSTC) is located across Sparkman Drive and contains offices for Atmospheric Science, research laboratories, meeting rooms, and the Global Hydrology Resource Center computer laboratory to support the extensive ongoing research between NASA, UAH, and the Universities Space Research Association. All three have employees housed in the building.

The University Fitness Center provides facilities for student recreation and physical education activities. It contains three basketball courts, weight training area, aerobic area, cardiovascular fitness area, elevated running/walking track, swimming pool, locker rooms, offices, and support areas. The facility serves UAH students and employees as well as the general public through external memberships.

**M. Louis Salmon Library**

The Salmon Library supports the academic and research programs of the University. It has a collection of 325,973 volumes, a selective collection of U.S. Government Documents, materials in microform, and manuscript collections. The library currently subscribes to 1,120 periodicals and provides access to over 250 premium subscription databases, and over 12,000 full-text online journal titles. In addition, the University Archives/Special Collections offer a number of unique collections, including the papers of former Congressman Robert Jones and the personal library of Willy Ley, and the architectural research collection of Harvie P. Jones. For students in the social sciences and humanities, microfiche collections such as the Library of American Civilization are of particular value. For students in the sciences, research at UAH is supported by the Redstone Scientific Information Center 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 is one of the finest technical libraries in the southeast. It is available without charge to UAH faculty members and graduate students. Reciprocal borrowing agreements are also in force with Alabama A&M University, the University of Alabama, the University of Alabama at Birmingham, and Auburn University to allow UAH students free access to those libraries. The library is also a member of several consortia that provide access to 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 a library computer laboratory/classroom, library instruction, and mediated database searching, assist faculty and students in their research. The library Internet web site (http://www.uah.edu/library) provides access to the library catalog, electronic reference and research sources, and information about the library. Guides and handouts detailing individual services of the library are available at the library's reference desk and on the library web site.
STUDENT INFORMATION

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. Student Affairs also coordinates and supports group activities, campus events, and Student Government Association activities and programs. The Division of Student Affairs 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, counseling, and the Wellness Center.

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 824-6203 for information or make application at UC 113.

Mathematics Learning Center
The Mathematics Learning Center has approximately 50 computers equipped with a variety of mathematical software packages including Maple, Mathlab, and various tutorial programs. Located on the second floor of the Salmon Library, the MLC is open approximately 40 hours per week and is staffed by mathematics faculty and graduate assistants. For more information, please call the Mathematical Sciences Department at 824-6470, or visit our website at http://www.math.uah.edu.

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 824-6592.

Counseling Center
Personal counseling is available to all UAH students through the Counseling Center. Assistance is provided in helping students accomplish personal, social and academic goals. Issues may include relationships, self-esteem, time management, test anxiety, family concerns, and stress management. In keeping with accepted professional practice, all counseling is confidential except when such information is required by law. Students may be referred by faculty or staff members or they may contact the Counseling Center directly at 824-6203.

Services for Students with Disabilities
The Student Development Services Office provides professional counselors for students with disabilities.
Services offered to students with disabilities include: classroom accommodations, assistance locating note-takers and readers, ordering textbooks on tape, counseling, auxiliary equipment, assistance during orientation, liaison to UAH faculty, liaison to admissions, housing and financial aid, and community resources.
In addition, the staff provides educational “awareness” programs for students, faculty and staff as well as in-service faculty training on accommodating students with disabilities. At least one month 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 824-6203.

**Multicultural Affairs**

The Office of Multicultural Affairs, a unit of the Office of the Provost and Vice President for Academic Affairs, assists the University in providing an atmosphere that is welcoming, supportive and rewarding for students from diverse cultural backgrounds. 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 (256) 824-6822, or willial@email.uah.edu.

**Wellness Center (Student Health Services)**

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 5:00 p.m. The telephone number is 824-6775.

**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 assist students and graduates discover 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 provides 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 Career and Occupational Preference System. 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. Other assessment tools are available. In addition to career assessment and individual career counseling, the office also offers 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. On campus and off campus part-time employment opportunities are available for currently enrolled students. Gaining work experience while in school can be a big advantage upon graduation. The annual Fall and Spring Career Information Days 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 alumnus who registers with the office establishes a credential file. The file includes 10 resumes and a candidate registration form. Students should register at least 9 months prior to graduation. Participants receive a 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 job listings, and on-campus interviews. Held in conjunction with the Fall and Spring Career Information Days, Interview Days 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, 117 Engineering Building, 824-6612, 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 (CCRH) which opened in the fall of 1991. Second-year residents and students who are at least 21 years of age may apply to our newest residence hall, North Campus Residence Hall (NCRH). Residents who are of at least junior status or 21 years of age may apply to Southeast Campus Housing.

CCRH is a seven-story building that opened in the fall of 1991. This seven-story traditional residence hall located in the center of campus is connected the University Center by an enclosed walkway. The bridge connecting CCRH to the University Center provides all-weather access to the cafeteria, a convenience store, the game room, bookstore and various student activities, offices and meeting rooms.

Both CCRH and NCRH are near the library, the gym and classrooms for liberal arts, nursing, administrative science and natural sciences. Each resident has an air-conditioned, carpeted, private room in a four-person suite and shares a bath with one other suitemate. Suites are furnished with a study table and chairs, small sofa and easy chairs. CCRH has a mini kitchen with a small refrigerator, microwave and sink. NCRH has a mini kitchen with an apartment-size refrigerator, microwave and sink. Each resident has an extra-long twin bed, a wardrobe, a desk, a bookshelf and a three-position chair. Rooms for disabled students are available. Access to the buildings is by electronic card access. Laundry facilities, a recreation room, a student room and mail service are available. NCRH also contains a computer lab.

Southeast Campus Housing consists of a cluster of nine three-story buildings located on John Wright Drive near Madison Hall, next door to the University Fitness Center and most engineering and science classrooms. Both double-occupancy (shared) and single (private) rooms in three-bedroom suites are available in Southeast Campus Housing for students who are at least juniors or at least 21 years of age. In addition, one-bedroom private apartments are available for graduate students or students with spouses and/or 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. 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 and North Campus Residence Hall has a Resident Director and at least one Student Resident Advisor (RA) on each floor. Southeast Campus is staffed with a Resident Director and a team of RAs. 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 installments are due monthly.

Current rates and additional information are all available from the Housing Office, 606-A John Wright Drive (256/824-6108). 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 (256) 837-9553 for information.

Student Identification Cards

The Charger Card is your official identification card, with your picture on the front and account information magnetically encoded on the back. The Charger Card may be used for access to:

- University Fitness Center
- Campus Athletic Events
- Salmon Library (in order to check out books)
- Wellness Center
- Residence Hall
- Computer Labs/Information Services
- Campus Entertainment Events

The Charger Card accounts are similar to a checking account (with a pre-deposit of funds), and can be used to make purchases at participating locations. Opening an account is free; there are no service charges. There are two types of charger card accounts: Charger Dining and Charger Flex.

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 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, Student Financial
Services, Academic Advisement, International Student Services, Charger Central, Student Activities, Student Development Services and the Bursar are also located in the University Center.

**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**

A well lit, spacious lounge, designed as a place to relax and meet friends, is 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. 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 food service for the campus in the University Center Charger Café. The food court has a variety of fare to include sub sandwiches, wraps and sizzling salads, traditional entrees and accompaniments, grilled favorites, pizza, hot wings, salads, a wide variety of beverages, assorted desserts, and Freshens frozen yogurt and smoothies. A spacious dining room with an adjacent patio is available for all guests. Catering is also offered in the University Center as well as other areas of campus. The hours of operation for Charger Café are posted near the entrance.

The student ID card serves as a declining balance card for meals or snacks. Each time the card is used for payment, the amount spent is deducted resulting in a new balance. All first year resident freshmen and second year resident students are required to purchase an academic year food contract in the form of a declining balance card.

**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 maintains a complete listing of clubs and organizations.
Student Government Association (SGA)
The SGA is the supervising organization of student-led and -oriented clubs and organizations on the UAH campus. Students wishing to join or create a club need to contact SGA to determine if a club with their interest is already in place or to obtain help in creating an organization.
The SGA also advocates positive changes in the University system, seeking to continually improve student life by voicing student concerns and suggesting courses of action that will better serve the student body and the University as a whole. The SGA also focuses the leadership efforts of the student body to help create a united, cohesive campus.
The SGA may also be found on the web site at http://sga.uah.edu and is reachable via email at SGA@email.uah.edu.

Association for Campus Entertainment (ACE)
The Association for Campus Entertainment presents student activity programs for UAH through its four activity boards. The purpose of ACE is to provide entertainment and to enhance the cultural, intellectual and social life of students. The activity boards in ACE are as follows:
1. Cabaret
   The ACE Cabaret Series presents various types of live performers to UAH, from comedians to magicians.
2. Film and Video
   The Film series consistently provides a wide variety of quality films, which appeal to the broad spectrum of UAH students.
3. Publicity
   The Publicity and Promotions Director informs potential audiences of all programs that the other ACE Activity Boards are bringing to campus through various media.
4. Special Events
   The Special Events Committee is responsible for planning annual events such as Homecoming, Fallfest, and Springfest, which is the culmination of a year's activities. Springfest is mandatory for students seeking fun! Some events include “Extreme Air,” “Human Foosball,” concerts and comedians, and “Singed Out.” The Director of Student Activities can be reached at 824-2717 or in the UC 100B.

Student Organizations
UAH has more than 130 special-interest organizations and clubs. For a complete listing, see the Director of Student Activities in University Center 100B or call (256) 824-2717.

Greeks
Interfraternity Council (IFC)
IFC serves as the governing body of four fraternities at UAH in order to develop cooperation and coordination of activities among the member fraternities. The four national social fraternities on campus are Alpha Tau Omega, Delta Chi, Pi Kappa Alpha, and Sigma Nu.

Panhellenic Council (NPC)
The Panhellenic Council is the organization which coordinates sorority activities at UAH. The two social sororities available to young women at UAH are Delta Zeta, and Kappa Delta.

National Panhellenic Council (NPHC)
The National Panhellenic Council is the organization that coordinates activities for traditionally African-American fraternities and sororities at UAH. The fraternities include Alpha Phi Alpha and Kappa Alpha Psi. The sororities include Alpha Kappa Alpha and Delta Sigma Theta.
Academic Honor Societies

Alpha Epsilon Delta (Pre-Medical)
The UAH chapter of Alpha Epsilon Delta, the national pre-health professional honor society, was established in the fall of 1978 and chartered in the spring of 1979. Membership 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 must complete at least 10 credit hours in sociology, with an overall GPA of 3.0, must maintain a B average in sociology. Must be in the upper 35% of the class.

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 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 year 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. The Constitution states that only those ranked in the upper one-fifth of the junior class or the upper one-third of the senior class can be considered for membership.

Beta Alpha Psi (Accounting)
The Iota Theta Chapter of Beta Alpha Psi was chartered in 1999. Beta Alpha Psi is the national honor society for students majoring in accounting, finance, or information systems at schools accredited by AACSB International - The Association to Advance Collegiate Schools of Business. The organization especially encourages and recognizes high academic achievement, as well as service to one’s profession and to the public. Members have the opportunity to interact with professionals in the various areas of financial management.

Beta Gamma Sigma (Business or Management)
Membership in Beta Gamma Sigma is the highest recognition a business student anywhere in the world can receive. To be eligible for nomination, a student must be in a program accredited by AACSB International - The Association to Advance Collegiate Schools of Business and rank in the upper seven percent of the junior class, upper ten percent of the senior class, or upper twenty percent of the master’s graduating class. Members are elected to membership. Beta Gamma Sigma encourages and honors high academic achievement and personal excellence in the study and practice of business.

Kappa Delta Pi (Education)
Kappa Delta Pi, an international honor society, is dedicated to scholarship and excellence in education. The society as a community of scholars pledged to worthy ideals recognizes scholarship and excellence in education, promotes the development and dissemination of worthy educational ideas and practices, enhances the continuous growth and leadership of its diverse membership, fosters inquiry and reflection on significant educational issues, and maintains a high degree of professional fellowship. Scholarship criteria for undergraduate students: junior standing, admitted to the Teacher Education Program, and maintain a 3.25 GPA. Kappa Delta Pi was chartered at UAH on November 2, 1997.
Eta Kappa Nu (Electrical Engineering)
The Theta Eta 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.

Omega Chi Epsilon (Chemical Engineering)
Omega Chi Epsilon is the Chemical Engineering Honor Society. OXE recognizes superior service and research of undergraduate and graduate majors in chemical engineering. UAH received its charter April 17, 2001.

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 inter-collegiate interest; and to bring together members of the faculty and student body of the institution on a basis of mutual interest, understanding, and helpfulness.

Order of Omega (Greek)
Membership is open to juniors and seniors of the Greek organizations on campus who have been members at the institution for one full academic year, who rank academically above the all-fraternity or all-sorority average of the system, and are in good standing with their fraternal organization.

Phi Alpha Theta (History)
UAH has a chapter of Phi Alpha Theta, international history honorary society. Membership is by invitation only to history 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 any 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 student who is at least a junior with 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 plans 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. Its purposes 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. Membership is open to those students in 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. Its purposes 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. Membership is open to students with a 3.0 overall grade point average and a 3.0 in psychology having completed 12 hours of psychology courses toward a minor or 15 hours toward 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 five courses in physics are required for membership.

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 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. Its purposes 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 undergraduate nursing students who have completed at least one-half of the professional nursing curriculum, who are in the upper 35 percent of their class and who have a grade point average of 3.0. Graduate students in nursing who have completed at least one-fourth of their required nursing course work and have a grade point average of 3.5 may be invited for membership.

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. Election to membership is open to all undergraduates, graduate students, and faculty in scientific and engineering disciplines who have evidence of notable achievement in research.

Tau Beta Pi (Engineering)
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. Membership is by invitation to those whose class standing is in the top eighth of the junior class or the top fifth of the senior class who have demonstrated 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 Union Grove Gallery and Meeting Hall, 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 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.

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.

UAH Jazz Ensemble
This is a group designed to give the beginning through advanced jazz musician exposure to a variety of jazz literature and styles. Additionally, the members will develop a basic understanding of jazz improvisation, and, if interested, will be encouraged to explore jazz arranging. Attendance at all rehearsals and performances is required. An audition with the instructor is also required.

UAH Wind Ensemble
The Wind Ensemble is 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.
Intercollegiate Athletics

UAH is an NCAA Division II school and a member of the Gulf South Conference. The athletic department sponsors 12 intercollegiate sports providing the student-athlete with the opportunity to complete intercollegiately within a structured sporting environment and enhances personal growth and development in parallel with the goals of the institution. Sports sponsored are ice hockey, basketball, soccer, cross country, and tennis for men, and basketball, softball, volleyball, cross country, and tennis for women.

Baseball (Men)
Baseball was added in the spring of 1996, and has already become a prominent competitor in the GSC and NCAA. Home games are played at Joe Davis Stadium in Huntsville, the home of the Huntsville Stars, the affiliate of the Milwaukee Brewers organization. The Gulf South Conference is nationally known as a premier conference for baseball.

Basketball (Men and Women)
Competition is high in the GSC in basketball, and UAH enjoys exciting competition during their basketball games, which 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 in September.

Ice Hockey (Men)
UAH is the original “Hockey Capital of the South,” building a very strong hockey program with local players as well as skaters from points north. The Chargers have competed in a number of NCAA Championships in the last few years, winning in 1996 and 1998 before capacity home crowds at the Von Braun Center, the site of all home games. Beginning in the year 2000 UAH has competed at the Division I level.

Soccer (Men and Women)
The soccer teams attract players from around the world. Games are played on Charger Field located on campus. UAH has been a soccer leader in the GSC in recent years.

Softball (Women)
As a member of the GSC, competition is always on a quality level. In only their first year of existence in 1996, the UAH softball team competed on the NCAA regional level. Home games are played at the Metro Kiwanis SportPlex.

Tennis (Men and Women)
The Charger tennis programs provide an opportunity for competition in both singles and doubles. Home matches are played at the Charger Tennis Center, located next to Spragins Hall on campus.

Volleyball (Women)
UAH volleyball is a consistent leader in GSC competition. The program annually hosts a quality tournament, which attracts a number of outstanding teams. In 1998 the team was selected to participate in the NCAA Regionals.

Cheerleading and Dance Teams (Men and Women)
The UAH cheerleading squad and Dance Team are composed of students whose primary purpose is to promote spirit and enthusiasm for intercollegiate athletics. Try-outs are conducted for interested students based on availability of participant spots.

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

Student Information 20
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, volleyball, sandpit volleyball, ultimate frisbee, wallyball, and 4 on 4 volleyball.

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: 824-6090. 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 the work to the Exponent office, Room 104, University Center.
FINANCIAL INFORMATION

Residency

“Resident” is defined as one whose residence is in the state of Alabama as shown below. Residents of the following Tennessee counties - Bedford, Coffee, Franklin, Giles, Lawrence, Lincoln, Marion, Marshall, and Moore - are considered as residents for the purposes of this section.

A “resident student” is one who, at the time of registration, is not a minor and:

• is a resident of the state of Alabama or one of the above counties in Tennessee and has been so for at least one year immediately preceding the date of registration; or
• is a full-time (not temporary*) employee of UAH or is the spouse of such an employee; or
• is employed by UAH as a graduate assistant or fellow with at least 0.50 FTE (half-time); or
• has accepted full-time (not temporary*) employment within the state of Alabama or is the spouse of such an employee; or
• is a member or the spouse of a member of the U.S. military on full-time active duty stationed in Alabama under orders for duties other than attending school.

A “resident student” is also one who, at the time of registration, is a minor and whose supporting person:

• is a resident of the state of Alabama and has been a resident of the state for at least one year immediately preceding the date of registration; or
• is a full-time (not temporary*) employee of UAH; or
• has accepted full-time (not temporary*) employment within the state of Alabama; or
• is a member of the U.S. military on full-time active duty stationed in Alabama under orders for duties other than attending school.

*“Not temporary” means the employment is full-time and ongoing, not seasonal or for a specific period of time, nor for the express purpose of financing one’s college education.

“Residence” means the single location at which a person resides with the intent of remaining there indefinitely as evidenced by more substantial connections with that place than with any other place. Individuals claiming resident status under this policy shall certify under penalty for perjury that a specific address or location within the state of Alabama (or the aforementioned counties in Tennessee) is their residence, that they intend to remain there indefinitely, and that they have more substantial connections with the state of Alabama than with any other state. Though certification of address and an intent to remain in the state indefinitely are prerequisites to establishing status as a resident, ultimate determination of that status shall be made by the institution by its evaluation of the presence or absence of connections with the state of Alabama.

All students registering at UAH who do not establish that they are resident students shall pay non-resident tuition, which shall be at least twice the amount of resident tuition. Classification of students as resident or non-resident shall be made at the time of their initial registration and shall continue unchanged through all subsequent registrations at the institution until satisfactory evidence to the contrary is submitted to the Office of Enrollment Services, UC 118, at the time of any subsequent registration.

PLEASE NOTE: If a student came to Alabama from out-of-state primarily for the purpose of receiving an education, that student will - with few exceptions - continue to pay “non-resident” tuition.
### TUITION

#### GRADUATE Tuition

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Each additional hour over 12: $187.00 (resident), $386.00 (non-resident)

#### UNDERGRADUATE Tuition

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Each additional hour over 20: $85.00 (resident), $186.00 (non-resident)

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**Laboratory and Studio Instruction Fees**

Laboratory fees are assessed as applicable and are specified in course descriptions.

**Cooperative Education Fees**

Parallel Work Semester is $40
Alternating Work Semester is $80

**Engineering Equipment Fees**

Equipment fees are assessed at $19 per credit hour.

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.

**International Student Fee**
All international students are assessed a $50 fee for SEVIS services each Fall and Spring semester in which they are enrolled.

**Acceptable Forms Of Payment**
Payment can be made in cash, by check or money order, or can be charged to a VISA, MasterCard, American Express, or Discover charge card. Sponsoring agencies, faculty/staff or University tuition assistance supported by written documentation, or anticipated financial aid verified by Student Financial Services 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, American Express, or Discover by paying on the web or calling (256) 824-7321. Students who do not pay bills in full by the first day of classes are assessed a $50 late fee. Students who do not pay bills in full by the end of the second week of classes for fall and spring semesters may be dropped from class rolls and enrollment will be canceled. For summer sessions, please check dates in the Timetable of Classes.

Send payments to The University of Alabama in Huntsville, Office of the Bursar, 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 the semester. The second payment of the remaining balance is due the end of the sixth week of the semester. There is a $20 non-refundable administration fee that must accompany the deferment agreement form. Deferment agreement forms are available in the Bursar’s Office (UC 214) and Charger Central (UC 118). After completion and authorization, the deferment agreement form should be presented with the first payment to the Bursar’s Office. The deferred payment is only offered for the Fall and Spring semesters and a deferment agreement form must be completed each semester.

**Balances**
Past due balances are a debt owed the State of Alabama and appropriate action will be taken to collect all balances. Holds will be placed on all students’ accounts that have a past due balance. This hold will prevent them from receiving grades, transcripts or registering for another semester at UAH. To the extent permitted by the laws of the State of Alabama, any costs to collect a past due account, to include collection agency charges and attorney fees, will be charged back to the student who shall be liable for payment of those charges.

**Other Charges**
- Credit by examination or validation, per semester hour: $10
- Replacement of I.D. card: $20
- Transcript: $4
- Graduation Application fee (non refundable): $20
- Duplicate Diploma: $10
- Thesis and Dissertation binding
  - Master’s thesis: $55
  - Ph.D. dissertation: $55
- Vehicle registration (Regulations concerning traffic and parking are available at the Campus Safety Office)
  - Summer only: $5

Note: UMI Thesis/Dissertation publication fee: Master’s thesis - $45.00; Ph.D. Dissertation - $55.00.

Financial Information 24
College of Nursing

Liability Insurance (per year) variable
College of Nursing Pin (graduation) $50 - $150
Annual health examinations variable

Refunds

Students may drop a class through the second week of classes and receive a 100% tuition refund. A student desiring to drop one or more classes must complete a drop request form at Charger Central, University Center Room 118. The date of drop request is the date the written request is received at the Office of Student Records.

Housing Charges

Suites (Single Students: Academic Year Contract—Fall & Spring Semesters) $3,200 per year
Private room in 4-person suite, Central Campus Residence Hall (all freshmen and sophomores) $1,800 per year
Shared room in Southeast Campus Housing (available for juniors, seniors, and graduate students) $2,900 per year
Private room in Southeast Campus Housing (available for juniors, seniors, and graduate students) $5,400 (payable in 12 installments of $450)
1-bedroom furnished $4,980 (payable in 12 installments of $415)
1-bedroom unfurnished

Note: All housing rates include basic utilities and basic television cable.

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 Office of the Bursar by the first day of the 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

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 Josephine Cooper Dark Presidential Scholarship

This scholarship was established by Billie B. Bleier, ’91, ’93, and Edwin W. Bleier, ’81, in memory of his mother and her aunt. It provides scholarships annually to both undergraduate and graduate
students enrolled in the College of Administrative Science who require financial assistance and maintain a 3.0 or higher GPA. Preference is given to students whose college careers have been interrupted and who have returned to complete a degree or seek a graduate degree.  

David and Cindi Cassis Branham Scholarship  
Established by UAH alumni David Branham, '76, '78, and Cindi Branham, '82, this scholarship is presented to full-time students enrolled in the College of Administrative Science who meet the criteria of academic merit and financial need.  

Bill Dale Wind Ensemble Scholarship  
Mr. and Mrs. William I. Dale created this scholarship award for students who require financial assistance. To apply for the award, a student must be a member of the UAH Wind Ensemble. Consideration will be given to students who have participated in school and community activities, particularly the Huntsville Symphony Orchestra.  

Thomas James Dimopoulos Memorial Fellowship  
Established in loving memory by his brother, George Dimopoulos and his sister, Sophie Dimopoulos, this fellowship was created to honor Thomas’ dedication to the environment and his concern for the earth. This fellowship is awarded as a graduate research assistantship to full-time graduate students who are enrolled in the Department of Biological Sciences and is based on academic merit.  

Dynetics, Inc. Scholarship  
This scholarship is awarded to a graduate student whose undergraduate degree is in Engineering or Science and whose graduate program is in Electrical Engineering, Optical Science and Engineering or Computer Science. The President of Dynetics, Inc., Dr. Marcus Bendickson, is a UAH alumnus whose support and interest in the University has been so generous.  

Elizabeth M. Fisher Memorial Scholarship  
Dr. B. Jeanne Fisher established this scholarship in memory of her mother. It is awarded to students enrolled in the College of Nursing who require financial assistance.  

Dr. Daniel G. Hays Memorial Scholarship  
Established in memory of Dr. Daniel G. Hays, former associate professor of psychology at UAH, this scholarship is awarded to both graduate and undergraduate students enrolled in the College of Liberal Arts who require financial assistance. Students must have earned a high school diploma or college degree with demonstrated leadership potential, along with participation in community and professional activities, which may include the field of psychology.  

Gerry Higgins Scholarship for Excellence  
This scholarship was established in memory of UAH alumnus Gerry Higgins, '89, and is awarded to students enrolled in the College of Science who are U.S. citizens and residents of Alabama. Based on academic merit, recipients may apply for renewal if they maintain a 3.2 GPA and continue to demonstrate leadership potential.  

Donald D. Zana Memorial Scholarship  
Established in 1998 by family, friends, and co-workers to memorialize Donald Zana, this scholarship is awarded to students with a minimum 2.5 GPA, and is renewable for two years.  

Loans  
UAH participates in the William D. Ford Federal Direct Stafford Loan program. Student loan funds are made available directly from the U.S. Department of Education without the necessity of secondary marketers such as private lending institutions. Although it is sometimes necessary to borrow money to finance an education, caution is advised. Generally, a student should not rely primarily on loans and is advised not to borrow more than half of what is needed to meet expenses. Additional information regarding eligibility amounts, loan limits, application procedures and suggested application timelines is published in the brochure Making College Affordable. This and
other valuable information regarding the financial aid process are available in the Office of Student Financial Services as well as Charger Central.

**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 or part-time students who will graduate within 12 months. 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 Student Financial Services, Room 212, 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.

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

Equal Opportunity and Affirmative Action Policy

The University of Alabama in Huntsville (UAH) is committed to making employment opportunities available to qualified applicants and employees without regard to race, color, religion, sex, natural origin, age, disability, citizenship, or status as a Vietnam-era, special disabled, or other eligible veteran. 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, individuals with a disability, and Vietnam-era, special disabled, and other eligible 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, national origin, disability, citizenship, or veteran status. Its admissions, financial aid, athletics, student services, and other programs are administered in accordance with this policy.

Discrimination, under this policy, shall be understood to include harassment in the form of verbal or physical conduct relating to an individual’s race, color, religion, sex, age, national origin, disability, citizenship, or veteran status. Such harassment must have the purpose or effect of either creating an intimidating, hostile, or offensive working/learning environment for an individual or unreasonably interfering with an individual's performance as an employee or student. Harassment in the form described above which adversely and substantially affects an individual's employment or educational opportunities in other ways is also considered to be unlawful discrimination.

Sexual harassment, in addition and more specifically, includes sexual advances, requests for sexual favors, and other verbal or physical conduct that is unwelcome and is directed toward a person on the basis of that person's sex when any of the following are present: submission to such conduct is made a condition, explicitly or implicitly, of employment or academic advancement; submission to or rejection of such conduct by an employee or student is used as the basis for a significant change in employment or academic status; or such conduct is so severe or pervasive that it interferes with an individual’s performance as an employee or student or creating an intimidating, hostile, or offensive working/learning environment.

In these respects, the University affirms its desire to create a work environment for all employees and a learning environment for all students that is fair, humane, and responsible—an environment which supports and rewards career and educational goals on the basis of such relevant factors as ability and employment or academic performance. A University student or employee who is found, under established University procedures, to have been guilty of discriminatory conduct in violation of these policies will be subject to discipline, up to and including possible dismissal or expulsion, by the University.

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 Americans with Disabilities Act of 1990; the Equal Pay Act of 1963; the Age Discrimination in Employment Act of 1967; the Age Discrimination Act of 1975;
the Vietnam Era Veterans’ Readjustment Assistance Act of 1974; the Immigration Reform and Control Act of 1986; contract and grant agreements with governmental agencies; the Alabama Age Discrimination Act of 1997; 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 insure compliance with the foregoing laws. Inquiries or complaints concerning the application of this policy and these federal requirements should be directed to one of the following persons:

Ms. Delois Smith, Vice President for Student Affairs  
Student Equal Educational Opportunity Officer  
114 University Center  
The University of Alabama in Huntsville  
Huntsville, AL 35899 (256-824-6700)

Dr. Fran Johnson, Associate Provost  
Faculty Equal Employment Coordinator  
111 Madison Hall  
The University of Alabama in Huntsville  
Huntsville, AL 35899 (256-824-6767)

Ms. Phyllis Hollins  
Staff Equal Employment Coordinator  
137 Madison Hall  
The University of Alabama in Huntsville  
Huntsville, AL 35899 (256-824-6545)

Grievances alleging unlawful discrimination will be resolved according to the discrimination grievance procedures set forth in the Student Handbook.

Confidentiality of Student Records

The Family Educational Rights and Privacy Act of 1974 (FERPA) is a federal law that protects the confidentiality of student education records. To implement FERPA, the University has formulated and adopted a written institutional policy governing the handling of these records. Copies of this policy document are available to students in the Office of Admissions and Records, and it should be referred to for a more comprehensive treatment of this subject.

The term “education records” under FERPA includes generally any record, whether in a printed, handwritten, audio, video, or computer media format, maintained by the University and containing information directly related to a student in his/her role as a student. Certain records are, however, excluded by FERPA from this broad definition, such as those made by instructional, supervisory, and administrative personnel and kept in their sole possession, those made by campus police, and those made by a physician or other professional medical personnel in connection with treatment of the student.

Under FERPA and University policy, a student has a right of access to his/her education records and may inspect and review the information contained in them. To exercise this right, the student should present a request to the University office where the record is located, and a response will be made no later than 45 days later. In certain cases, a copy of the record may be provided, with a copying fee, as an alternative to actual inspection. Some records are not within this right of review, such as financial information from the student’s parents and confidential letters or statements of recommendation where the student has waived the right of access.

A student who believes his/her education records contain information that is inaccurate, misleading, or in violation of his/her privacy rights may bring the matter to the attention of the appropriate records official. If by informal discussion with this official the student does not obtain the corrective action desired, the student will then be entitled to a hearing at which he/she may challenge the objectionable item. Additional information about hearing procedures will be given to the student at that time. The decision of the hearing official or panel shall be final. If the decision is adverse to the student, he/she may insert in the education record an explanatory statement about the disputed item.
A student's privacy interest in the education record is further protected by the rule against unauthorized disclosure. Generally, the University may not, without the student’s consent, release the education record or personally identifiable information in it to other individuals or entities.

Disclosure in certain circumstances, however, is specifically excepted by FERPA from the foregoing rule: These circumstances include disclosure to certain parties—University personnel who have a legitimate educational interest in the information, officials of institutions where the student is seeking to enroll, parties to which the student is applying for financial aid, the parent of a dependent student, etc.; disclosure to comply with a judicial order or lawfully issued subpoena; or disclosure in connection with a health or safety emergency. Under the first exception, “University personnel” includes any UAH employee, and a “legitimate educational interest” means that the employee has a need for access to the record to perform appropriate tasks clearly within the area of responsibility of the employee, to perform a task related to the education or discipline of the student, or to provide a benefit or service relating to the student. Personally identifiable information will be transmitted by the University under these exceptions only upon the condition that the recipient not permit any other party to have access to it without the student’s consent.

The University may also release what is called “directory information” without obtaining the student’s consent. Directory information is limited to the following: the student’s name, address (local and permanent), telephone number, e-mail address, date and place of birth, enrollment status (full-time or part-time), class schedule/class roster, major field of study, participation in officially recognized activities and sports, weight and height statistics of athletic team members, dates of attendance, degrees and awards/honors received, the previous educational institution most recently attended, and a photograph of the student. However, a student may prevent the release of even this information, if he/she wishes, by so indicating on a form provided for this purpose. A request for nondisclosure of directory information remains in effect until the student submits a new disclosure form allowing release of this information.

Any student who believes that his/her rights under FERPA have been violated by the University may notify and request assistance from the Provost and Vice President for Academic Affairs. The student may also file a complaint with the Family Policy Compliance Office, U.S. Department of Education, 400 Maryland Avenue SW, Washington, DC 20202-4605.

**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” or “Application for Graduate Certificate,” as appropriate, through their department to the School of Graduate Studies at least 3 months before the expected date of completion of requirements;
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 college dean, and the Office of the Provost, in that order.

General Academic Information

A student (other than a senior taking graduate courses with appropriate authorization; see "Seniors Taking Graduate Courses" on page 49) must be admitted to the School of Graduate Studies to receive graduate credit for courses taken or to take courses at the 600-level or above.

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 chair 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. All students pursuing a doctoral degree and who have completed the minimum coursework requirements for that degree must register for a minimum 3 semester hours of graduate credit (to include dissertation credit) each fall and spring semester until all degree requirements are complete. Thesis and dissertation supervision courses are graded on satisfactory/unsatisfactory basis.

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 four weeks of classes. For students whose tuition is paid by the University through graduate assistantships or tuition scholarships, changing a course from credit to audit will require the student to reimburse the University for that course's tuition.
Removal of Course from Schedule

1. In the case of a cancelled class, submission of a change-of-course form by the student helps to correct the record.
2. In the case of a drop before class begins, a change-of-course form must be submitted before the first day of the 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.

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.

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.

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.
Course Numbering System

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<td>Refresher (noncredit)</td>
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<td>300-399</td>
<td>Junior (upper level)</td>
</tr>
<tr>
<td>400-499</td>
<td>Senior (upper level)</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>
</tr>
<tr>
<td>600-799</td>
<td>Graduate (postgraduate and senior undergraduate students with authorization - see “Seniors Taking Graduate Courses” on page 49).</td>
</tr>
</tbody>
</table>

Grading System

The University of Alabama in Huntsville’s School of Graduate Studies grading system includes grades of A, B, C, D, F, I, X, W, S, U, AU, and N. To be successful in graduate school, a student must achieve at the “B” or better 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**: Average achievement. Three quality points given per semester hour.
- **C**: Below average achievement. Two quality points given per semester hour.
- **D**: Unacceptable work. One quality point given per semester hour. Cannot be counted toward a graduate degree or certificate.
- **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.
- **S**: Satisfactory work. Applicable to specified credit courses, and all thesis and dissertation work, and will not be counted in the GPA.
- **U**: Unsatisfactory work. Applicable to specified credit courses.
- **W**: Withdrawal. Recorded by the Office of Student Records when a student withdraws. (Non attendance does not constitute withdrawal; see “Withdrawal Policy” on page 34)
- **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.

Student Grade Report

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

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

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.

Withdrawal Policy
Through the tenth week of the fall or spring semester, a student may withdraw from any course. After the tenth week, a student may withdraw from a course only under extenuating circumstances with appropriate documentation and 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.

For students whose tuition is paid by the University through graduate assistantships or tuition scholarships, withdrawal from any course or courses that results in a course load below the level specified in their contract for that semester will require the student to reimburse the University for the tuition and fees for the course(s). 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.

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.

Retroactive Withdrawal Policy
Graduate students may at times experience extraordinary problems during an academic semester. Within two years of having completed such a semester, a student may petition the Dean of the School of Graduate Studies to withdraw retroactively from ALL classes taken during that semester. A retroactive withdrawal is granted only under exceptional circumstances, such as extraordinary medical or personal problems. The petition should include clear and documented evidence whenever possible. If a retroactive withdrawal is granted by the Dean of the School of Graduate Studies, the grades for all courses taken during the semester in question will be changed to W’s. If a retroactive withdrawal request is denied, the student may appeal to the Graduate Council.

Academic Information 34
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.

Course Repeat Policy

Students should be aware that course repeats, for any reason, may not be looked upon favorably by some employers and by professional schools; hence, they should avoid the need for repeats. Students may repeat any course an unlimited number of times in order to achieve a passing grade or an improved understanding of the course material.

A maximum of two course repeats may be excluded from the calculation of the student's grade-point average. The student must declare such course repeats before the end of the regular registration period for the semester in which the course will be repeated. Only courses for which the student has received a grade of C, D, or F may be repeated under this option. When withdrawing from a course that has been declared as a course repeat, the previous grade will still be used in the computation of the GPA, and the course will not count toward the maximum of two repeats. Each course repeat counts against the maximum of two such repeats under this option. Students may use both repeats in a single course or in two separate courses. Until a grade other than W is reported, the previous grade will be used for the GPA. The transcript will show both the original grades and the course repeat grades, but only the grade points and credit hours earned in the repeated courses will count toward graduation and will be averaged into the student's GPA. Concurrent registration for multiple sections of a course is not allowed.

For all other courses repeated at UAH, both the original grade and the course repeat grade will show on the transcript and will be calculated in the student's GPA.

A student wishing to exercise the option of repeating a course must file the intent to do so in the Office of Student Records before the end of regular registration.
SCHOOL OF GRADUATE STUDIES

Dean: A. Gordon Emslie, B.Sc., M.S., M.S.E., Ph.D., D.Sc., Professor of Physics

C206 Materials Science Building
Telephone: (256) 824-6002 / FAX 824-6405
Email: deangrad@uah.edu
Web Site: http://www.uah.edu/HTML/Academics/Grad

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. The student should plan this program of study 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.

Quick reference index:
- Graduate Programs
- Collaborative Programs
- Graduate Admissions
- Graduate Assistantships
- Graduate Degree Requirements
- Master’s Degree
- Doctor of Philosophy Degree
- Interdisciplinary Programs

Page 37
Page 44
Page 45
Page 49
Page 50
Page 51
Page 53
Page 56

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 PROGRAMS

Degree Programs

Master’s Level Programs

College of Administrative Science

Accounting

Management of Technology

*Areas of Specialization:*
  - Human Resource Management
  - Marketing
  - Management Information Systems (MIS)

Management Information Systems (MIS)

College of Engineering

Engineering - General Options:

Aerospace Engineering

*Areas of Specialization:*
  - Aerodynamics
  - Aircraft Stability and Control
  - Aircraft Structures
  - Acoustics
  - Combustion
  - Propulsion
  - Space Environment
  - Space Power
  - Space Structures

Chemical Engineering #*

*Areas of Specialization:*
  - Bioengineering
  - Biological Thin Films
  - Bioprocessing
  - Computational Fluid Dynamics
  - Fluid Mechanics
  - Surface Spectroscopy

Civil Engineering

*Areas of Specialization:*
  - Cementitious Composites
  - Environmental Engineering
  - Geographical Information Systems
  - Hypervelocity Impact Studies
  - Transportation

Degrees

- M.Acc.
- M.S.M.
- M.S.M.I.S.
- M.S.E.
Computer Engineering

*Areas of Specialization:*
- Computer Architecture and Performance Analysis
- Hardware, Software, and Co-Design
- Networks and Security
- Parallel Processing
- Real-time, Embedded and Ubiquitous Systems
- Software Engineering
- VLSI Design

Electrical Engineering +*

*Areas of Specialization:*
- Communications/Radar
- Control Theory
- Digital Signal Processing
- Electromagnetics
- Electronics
- Laser Systems
- Nano-electronic/MEMS Devices
- Opto-electronics
- VLSI Electronics

Industrial and Systems Engineering

*Areas of Specialization:*
- Engineering Management
- Manufacturing Systems Engineering
- Operations Research
- Quality Assurance Engineering
- Systems Engineering
- Systems Simulation

Mechanical Engineering

*Areas of Specialization:*
- Acoustics
- Applied Optics
- Combustion
- Computational Fluid Mechanics
- Computational Solid Mechanics
- Composite Materials and Structures
- Controls
- Engineering Mechanics
- Experimental Methods
- Fluid and Thermal Sciences
- Solids and Structures

Operations Research

M.S.O.R.

College of Liberal Arts

English

*Areas of Specialization:*
- American Literature
- English Literature
- Reading Specialist

M.A.
Teaching of English to Speakers of Other Languages
Technical Writing

History
Areas of Specialization:
American History
European History

Psychology
Areas of Specialization:
Applied Psychology (Human Factors)
Biopsychology
Cognitive Psychology
Developmental Psychology
Social/Personality Psychology

Public Affairs

College of Nursing
Tracks:
Acute Care Nurse Practitioner
Adult Health Clinical Nurse Specialist
Family Nurse Practitioner
Nursing Administration

College of Science

Atmospheric Science
Areas of Specialization:
Air Pollution Meteorology
Atmospheric Chemistry
Climate Diagnostics
Geographical Information Systems
Mesoscale Modeling
Radiation and Remote Sensing
Satellite Meteorology

Biological Sciences #
Areas of Specialization:
Bioinformatics and Genomics
Cell and Developmental Biology
Environmental Biology
Genetics and Molecular Biology
Microbiology
Physiology
Plant Biotechnology
Plant Pathology

Chemistry #+
Areas of Specialization:
Biopolymers
Critical Phenomena
Inorganic Materials
Materials Processing
Natural Products/Drugs
NMR
Organic Structure and Mechanisms
Protein Crystal Growth and Structure
Surface Coatings
Surface Science

Computer Science

Areas of Specialization:
Artificial Intelligence
Computer Architecture
Data and Information Systems
Image Processing and Vision Systems
Languages and Software Systems
Software Engineering
Theoretical Computer Science

Mathematics

Areas of Specialization:
Applied Mathematics
Combinatorics and Graph Theory
Dynamical Systems
Fourier Analysis
Linear Algebra and Matrix Theory
Numerical Analysis
Ordinary and Partial Differential Equations
Probability and Statistics
Ordinary and Partial Differential Equations
Probability and Statistics

Physics

Areas of Specialization:
Astrophysics
Materials
Optics
Quantum Electronics
Solar Physics
Space Science

Doctoral Level Programs

College of Engineering

Civil Engineering (joint with UAB)

Areas of Specialization:
Environmental Engineering
Experimental Mechanics
Geotechnical Engineering
Hazardous Waste Management
Hydraulic Engineering

Degrees

Ph.D.
Intelligent Transportation Systems
Natural Hazard Mitigation
Structural Dynamics
Structural Engineering
Water Resources Engineering
Water Quality Control

Computer Engineering (shared with UAB)
Areas of Specialization:
- Computer Architecture and Performance Analysis
- Hardware, Software, and Co-Design
- Networks and Security
- Parallel Processing
- Real-time, Embedded and Ubiquitous Systems
- Software Engineering
- VLSI Design

Electrical Engineering +*
Areas of Specialization:
- Communications/Radar
- Control Theory
- Digital Signal Processing
- Electromagnetics
- Electronics
- Laser Systems
- Nano-electronic/MEMS Devices
- Opto-electronics
- VLSI Electronics

Industrial and Systems Engineering
Areas of Specialization:
- Engineering Management
- Manufacturing Systems Engineering
- Operations Research
- Quality Assurance Engineering
- Systems Engineering
- Systems Simulation

Mechanical Engineering +
Areas of Specialization:
- Computational Fluid Mechanics
- Computational Methods in Mechanics
- Experimental Methods
- Fluid and Thermal Sciences
- Optics and Photonics Technology
- Solids and Structures

College of Science

Applied Mathematics
Areas of Specialization:
- Applied Mathematics
- Combinatorics and Graph Theory

Ph.D.

School of Graduate Studies
Dynamical Systems
Fourier Analysis
Linear Algebra and Matrix Theory
Numerical Analysis
Ordinary and Partial Differential Equations
Probability and Statistics

Atmospheric Science
Areas of Specialization
Air Pollution Meteorology
Atmospheric Chemistry
Climate Diagnostics
Geographical Information Systems
Mesoscale Modeling
Radiation and Remote Sensing
Satellite Meteorology

Computer Science
Areas of Specialization:
Artificial Intelligence
Computer Architecture
Data and Information Systems
Image Processing and Vision Systems
Languages and Software Systems
Software Engineering
Theoretical Computer Science

Physics+*
Areas of Specialization:
Astrophysics
Materials
Optics
Quantum Electronics
Solar Physics
Space Science

Interdisciplinary Programs

Biotechnology Science & Engineering
Areas of Specialization
Biomolecular Sciences
Bioprocess Engineering
Plant Biotechnology and Functional Genomics
Structural Biology

Materials Science
Areas of Specialization:
Biomaterials
Electronic, Optical and Magnetic Materials
Macromolecular Materials
Materials Processing
Materials Structure and Properties
Mechanical Behavior of Materials

School of Graduate Studies
Optical Science & Engineering

*Areas of Specialization:
  - Laser Dynamics
  - Laser Systems
  - Micro- and Nano-optics
  - Optical Properties of Materials
  - Optical Sensors
  - Optical Signal and Image Processing
  - Optical System Design
  - Optical Testing
  - Opto-electronics
  - Photonic Integrated Systems
  - Quantum Optics

# Also participates in the interdisciplinary Biotechnology Science & Engineering Program to offer several specialties.
+ Also participates in the interdisciplinary Materials Science Program to offer several specialties.
* Also participates in the interdisciplinary Optical Science & Engineering Program to offer several specialties.

Fifth Year Programs

The School of Graduate Studies offers “fifth-year” programs in the following disciplines:

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

Completion of the requirements of one of these programs leads to the award of both the master’s degree indicated plus a Class A Teaching Certificate. Interested students should refer to the catalog sections for both the relevant department and the Department of Education for details.

Graduate Certificate Programs

The School of Graduate Studies offers non-degree certificate programs in the following disciplines, under the auspices of the department(s) listed:

- Environmental Science
- Family Nurse Practitioner (post masters)
- Information Assurance
- Nursing Education
- Software Engineering
- Teaching of English to Speakers of Other Languages
- Technical Communication
- Atmospheric Science, Biological Sciences
- Nursing
- Computer Engineering, Computer Science, Management Information Systems
- Nursing
- Computer Science
- English
- English

Successful completion of the requirements of a graduate certificate program leads to the award of a certificate. In certain cases, these certificates may be pursued concurrently with an advanced degree. For more details on admission requirements, programs of study, and completion requirements, refer to the appropriate department section of this catalog. Candidates for a certificate
should submit the appropriate form through their department chair to the School of Graduate Studies at least 3 months before the end of the semester in which requirements are expected to be complete.

**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**

Ms. Suzanne Norris, Director  
117 Engineering Building  
(256) 824-6741  
Email: info@uah.edu  
Web page: www.uah.edu/coop/

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, Engineering Building, The University of Alabama in Huntsville, Huntsville, AL 35899.

**Collaborative 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 Office of Student Records for appropriate forms.

Between UAH and The University of Alabama at Birmingham (UAB)

A collaborative 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, or mechanical engineering; while a UAH student may pursue the master's 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.

Graduate Admissions

The University of Alabama in Huntsville welcomes inquiries and applications from interested persons who wish to further their education. Email inquiries are welcome and should be addressed to the specific department/program or to the Office of Graduate Admissions at grad.admit@uah.edu. Further information is available at: http://www.uah.edu/HTML/Academics/Grad.

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 (at least eight weeks for US residents and six months for international students) of the date of proposed entrance.

Application forms, detailed application instructions, and information brochures are available from departments and the Office of Graduate Admissions in the Materials Science Building, and on the web at www.gdeanoff.uah.edu/ admis.html. Copies of the UAH catalog are available in the Office of Graduate Admissions and at Charger Central in the University Center. The catalog may also be viewed through the UAH web site: http://www.uah.edu/Cat03-05. Campus tours on an individual or group basis are available. Faculty members and academic advisors for the various graduate programs are available to confer with interested individuals to discuss their enrollment plans and opportunities at UAH. Students may telephone or email departments or program offices directly or call the Office of Graduate Admissions (256-824-6198).
Application Procedure

An applicant should submit a completed graduate application form and a nonrefundable application fee to the Office of Graduate Admissions, MSB C-206, UAH, Huntsville, AL 35899. Previous UAH students are exempt from this fee. In addition, the student must request that the following items be sent to the Office of Graduate Admissions:

1. Two official copies of the academic record from each collegiate institution attended;
2. For most programs, applicants should submit scores of the Graduate Record Examination (GRE) from Educational Testing Service (ETS). The institutional code for UAH is 1854. Administrative Science applicants should submit scores on the Graduate Management Admissions Test (GMAT). Applicants for English, Nursing and Public Affairs should submit either a set of GRE scores or a score on the Miller Analogies Test;
3. The GRE/MAT requirement may be waived by the Graduate Dean upon recommendation of the department or program chair if at least one of the following conditions holds:
   (a) the applicant is the holder of a post-baccalaureate degree;
   (b) the applicant presents evidence of having taken the GRE/MAT over 5 years ago and hence cannot obtain official scores;
   (c) the applicant graduated from an accredited college or university five or more years ago and has not subsequently been enrolled since that time, and if the student has a record of consistent professional and/or academic achievement as documented on a submitted resume.

If the applicant meets and satisfies all other applicable admission requirements, the student may be conditionally admitted to the graduate program.

An applicant for an additional graduate program (including a different degree in the same discipline) who has been previously admitted to the School of Graduate Studies must submit a completed re-evaluation form to the Office of Graduate Admissions. The student must inform the chairs of both departments/programs that he/she is pursuing the two degree programs concurrently.

Students who fail to enroll in classes within one year of their date of admission must submit a new application.

Instructional and Testing Services

Pertinent tests which are administered through this office include: the UAH English Language Placement Test (ELPT), the Graduate Record Examination (GRE) and the Miller Analogies Test (MAT). Applications and information pertaining to the Graduate Management Admissions Test (GMAT) and the Test of English as a Foreign Language (TOEFL) are also available.

Testing calendars with dates and deadlines, as well as information pertaining to testing, are available in the Office of Instructional and Testing Services located in Room 226 of the Administrative Science Building, telephone 824-6725.

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 school; individual colleges and/or departments may require higher averages or additional or more specific requirements. See college/departmental sections for specific admissions information.

Unconditional Admission

To be admitted unconditionally, applicants must satisfy the following criteria:

All programs except those in the College of Administrative Science

1. Have a minimum grade-point average of B (3.0) on the undergraduate record, and
2. Have a minimum total score of 1500 on the aptitude test (verbal, quantitative, and analytical) portion of the Graduate Record Examination. (For GRE tests taken after October 1, 2002 the
score on the analytical portion is obtained by taking the \((\text{raw score} + 2) \times 100\). For the English, Nursing, and Public Affairs programs, applicants must have a minimum total score of 50 on the Miller Analogies Test.

**College of Administrative Science**

1. Have a minimum total score of 450 on the Graduate Management Admissions Test (GMAT).
2. Have a minimum index score of 1000, determined by taking \((\text{the undergraduate GPA multiplied by } 200) + \text{the GMAT score}\).

**Conditional Admission**

The graduate school may conditionally admit applicants who do not satisfy all of the above requirements for unconditional admission but who do show reasonable potential for doing graduate work. Conditional admission requires the approval of both the graduate dean and the chair of the department in which the applicant plans to pursue an advanced degree.

If a conditionally admitted student has an overall grade average of B (3.0) or better for all graduate work attempted up to and including the semester in which the student completes 12 hours of graduate work at UAH, then the student assumes the status of an unconditionally admitted student. Otherwise, the student is dismissed from the School of Graduate Studies. Under exceptional cases, a student may be readmitted upon justified recommendation of the faculty in the student’s major department and approval of 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. In addition, applicants whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL) and score at least 500 (written test) or 173 (computer test). TOEFL scores must be sent directly to the Office of Graduate Admissions from Educational Testing Services (ETS). College and/or departments may require a minimum TOEFL score for admission. All international applicants must apply for admission at least six months prior to the beginning of the term in which they wish to enroll and all application materials must be received in the Office of Graduate Admissions by June 1 (September 15) for admission for the following Fall (Spring) semester.

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) or Miller Analogies Test (MAT) scores, as appropriate, be sent directly to UAH from Educational Testing Service;
3. A certified financial statement be submitted as evidence of sufficient finances to cover fees and personal expenses while attending UAH. The Office of Graduate Admissions will send an Affidavit of Financial Support form (also available on the world-wide web at www.gdeanoff.uah.edu/affidav.html) to the student after the International Graduate Application is received. The completed affidavit form must be accompanied by a bank statement which indicates that there are sufficient funds to sponsor the student for one calendar year. Health insurance may be purchased through the Student Government Association. Proof of continued health insurance coverage must be presented by the student during each semester of enrollment;
4. Scores from the Test of English as a Foreign Language (TOEFL) Test be sent directly to UAH from Educational Testing Service. Students may also submit scores from the Test of Spoken English (TSE) and Test of Written English (TWE).
Students whose native language is not English must demonstrate English proficiency by taking the university’s English Language Placement Test (ELPT) and complete any course work in English as a Second Language (ESL) which the test indicates is required. These courses become part of the Program of Study but do not count toward minimum degree requirements.

Students who present an official TOEFL score of at least 600 (written test) or 250 (computer test) will be exempted from the standardized listening, structure and vocabulary comprehension portion of the ELPT.

Students who present an official score of at least 50 on the Test of Spoken English (TSE) will be exempted from the oral interview portion of the ELPT.

Students who present an official score of at least 5 on the Test of Written English (TWE) will be exempted from the writing portion of the ELPT.

Students who have earned a bachelor’s or higher degree from an accredited U.S. institution will be exempted from the TOEFL, TSE, TWE and ELPT requirements above. Students with degrees from non-U.S. institutions that have English as their primary language of instruction (e.g. United Kingdom, Canada, etc.) may petition the Dean of the School of Graduate Studies for an exemption from the ELPT.

Note that, notwithstanding these exemptions, students seeking Graduate Teaching Assistant positions must comply with the appropriate section of this catalog regarding English language proficiency (page 49).

Other Categories of Admission

Provisional Admission

A student (other than an individual with nonimmigrant visa status) whose application to the graduate school is not complete, or is pending approval, may, with department approval, be admitted to UAH on a provisional basis. Students admitted in this category may register for graduate level courses with approval from the department(s), provided that all prerequisites for those courses have been met. Students admitted provisionally are not eligible for federal financial aid.

Students may be admitted provisionally for one semester unless specified otherwise. Within that period they must submit a completed set of application materials in time to be considered for regular admission. Students who do not complete the application process within the allowed period, or are subsequently not admitted to the graduate program, will not be allowed to take additional graduate classes.

Once a student gains regular admission to the Graduate School, all policies regarding conditional or unconditional admission become effective in the provisionally admitted semester. Graduate credit for courses at the 500-level or above taken as a provisional student may, with approval of the major department, be applied toward a graduate degree program only if the grades earned in such courses were B or higher.

Non-degree Admission

Students who are interested in earning graduate credit but are not applicants for a graduate degree at UAH may be admitted as non-degree graduate students. Admission in this category requires proof of a bachelor’s degree from an accredited institution and department and/or college approval. This category is not available to students with nonimmigrant visa status. Non-degree students are not eligible for federal financial aid.

All courses taken while in non-degree status require approval of the instructor. Students must maintain the same grade point average requirements expected of conditionally admitted graduate students. Graduate courses numbered 500 and above may be taken while in this category provided that all prerequisites have been met.

Individuals admitted as graduate, non-degree students may decide to make formal application to a graduate degree or certificate program. If admitted, credit earned as a non-degree graduate student
may be applied toward a graduate degree or certificate program subject to the following conditions and limitations:

- All grades earned in 500-level courses or above during non-degree status and applied to a graduate degree or certificate program must have been B or higher;
- No more than twelve graduate credit hours may be granted for courses taken as a non-degree student;
- Courses used to satisfy degree or certificate requirements are subject to approval by the major department and grades for those courses become 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.

Students initiate the process by filling out the Request for Approval of Graduate Credit by UAH Senior (available in Charger Central, Room 118, University Center), which requires the approval of the department chair and graduate dean. Graduate tuition and fee rates apply to courses taken in this category. A student may not use courses taken for graduate credit as part of the baccalaureate degree.

Graduate Assistantships

Graduate assistantships are offered to encourage graduate work, to promote teaching, and to promote research. Graduate assistants have a graduate degree as their primary goal, and the assistantships are part of their graduate education. Assistantships are available through various departments of instruction, 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.

A student eligible for an assistantship may be appointed as a Graduate Teaching Assistant (GTA) or Graduate Research Assistant (GRA). 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 (six hours in the summer term) during any semester in which an appointment is held. Normally, all courses for which the student is registered shall be graduate credit courses. Exceptions must be approved by the department chair and graduate dean.

Benefits

A graduate assistant who holds a one-half time (20 hours per week) appointment will receive tuition and fees for 9 to 10 hours per semester (6 hours in the summer term) and are eligible for health insurance benefits (single person coverage). Tuition, fees and health insurance benefits for assistants who hold lesser appointments are prorated accordingly. Further information may be obtained in the department or in the School of Graduate Studies.

Two kinds of assistantships are available:

1. Graduate Teaching Assistantships

As the title implies, graduate teaching assistants (GTAs) 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.
For students whose native language is not English, English proficiency, as determined by the director of the ESL program, is a prerequisite for classroom or laboratory instruction.

GTAs must have completed at least 18 semester hours of graduate coursework in their discipline to qualify as the instructor of record in any class. The GTA’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. A mandatory GTA workshop is held prior to the beginning of classes each fall semester.

2. Graduate Research Assistantships

A graduate research assistant (GRA) 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 or dissertation. 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 end of the semester in which the assistant expects to complete degree requirements. Some contracts or grants may specify U.S. citizenship as a prerequisite for appointment.

Further information may be obtained in Student Financial Services, the department, or the School of Graduate Studies.

Tuition Scholarships

A limited number of tuition scholarships may be awarded to students without assistantship appointments who have unconditional admission status and are in good academic standing. Such scholarships may be awarded for up to 9 hours of graduate credit hours per semester (6 hours in the summer term). Students receiving tuition scholarships are bound by the same rules as graduate assistants with respect to course withdrawal, contingency of the award on satisfactory performance toward the graduate degree, general eligibility, and special department requirements.

The departmental faculty select the proposed awardees from qualified applicants. An appointment letter, similar to a graduate assistantship letter but without assigned duties, is prepared by the department chair and sent through the college dean to the graduate dean for approval at least one month prior to the start of the semester in which the scholarship is proposed. After approval, a copy is furnished to the student.

Graduate Fellowships

Several fellowship awards programs exist, which can provide graduate student stipends, tuition allowances, and funds for other purposes (e.g., equipment purchase). Examples of such fellowships are the NASA Graduate Student Research Program (GSRP), National Science Foundation Fellowships, and Space Grant Fellowships. Announcements of these fellowships are typically made annually, both as brochures and on the World Wide Web. Interested students may obtain information on such fellowships from the Office of the Graduate Studies or from departmental offices.

Graduate Degree Requirements

The following scholastic requirements are those of the School of Graduate Studies. Individual colleges and/or 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 half of the credit hours (including dissertation credits) toward a doctoral degree must
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. Students who appear on the Dean’s list for both Spring and Fall semesters in a given calendar year are placed on the Calendar Year Dean’s list and recognized on University Honors Day in the following year.

Probationary Status

1. 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.

2. For unconditionally admitted students, 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. Conditionally admitted students must maintain a B average over the first 12 hours of graduate coursework; see page 47.

3. Failure to remove probation in the manners described may result 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 submit 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 not apply toward a degree.

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. All theses must be accessible to the general public.

The thesis is supervised and approved by a faculty committee composed of at least three members of the graduate faculty and appointed by the chair of the department, with approval of the graduate dean. The supervisory committee is composed of at least three members of the graduate faculty, with a majority being from the major department/program. The chair and at least half of the committee must 1) be full-time UAH faculty members and 2) have full membership in the graduate faculty.

A completed copy of the thesis must be submitted to the major department at least eight weeks before the end of the semester in which degree requirements are expected to be completed. After the student has passed his/her thesis defense and at least five weeks before the end of the semester in which degree requirements are expected to be completed, 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 Graduate Studies 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, available online at www.gdeanoff.uah.edu/thman/welcome.html.

In exceptional cases, theses may be written in absentia. Before leaving the University, students must 1) select a thesis subject, 2) submit to the chair 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. The student’s advisor, the department chair, and the graduate dean must then approve such a plan.

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. However, a candidate working under this option 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 that 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.

Time Limit
All requirements for the master’s degree are expected to be completed within 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 must be validated by the department that offered the course through the administering of a written or oral examination. Once a course is validated, it is considered valid through the tenth year only.

Credit for courses more than ten years old, or transferred from other institutions, cannot be validated at UAH.

The requirements of this section also apply to post-master’s certificate programs.

Application for Degree
All candidates for a master’s degree must apply for the degree by submitting the appropriate form through their department chair to the School of Graduate Studies at least three months before the degree is to be conferred.

Final Examination
A final comprehensive examination, or satisfactory performance (B or better) in a capstone course, is required of all candidates for a master’s degree. Capstone courses must be designated as such by the department/program during the course approval process and approved by the College Dean, the Graduate Council Curriculum Committee, the Graduate Dean, and the Provost.

Final examinations for non-thesis candidates may be written, oral, or both. Thesis option candidates must pass a final examination that includes an oral presentation of the thesis in the form of a seminar before the student’s supervisory committee; the oral presentation is open to the members of the University community. The examination must be given at least six weeks before the end of the semester in which degree requirements are expected to be completed, and the results reported within two working days to the graduate dean.

A written notice of the time and place of examination is sent to the graduate dean at least two weeks before the examination date. The graduate dean appoints an additional member of the graduate faculty to act as observer for all thesis defenses. Once set, the examination becomes an official Graduate School matter; the date cannot be changed without prior arrangement amongst the supervisory committee members and the student and without approval of the graduate dean. For more details, consult the Graduate School Handbook.

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 end of the semester in which degree requirements are expected to be completed, and the results reported within two working days to the graduate dean. A student may take the final examination no more than twice.

**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.

- **Program of Study.** This form must be filed as early as possible and definitely before the completion of 12 semester hours. If a supervisory committee develops the program, the student should be invited to the committee meeting.
- **Petition for a Change in Program of Study.** A valid reason must be given for the change.
- **Application for Advanced Degree.** This is to be filed at least three months before the end of the semester in which degree requirements are expected to be completed. It is available in department offices.
- **Notification of Thesis Defense/Final 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 the end of the semester in which degree requirements are expected to be completed, and not earlier than the semester in which the student will complete all required coursework. A graduate faculty observer will be appointed to participate in the student’s thesis defense.

**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 may include mastery of certain research skills (e.g., languages, computer programming, statistics, and others approved by the Graduate Council), and must include 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 colleges and/or departments as shown in this catalog under the appropriate section.

**Course Requirements**

Course requirements, including at least 48 hours of graduate coursework (excluding dissertation research), 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 48 hour requirement. Students must also register for a minimum of 18 semester hours of dissertation research.

Students must register for dissertation research each semester in which they receive faculty supervision. All students who have completed the minimum coursework requirements for the doctoral degree they are pursuing must register for a minimum of 3 semester hours of graduate credit (to include dissertation credit) each fall and spring semester until all degree requirements are complete.
The approval of the Program of Study should be accomplished as early as possible, but no later than one year after admission to the Ph.D. program. Once approved, the program may be amended only by the supervisory committee upon submission of the appropriate form and approval of the graduate dean.

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 that institution.

At least half of the credit hours (including dissertation credits) toward a doctoral degree must have been earned at UAH (or, in the case of joint/shared programs, at the participating institutions).

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.

Residence may be established through either (1) being enrolled as a full-time student (at least 9 graduate semester hours) either for one continuous academic year, or for Spring and Fall semesters in the same calendar year, or (2) being enrolled in at least 6 hours of graduate course work in at least three of four consecutive semesters. Colleges and/or departments may have more stringent requirements and students should refer to the appropriate section of the catalog for details.

All research effort presented for residence credit toward the Ph.D. degree must be performed under the direction of a full member of the graduate faculty.

Supervisory Committee
A supervisory committee is appointed for each student working toward the Ph.D., usually after satisfactory completion of a preliminary examination administered by the major department. The supervisory committee is appointed by the department chair with approval of the graduate dean as part of the Program of Study approval and will examine the student’s research proposal for the dissertation. The supervisory committee is composed of at least five members of the graduate faculty, with at least half being from the major department/program. The chair and at least half of the committee must 1) be 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 School of Graduate Studies and must be administered by the Supervisory Committee within one year of the date the student completes the formal coursework on the Program of Study. It is conducted in two distinct stages which may be separated by a length of time deemed appropriate by the supervisory committee.

The first stage is a demonstration through written and oral examination that the student is proficient in the subject matter in the Program of Study. The final stage is the dissertation proposal review in which the student prepares a written report and makes a subsequent oral presentation describing the proposed dissertation research. Both the dissertation topic and expected approach(es) must be clearly delineated to the committee’s satisfaction in order for a pass to be granted.

The presentation of the oral dissertation research proposal must be scheduled through the School of Graduate Studies at least two weeks in advance. Once this review is complete, the results of the Qualifying Examination are reported to the School of Graduate Studies within two working days on the prescribed form. The presentation of the oral dissertation proposal may be given no more than twice.

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

School of Graduate Studies 54
Application for Degree

All candidates for a Ph.D. degree must apply for the degree by submitting the appropriate form through their department chair to the School of Graduate Studies at least three months before the end of the semester in which degree requirements are expected to be completed.

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 the end of the semester in which degree requirements are expected to be completed. At least five weeks prior to this date, 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, must be deposited in the Office of Graduate Studies with a receipt for the binding fee. A copy of the dissertation will be submitted for microfilming to University Microfilms International (UMI) by the time of graduation. Dissertations must comply with the regulations set forth in the Graduate School’s *Thesis and Dissertation Manual*, which is available online at http://www.gdeanoff.uah.edu/thman/welcome.html.

Final Examination

The final examination must include an oral presentation of the dissertation in the form of a seminar before the student’s committee; this presentation is open to the members of the University community. The examination must be given at least six weeks before the end of the semester in which degree requirements are expected to be completed, and the results reported within two working days to the graduate dean. The graduate dean appoints an additional member of the graduate faculty to act as observer for all dissertation defenses.

Once set, the examination becomes an official Graduate School matter; the date cannot be changed without prior arrangement amongst the supervisory committee members and the student and without approval of the graduate dean. For more details consult the *Graduate School Handbook*. A student may take the final examination no more than 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.

- **Program of Study.** The supervisory committee should meet to develop a complete program for the student, who should be invited to the meeting.
- **Petition for a Change in Program of Study.** A valid reason must be given for the change.
- **Notification of Qualifying Examination.** Notification of the qualifying examination must be turned in to the Graduate Studies Office at least two weeks before the examination date.
- **Application for Advanced Degree.** This should be filed three months before the end of the semester in which degree requirements are expected to be completed. (Available from department offices.)
- **Notification of Dissertation Defense.** Notification of the defense must be turned in to the Graduate Studies Office at least two weeks before the examination date. This examination must be taken at least six weeks before the end of the semester in which degree requirements are expected to be completed. A graduate faculty observer will be appointed to participate in this examination.
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 biotechnology science & engineering, materials science and optical science & engineering. Inquiries about these interdisciplinary programs should be addressed to the Graduate Dean or the respective college deans.

BIOTECHNOLOGY SCIENCE & ENGINEERING PROGRAM

Degree: Doctor of Philosophy

Program Director: K. K. Chittur, Professor (CHE)

Materials Science Building, Rm. 137
(256) 824-6850
Email: kchittur@che.uah.edu
Homepage: http://www.biotech.uah.edu
Program Office: Materials Science Building, Room 135
(256) 824-3421

Professors:
- Baird, J.K. (CH); protein crystal growth, fundamental mechanisms
- Campbell, P.S. (Emeritus) (BYS); reproductive physiology, sex steroid hormone action, endocrine disrupters
- Chittur, K.K. (CME); FTIR, biosurfaces, protein interaction, expression profiling
- Gartska, W.R. (BYS); reproduction and chemical communication in vertebrates, paleontology
- Leahy, J.G. (BYS); bioremediation, environmental microbiology
- Meehan, E.J. (CH); protein crystallography, structural genomics, structure-based drug design
- Moriarity, D.M. (BYS); regulation of eukaryotic gene expression, natural products biology
- Naumann, R.J. (CH); space processing, crystal growth
- Podila, G.K. (BYS); plant molecular biology and biotechnology
- Setzer, W.N. (CH); biomedicinal aspects of biologically active phytochemicals, natural products chemistry
- Shriver, J.W. (CH, BYS); Protein structure and function, NMR spectroscopy, structural biology/biophysics

Associate Professors:
- Edmondson, S. (CH; Research); NMR spectroscopy, protein structure and function
- Hayes, D.G. (CME); bioseparations, microemulsions

Assistant Professors:
- Boyd, L. (BYS); gene function and expression, embryogenesis
- Chen, L. (CH; Research); protein crystallography, structural genomics, structure-based drug design
- Davis, M.R. (BYS); plant genomics
- DiGiammarino, E.L. (CH; Research); protein crystallography, molecular mechanisms of diseases
- Gebauer, A. (CH); small molecular mimics for proteins and enzyme active sites
- George, M. (CH); scanning probe microscopy
Biotechnology is not a single area of study itself, but is a multidisciplinary field concerned with the practical application of biological organisms and their subcellular components to industrial or service manufacturing, to environmental management and health and medicine. It is, in essence, a series of enabling technologies drawn from the fields of microbiology, cellular biology, molecular biology, genetics, biochemistry, immunology, fermentation technology, environmental science and engineering which allow one to synthesize, breakdown or transform materials to suit human needs. Biotechnology ("Current Trends in Chemical Technology, Business, and Employment," American Chemical Society, Washington, DC. 1998) can therefore be defined as the safe study and manipulation of biological molecules for development of products or techniques for medical and industrial application. Although biotechnology in the broadest sense is not new, the current ability and demand for manipulating living organisms or their subcellular components to provide useful products, processes or services has reached new heights. Modern biotechnology has resulted from scientific scrutiny of old and familiar processes and from new advances in molecular biology, genetic engineering and fermentation technologies.

The future industrial landscape will continue to include research, development and the manufacturing of products such as proteins and nucleic acids that will be based wholly or in large part on biological processes. The interdisciplinary program in Biotechnology Science and Engineering will provide broad training in sciences and engineering dealing with the handling and the processing of macromolecules and living systems. Students will receive advanced training in one of three specializations: Structural Biology, Biomolecular Sciences or Bioprocess Engineering. The principal core of instructors and research advisors are drawn from the Departments of Biological Sciences, Chemistry, and Chemical and Materials Engineering. The program includes significant involvement from local biotechnology companies as well as NASA’s Marshall Space Flight Center.

In addition to a set of core courses, the Ph.D. program requires the successful completion of a comprehensive exam, seminar attendance, the preparation of a U.S. National Institutes of Health (NIH) style research proposal, oral presentations and defense of a dissertation describing original research. It is the intent of the program to produce internationally competitive graduates who will make significant contributions to the field of biotechnology.

Admission Requirements

Applications may be unconditionally admitted to the program if they have:

a) A bachelor’s degree in science or engineering from an approved college or university;

b) 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;

c) A combined score of 1700 on the verbal, quantitative and analytical sections of the Graduate Record Examination (GRE). (For GRE tests taken after October 1, 2002 the score on the analytical portion is obtained by taking the (raw score + 2) x 100);

d) A score of at least 550 (213 computer-based) on the Test of English as a Foreign Language (TOEFL) for international students.

Applications may be admitted conditionally if they do not meet these requirements but indicate the potential for success in the Biotechnology Science and Engineering program. Applicants must have
knowledge from coursework in the areas of general biology, cell biology, genetics and molecular biology, general and organic chemistry, physics and calculus to satisfy the prerequisites of calculus-based physical or biophysical chemistry. Students with deficiencies in any of these areas may be admitted only conditionally pending remedy of the deficiencies.

**Doctor of Philosophy**

To obtain a Ph.D. in Biotechnology Science and Engineering, the student must satisfy all requirements of the School of Graduate Studies as well as those of the Biotechnology Science and Engineering Program. The requirements are as follows:

1. **Successfully complete the core courses:**
   - CHE 560: Introduction to Bioprocess Engineering
   - CHE 561: Bioseparations, Recombinant Techniques and Protein Engineering
   - CH 561/BYS 547: Graduate Biochemistry I
   - CH 562/BYS 548: Graduate Biochemistry II
   - BYS 519: Gene Structure and Function
   - BYS 543: Molecular Biology of the Cell
   - BSE 601: Current Topics in Biotechnology
   - BSE 702: Laboratory Rotations in Biotechnology

2. **Pass the Preliminary Examination**

Each student must pass the preliminary examination which has to be taken at the end of the first summer of residence, and will consist of three 3-hour exams in Biochemistry, Cellular and Molecular Genetics and Bioprocessing/Bioseparations. Students will have to take all three examinations during the first attempt. Students are required to repeat only the part of the exams that they did not pass. Students will have a maximum of two attempts to pass the preliminary examination. Appeals to this policy must be filed with the Director of the Biotechnology Program who will consult with the Graduate Dean and the Deans of the Colleges of Engineering and Science.

3. **Choose a dissertation advisor and committee**

Students who qualify for the Ph.D. program by passing the preliminary examination will choose a dissertation advisor and a Supervisory Committee during the fall semester of their second year. The committee will meet for the first time with the student to review the initial research goals (Research Start Meeting).

4. **Write and defend a research proposal**

In consultation with the dissertation advisor and committee, the student will begin working on a research project which will subsequently lead to an NIH style proposal. This written proposal will be submitted to the committee by the middle of the second summer. By the first semester of the third year, the student will defend this proposal in a seminar, followed by questions from committee members (Annual Research Appraisal I) (ARA-I). Successful completion of the written and oral presentation of the dissertation proposal constitutes the School of Graduate Studies Qualifying Examination.

5. **Complete an acceptable program of study**

The program of study will consist of at least 48 semester hours of coursework at the graduate level including the core courses required to prepare for the preliminary examinations and courses required to prepare the student to conduct original research in their area of study. Students must register for a total of three hours of seminar. A maximum of three seminar hours may be considered towards fulfillment of the graduate course requirements.

6. **Complete and defend a research dissertation**

During the fall semesters of the next two years, students will meet with their advisors and committee for research appraisals. Following these annual evaluations, the student will begin
writing the dissertation and plan to defend it before the fifth year after passing the preliminary examination. The primary dissertation advisor and the committee have the discretion to allow students to defend the dissertation earlier if the work is of high quality and sufficient progress has been made toward the goals stated in the research proposal.

All requirements for the Ph.D. must be completed in no more than five years after the approval of the Research Proposal (ARA-I).

**Graduate Courses in Biotechnology Science & Engineering**

**Core/Required Courses**

**CHE 560 Introduction to Bioprocess Engineering** 3 hrs.
Application of engineering principles to the analysis of and development and design of processes using biological catalysts including enzymes, plant and animal cells and genetically engineered cells. Other topics will include fermentation and biological mass transport processes. Prerequisites: CH 361, 362.

**CHE 561 Bioseparations, Recombinant Techniques & Protein Engineering** 3 hrs.
General characteristics of separation processes used in the biotechnology industry including removal of insolubles, isolation and purification of thermally sensitive products and preparation of products for final use by the customer. Application of unit operation principles for biological separations, recombinant DNA techniques, protein engineering. Prerequisites: CH 361, 362, CHE 560.

**CH 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.)

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

**BYS 519 Gene Structure and Function** 3 hrs.
Molecular basis for inheritance and gene expression, advanced studies of replication, transcription, translation. Includes regulation of gene expression, gene cloning, and recombinant DNA technology. Prerequisites: BYS 219, BYS/CH 361.

**BYS 543 Molecular Biology of the Cell** 3 hrs.
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 219, BYS/CH 361.

**BSE 601 Current Topics in Biotechnology** 3 hrs.
Survey of current Biotechnology literature. Students will be required to critically evaluate the assigned literature, develop detailed written summaries and present their critical evaluations to the class and the instructor. Pre/Corequisites: CHE 560, CH 561/BYS 547.

**BSE 702 Laboratory Rotations in Biotechnology** 3 hrs.
Acquire a broad background in biotechnology science and engineering through two 6-week rotations in an active research program under the director of faculty mentors. Students will pursue an independent research project and a detailed written report will be required at the end of each of the two 6-week rotations. Prerequisites: BSE 601.

**BSE 799 Doctoral Dissertation** 3, 6, 9 hrs.
Required each semester student is enrolled and receiving direction on a doctoral dissertation.
Specialized/Track Courses

**BSE 620 Introduction to Bioinformatics: Fundamentals and Methodology** 3 hrs.
Students will learn how computational and mathematical techniques are being used to understand DNA and protein sequences, how the information from the genome is being used to understand phenomena at a macro-level. Pre/Corequisites: Graduate student admitted to the Ph.D. program in Biotechnology Science and Engineering. Graduate students in other programs may seek permission from the Director of the Biotechnology Science and Engineering Program to take this class. Required corequisite: BSE 621.

**BSE 621 Introduction to Bioinformatics: Computer Laboratory for Applications** 1 hr.
Students will use a variety of computational tools and software for data mining, sequence alignment, phylogenetic analysis, clustering, quantitative metabolic pathways analysis and other topics covered in BSE 620. Pre/Corequisites: Graduate student admitted to the Ph.D. program in Biotechnology Science and Engineering. Graduate students in other programs may seek permission from the Director of the Biotechnology Science and Engineering Program to take this class. Required corequisite: BSE 620.

**BSE 703 Biotechnology Research** 3 hrs.
Advanced research in a specific targeted topic under the direct supervision of a faculty member in collaboration with scientists and researchers at a biotechnology company or business or a research laboratory that has specific relevance to the biotechnology science and engineering program. Completion of this course will require a written report and an oral presentation to the faculty and students in the biotechnology program. Prerequisites: BSE 601, BSE 702, BYS 543, BYS 519, CHE 561. Exceptions to these prerequisites can be made by appeal to the Director of the Biotechnology Program.

**BYS 556 Advanced Molecular Techniques** 3 hrs.
Laboratory techniques in molecular biology, including methods of recombinant DNA technology for identification, cloning, and characterization of genes. Prerequisites: BYS 219, 340, and 519 (may be taken concurrently) or approval of instructor. One 2-hour and one 5-hour lab per week. Lab Fee: $250.

**BYS 691 Special Topics in Tissue Culture** 3 hrs.
Lecture and laboratory instruction in the preparation and maintenance of eucaryotic cell primary cultures and cell lines. Teaches students the basic techniques for tissue culture - aseptic technique, media preparation, equipment needs. Introduces them to several procedures used for isolating primary cultures from tissue and for culturing cell lines. Covers culture characterization and contamination issues. Prerequisites BYS 543; BYS/CH 361 or BYS 547/CH 561.

**BYS 691 Special Topics in Growth Factors and Oncogenes** 3 hrs.
Discussion of the cell cycle, the nature of growth factors and their relationship to oncogenes and cancer. This course is designed to provide an in-depth understanding of the regulation of the cell cycle and cell function by growth factors and the relationship between growth factors, oncogenes and cancer. Textbooks will provide the basic framework for the course, but a large part of the material will come from the latest published research articles. Prerequisites BYS 543 and BYS/CH 361 or BYS 547/CH 561.

**CH 565 Molecular Biochemistry Laboratory** 3 hrs.
Practical experience in isolation, characterization and manipulation of biomolecules. Lab Fee: $60. Prerequisite: CH 562.

**CH 661 Biological Macromolecules** 3 hrs.
Detailed analysis of structures of proteins, nucleic acids, and complex polysaccharides. Prerequisite: CH 562.
CH 765 Selected Topics in Biochemistry: Protein Crystallography 3 hrs.
Practical instruction in the use of X-ray crystallography for macromolecular structure determination. Examines both theoretical and practical aspects of macromolecular structure determination by x-ray diffraction methods. Topics include protein crystallization, theory of x-ray diffraction, phase determination, and data collection and analysis. Extensive laboratory and computer work is required, with the predominant focus on usage of the various program packages for model building and structure refinement. Basic knowledge of DNA/RNA, amino acids and proteins, enzymatic properties and functions. Prerequisites: CH 560, 661.

CHE 559 Special Topics in Polymeric Drug Delivery Systems 3 hrs.
Discussion of biocompatible polymers and their application in drug delivery systems. Polymers of natural and synthetic origin will be studied, special emphasis will be placed upon the synthesis of biocompatible polymers. The formation of polymeric micelles, hydrogels and liposomes will be studied. The process of extravasation as uptake mechanism for polymeric delivery systems will be discussed. Reading material will be based on the latest publications in the field. Prerequisites: CH 540.

CHE 650 Principles of Liquid and Solid Interfaces 3 hrs.
Basic principles in thermodynamics and kinetics applied to characterize surfaces and surface phenomena. Fundamental properties of gas-liquid, liquid-liquid, solid-liquid, an solid-gas interfaces and phenomena occurring at these interfaces. Prerequisite: CH 341.

CHE 659 Special Topics: Advanced Enzymology 3 hrs.
Enzymes and how they work on a molecular level, modeling kinetics of their reactions, how they can be modified by random mutagenesis and protein engineering, and how they operate in nonconventional media. Prerequisites: CHE 560, 561.

CHE 747 Advanced Topics in Bioengineering 3 hrs.
Engineering aspects of microbial processes and 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.

MATERIALS SCIENCE PROGRAM

Degrees: Master of Science (awarded by UAH)
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: James K. Baird (CH)

Telephone: (256) 824-2416
Email: chemch@uah.edu
URL: http://matsci.uah.edu/

Professors:
Baird, J.K. (CH); solution phase critical point phenomena, theory of crystal growth
Bower, M.(MAE); composite materials, viscoelasticity
Cerro, R.L. (CHE); transport phenomena
Cost, T. (MAE); hyperelastic materials
Chittur, K.K. (CHE); FTIR, biosurfaces, protein interaction
Dimmock, J. (PH); solid state physics, applied optics
Franz, J. (PH); solid state materials
Gilbert, J. (MAE); stress analysis, applied optics
Gregory, J.C. (CH); interaction of atomic oxygen with surfaces
Meehan, E.J., Jr. (CH); x-ray crystallography of proteins
Naumann, R.J. (MTS); crystal growth in low gravity, space processing
Setzer, W.N. (CH); biomedicinal aspects of biologically active phytochemicals
Shriver, J. (CH); NMR
Smith, J.E. (CHE); catalysis, powdered metals, space processing
Wessling, F.C. (MAE); space processing of materials

Associate Professors:
Edmondson, S. (CH; Research); NMR
Gregory, D.A. (PH); optical processing
Hayes, D.G. (CHE); enzymatic reactions in nonaqueous media, proteins at interfaces, surfactants
Kaukler, W.F. (CH; Research); solidification and interfacial energies, x-ray microscopy
Sheehy, J.A. (CH; Research); rocket propellants
Weimer, J.J. (CH/CHE); adhesion science, surface characterization

Assistant Professors:
Banish, M. (CHE); space processing, self diffusion
Chen, L. (CH; Research); x-ray structure of large molecules
DiGiammarino, E.L. (CH; Research); biomaterials
Gebauer, A. (CH); applications of macrocyclic compounds
George, M. (CH); sensors, thin film coatings
Ng, J. (BYS); molecular structure
Sanghadasa, M (PH); non-linear optical materials, polymer physics
Scholz, C. (CH); biosurfaces, biomaterials, polymers
Vogler, B. (CH); NMR
Zhu, S. (Adjunct, MTS); semiconductor and nonlinear optics

Adjunct Faculty
More than 40 faculty members from UAB and UA make up the list of adjunct faculty in the Ph.D. program. Each has expertise in areas of importance to the diverse field of materials science.

Research
Research in Materials Science focuses on the fundamental relations that exist between the structure of materials on the one hand, and properties and the methods for synthesizing and processing these materials on the other. The material may be a metal, a ceramic, or a polymer, and it may be dispersed in the solid, liquid or gaseous state. Depending upon the desired application, the structure of the material may have to be investigated at the nuclear, atomic, molecular, granular, or larger length scales. The property that is determined by the structure may be mechanical, electrical, magnetic, optical, thermal, chemical, or biological. The method of synthesizing the structure may be thermal, mechanical, photochemical, electrochemical, or biological. Many basic academic disciplines can be fruitfully applied to the solution of materials science problems. Among them, we note particularly chemistry, physics, biology, and engineering. Faculty members guiding students in the Materials Science Program represent all four of these areas.

Master of Science
Research in materials science at The University of Alabama in Huntsville is mainly directed at the chemical, physical, biological and mechanical properties of materials. The work often involves
collaboration of several faculty members at UAH with faculty members on other state campuses or scientists at Marshall Space Flight Center (MSFC), Redstone Arsenal and local industry. The materials science faculty, consisting of chemists, engineers, biologists and physicists, have diverse interests and expertise that can be orchestrated to solve complex materials problems. Typical research work includes preparation and characterization of biocompatible coatings, interaction of proteins and cells with surface coatings, metals, polymers surface studies, surface preparations, macromolecular structures, medicinal materials, crystallization, NMR analysis, and the design of sensors and rocket propellants.

**Equipment**

Major equipment available includes: 500 MHz and 800 MHz nuclear magnetic resonance spectrometer equipped for both liquid and solid phase studies, Auger electron spectrometer, GC/MS, MALDI fluorescence spectrometer, x-ray photoelectron spectrometer, plasma chemistry apparatus, Perkin-Elmer spectrometer, Jarrell-Ash 2 meter spectrometer, Varian DRIS-90 ultraviolet-visible spectrometer with kinetics apparatus, HP 353 Pentium controlled visible-ultraviolet spectrometer, atomic absorption spectrometers, SEM, EDS, scanning tunneling and atomic force microscopes, surface and single crystal x-ray diffractometers, FTIR with small angle and microscope attachments, molecular modeling system, Waters binary gradient liquid chromatography system, 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 Materials Science Program has numerous IBM compatible and Macintosh personal computers and Silicon Graphics work stations available for student use. Other equipment such as 300MHz and 400MHz NMRs, TEM and laser ablation coaters are available in conjunction with local industry or MSFC.

**Admission Requirements**

General requirements of the School of Graduate Studies (see Admissions Information section of this catalog) must be satisfied. In addition, students admitted to the graduate Materials Science Program are assumed to have background training in chemistry, mathematics, physics, and possibly biology and engineering, depending upon the student’s research interests. Technical physics and mathematics through linear algebra and differential equations are necessary. Organic chemistry and physical chemistry backgrounds are also highly recommended. Students should realize, however, that if deficiencies exist, some additional undergraduate courses may be required. The time required to complete the degree may then be proportionately increased.

**Master of Science Degree Requirements**

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 materials science. As such, it is based upon a core sequence of courses emphasizing areas of materials science.

**Plan I.** This plan requires 24 semester hours of graduate coursework, which must include a core consisting of

- MTS 501 Structure, Composition and Properties of Materials I 3 hrs.
- MTS 502 Structure, Composition and Properties of Materials II 3 hrs.
- MTS 660 Introduction to Solid State Physics I 3 hrs.
- CH 640 Advanced Chemical Thermodynamics 3 hrs.
- CH 642 Advanced Chemical Dynamics 3 hrs.

In addition, students must complete a minimum of nine more hours of graduate coursework in Materials Science or a related discipline. The courses selected must include at least one of CH 521, CH 560, or MTS 601. At least 50% of the coursework must be at the 600-level or above. Students must also register for at least 6 hours of MTS 699 and should also register for MTS 780 (Seminar).
during every semester they are in residence at UAH. A program of study must be planned in consultation with a member of the materials science faculty serving as a temporary advisor assigned by the program director. After a student following Plan I selects a thesis topic, a supervisory committee will be appointed. A student must complete an acceptable written thesis. A comprehensive examination, administered by the supervisory committee, shall be given subsequent to the student's oral thesis defense.

Plan II. This plan requires 33 or more semester hours of graduate coursework in Materials Science or a related discipline to include the 15 hour Materials Science core (see above). Students must also register for MTS 780 (Seminar) during every semester in which they are in residence at UAH. Half of any graduate coursework taken must be at the 600-level or above. A program of study must be planned in consultation with a member of the materials science faculty serving as an advisor assigned by the program director. To fulfill the requirement of a final comprehensive exam, the student must pass two of the four sections of the Materials Science Ph.D. Program Exam I.

Doctor of Philosophy

The Materials Science Ph.D. program is novel in that the three University of Alabama System (UAS) campuses offer a joint doctoral degree without a Materials Science Department on any campus. Instead, faculty members from various participating departments on each campus 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 UAS faculty come from the Departments of Chemical & Materials 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, Mechanical and Aerospace 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 differing background 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 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 approved 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;

Interdisciplinary Programs 64
3. A minimum score of 1500 on the Graduate Record Examination. For GRE tests taken after Oct. 1, 2002 the score on the analytical portion is obtained by multiplying the (raw score plus 2) by 100;
4. TOEFL score greater than 550 (213 computer-based test) in the case of international students.

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.

**Program Examination Requirements**

Program Examination I is a four-part written examination covering the program’s core material and qualifies the student to enter upon research. 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 pre-announced dates. Students must pass all parts of the examination according to a 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 plus at least 18 hours of MTS 799 are required. A student may transfer up to 24 hours of approved graduate coursework toward the 48 hour requirement. The Materials Science Ph.D. Program otherwise has no further specific course requirements. Students take courses to prepare for the Program I Examination or to complete their Program of Study as approved by their faculty advisor.

**Candidacy and Dissertation Requirements**

Admission to candidacy for the doctoral degree will be contingent upon the successful completion of the qualifying exam, called 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**

The Program I Examination is to be taken at the first September offering immediately after the student enters the program. The Program I Examination is generally to be completed by all full-time students within two years after first entering the program, with exceptions being made for part-time students.

The Program II Examination is to be attempted within a reasonable time after the Program I Examination. In general, it is to be taken no later than one year prior to submitting an application for graduation.
All requirements for the doctoral degree must be completed within a period of five 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 without research funding support will initially 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 is to be formed by the student in consultation with the research faculty advisor 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 awarding of the degree.

Graduate Courses in Materials Science (MTS)

The courses below constitute the main listing of MTS options. Since the Materials Science Program is interdisciplinary, courses acceptable to the MTS program of study are also offered through participating departments. Students are directed to the course listings in the Departments of Chemical and Materials Engineering (CHE), Chemistry (CH), Electrical and Computer Engineering (ECE), Mechanical and Aerospace Engineering (MAE), Mathematics (MA), and Physics (PH).

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, fraction 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.
601 Graduate Laboratory in Materials Science 1 hr.
Apply information learned in graduate lectures on materials properties to hands-on experiments in materials science and engineering. Topics include: data acquisition and analysis, crystallography and x-ray diffraction, microstructure analysis, phase diagrams, mechanical properties, corrosion, and electrical properties. Students should not register for this course if they have already completed laboratory or research credits at the 700-level. Prerequisite: MTS 501; MTS 502 recommended or in parallel.

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.
Fundamental thermodynamic review, phase equilibrium, chemical reaction equilibrium, free energy, binary and ternary phase transformations, solution models and selected topics. Prerequisite: CH 341 or equivalent. (Same as CHE 646 and CH 646.)

649 Polymer Synthesis and Characterization 3 hrs.
Synthesis of commercially relevant and novel polymers. Polymer characterization and discussion of the structural dependence of polymer properties. Prerequisites: CH 331. (Same as CH 540.) 600-level credit only upon approval of campus MTS program director. Students who have successfully completed CH 540 cannot also receive credit for CH 440 or MTS 649.

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.
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, CH 343 or PH 351, MA 244, 324. (Same as PH 451, PH 551, OSE 555, CH 553.) 600-level credit only upon approval of campus MTS program director. Fall.

652 Introductory Quantum Mechanics II 3 hrs.
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: CH 553 or PH 551. (Same as PH 452, PH 554, CH 554.) 600-level credit only upon approval of campus MTS program director. Spring.

660 Introduction to Solid State Physics I 3 hrs.
Crystal binding and crystal structure. Crystal structure determination. Phonons and lattice vibrations. Free electron gas. Electronic energy band theory. Prerequisite or parallel: PH 651. (Same as PH 560.) 600-level credit only upon approval of campus MTS program director. Fall.
661 Introduction to Solid State Physics II 3 hrs.
Thermal properties of solids. Electronic properties, optical properties, electronic properties in a magnetic field, semiconductor devices, magnetism, superconductivity, defects and alloys, dislocations and crystal growth, non-crystalline solids, surfaces and interfaces. Prerequisite: PH 560. (Same as PH 561.) 600-level credit only upon approval of campus MTS program director. Spring.

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.

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

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). Prerequisite: 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. Prerequisite: 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. Prerequisite: 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. Prerequisite: Upper division undergraduate background in thermodynamics and physical chemistry.

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.

Interdisciplinary Programs 68
747 Polymer Physical Chemistry 3 hrs.
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. Prerequisites: CH 341, 540. (Same as CH 645.)

780 Materials Science Seminar 1 hr.
Required of doctoral students during each semester of residence. This course may not be used to meet minimum degree requirements

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. A minimum of 18 hours is required.

OPTICAL SCIENCE & ENGINEERING PROGRAM

Degree: Doctor of Philosophy

Program Director: John O. Dimmock, Professor (PH)

400-E Optics Building
Telephone: (256) 824-2512
Email: dimmockj@uah.edu

Professors:
- Adhami, R. (ECE); digital signal/image processing
- Dimmock, J.O. (PH); spectroscopy
- Emslie, A.G. (PH); astrophysical optics
- Fork, R.C. (ECE); optical communications, lasers
- Gilbert, J.A. (MAE); applied optics, solid mechanics, fiber optic sensing, panoramic imaging
- Gregory, D.A. (PH); optical processing
- Hillman, L.W. (PH); geometric optics, laser dynamics, radiometry, medical optics
- Kulick, J.H. (ECE); computer-generated holography, medical image processing
- Madarasz, F.L. (OSE); solid state optics, non-linear optics
- Nordin, G.P. (ECE); diffractive optics, holography, physical optics, optoelectronics
- Nayyer, J (ECE); optical communications, optical devices
- Poularikas, A.D. (ECE); statistical optics, signal processing
- Stensby, J.L. (ECE); statistics, communications
- Vikram, C.S. (OSE); holography, speckle interferometry and metrology

Associate Professors:
- Boykin, T.B. (ECE); semiconductor device modeling
- Geary, J.M. (CAO); optical testing and metrology, lens design
- Reardon, P. J. (CAO); optical design, metrology

Assistant Professors:
- Pakhomov, A.V. (PH); laser induced plasma, spectroscopy
- Sanghadasa, M. R. (PH), non-linear optics, optical materials and bio-medical optics
Adjunct Faculty:

Stahl, H.P. (MSFC); optical testing, optical metrology
Smith, S. (MSFC); optical fabrication; optical testing

In addition, there are a dozen other adjunct faculty from UAH, UA, UAB, Alabama A&M, NASA Marshall Space Flight Center, and local industry.

Overview of the OSE Program

At the dawn of the 21st century, Optics stands today as an area of major scientific and technological importance. With considerable foresight, the Optical Science and Engineering (OSE) doctoral program was formally approved at UAH in 1992. Since then the program has grown steadily. Graduates of the program have little difficulty finding employment in rewarding careers. In 2000 the OSE core curriculum was redesigned to provide students more flexibility and to accommodate those coming into the program from various disciplines.

The OSE core consists of two major parts. The first part contains the following seven courses:

1) Geometrical Optics
2) Physical Optics
3) Fourier Optics
4) Optical Testing
5) Radiometry, Detectors and Sources
6) Lasers
7) Optical Testing Laboratory

This material is normally covered in the first year of graduate study, and is the basis for the Preliminary Examination given in the fall term of the second year of study. The second part consists of three focus areas, each of which contains three courses. The student is expected to select one of these areas, and is responsible for the material contained therein. The focus areas are:

A) Optical Communications
   Communications Theory
   Optical Fiber Communications
   Optical Communications
B) Quantum Physics and Devices
   Introduction to Quantum Mechanics
   Quantum Mechanics II
   Quantum Devices
C) Optical Engineering
   Lens Design
   Opto-Mechanical Design and Fabrication
   Optical System Design

This unique program is highly multi-disciplinary and is followed by a wide variety of advanced coursework and research in both fundamental and applied subjects. This diversity is reflected by the OSE faculty, which is drawn from the expertise of optical scientists and engineers from the departments of Physics, Electrical & Computer Engineering, and Mechanical & Aerospace Engineering, and from the Center for Applied Optics.

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 approved 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 (for GRE tests taken after October 1, 2002 the score on the analytical portion is obtained by taking the (raw score + 2) x 100);
3. TOEFL score greater than 550 (213 computer-based) 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 regulations. However, that student must follow the Graduate School’s policies in achieving unconditional 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 specific areas. A total of 48 semester hours of graduate coursework are required, of which 28 semester hours are in designated optics courses. An additional 18 semester hours must be in dissertation research. Students are also required to complete three semesters of Seminar in their home departments with a grade of ‘S’ (Note: seminar hours do not count toward the 48 course-hour degree requirement). In addition, all requirements of the School of Graduate Studies must be met in order to remain in good standing.

The student will complete three study phases, punctuated by three program examinations.

Phase I (the core phase) will consist of 19 semester hours of coursework. To complete this phase and become eligible for continuation in a focus 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 program faculty believe is necessary for the doctoral program. Full-time students will normally select a dissertation advisor during their first year. Once an advisor has been chosen and the Preliminary Examination passed, a graduate committee will be appointed and a Program of Study completed.

Phase II consists of coursework in the Program of Study (which includes a Focus Area). Much of this coursework will support the dissertation research to be conducted in Phase III. This phase will be completed when the student has completed most of the formal course work as prescribed in the Program of Study and has passed the Qualifying Examination which is prepared and administered by the student’s graduate committee. It will contain both written and oral parts. Questions can be drawn from part of the Program of Study (with special emphasis on the student’s Focus Area). This exam will also include a proposal for dissertation research prepared 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 related to the proposal has been reviewed, and that the student has a clear understanding of how to proceed and can set realistic goals. 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.

Phase III consists of all experimental and/or theoretical work needed to complete the student’s dissertation. These activities will be directly supervised by the student’s advisor. Since the Ph.D. is a research degree, recipients must demonstrate both the ability to perform independent and original research, and to clearly communicate this work both in written and oral formats. The Final Examination will consist of a public, oral presentation and defense of the dissertation.

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.
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. Credits earned toward a master’s degree (including up to 9 hours of master’s thesis) 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)

Below are listed all the graduate courses in optics at UAH. Currently, there are 33 offerings covering the full gamut of modern optics. Graduate courses in optics are designated as OSE, PH and/or EE. This reflects the sponsorship of the course. Multiple designations indicate joint responsibility. The OSE courses are listed with full descriptions below. This is followed by a listing of courses whose full descriptions can be found in this catalog under the appropriate department heading.

Part I - Core

541 Geometrical Optics 3 hrs.
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 541, PH 541.)

542 Physical Optics 3 hrs.
Scalar and electromagnetic waves, polarization, coherence, reflection and refraction; two beam and multiple beam interference, interferometers, Fabry-Perots, thin films, diffraction, and absorption and dispersion. (Same as EE 542, PH 542.)

546 Radiometry, Detectors, & Sources 3 hrs.
Theory and practice of radiometry and photometry. Blackbody radiation and Lambertian sources. Propagation of radiant energy in free space and through optical systems. Detector classes, responsivity, bandwidth and noise, power spectral density, properties of sources, photon noise. Prerequisite: PH 342 or equivalent. (Same as PH 546.)
632 Fourier Optics

Introducing the optical system as an invariant linear system, convolution, Sommerfield's diffraction integral, Fourier Transform, angular spectrum, coherent & incoherent imaging, optical transfer function. (Same as EE 632, PH 632.)

645 Lasers


653 Optical Testing Laboratory

Provides students with hands-on experience via the in-depth testing of an aerial reconnaissance photographic lens. The main measurement tools are a 168-inch Collimator/T-Bar nodal slide for image plane measurements, and a Fizeau phase shifting interferometer for exit pupil measurements. Measurements include: effective focal length, F-number, axial color, spherical aberration, field curvature, distortion, astigmatism, transmission, relative illumination falloff, resolution, modulation transfer function, on-axis interferometry, fringe analysis. Co- or Pre-requisite: OSE 654.

654 Optical Testing

Spherometry; refractive index measurements; optical bench measurements of imaging systems via T-bar nodal slide (effective focal length, f-number, axial color, field curvature and distortion, transverse ray aberrations); illumination falloff; image resolution tests (finite object); modulation transfer function; star image testing; knife edge tests; Hartmann tests; Fizeau interferometer and testing configurations; null lens testing of aspheres; wavefront measurements (point diffraction interferometer, radial shear interferometer); Prerequisites: OSE 541, 542. (Same as PH 654.)

Spring.

Part II - Focus Areas

A. Optical Communications

Communications via free-space, and guided-wave light signals.

506 Communication Theory

Review of elementary signals and systems including the Hilbert transform, cross and auto correlation, power density spectrum, and the Wiener-Khintchine theorem. Butterworth and Chebyshev lowpass filters. Bandpass signals and systems. The lowpass equivalent of a bandpass signal/system. Commonly used forms of linear and nonlinear modulation. Demodulation methods and circuits. Phase lock and frequency feedback techniques. Prerequisite: EE 382 (Same as EE 426/506.)

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. (Same as EE 534.)

634 Optical Communications

Optical communication systems; counting statistics; the optical detector response process; direct detection; heterodyne detection parameter estimation in optical communications; pointing, spatial acquisition and tracking. Prerequisite: EE 506. (Same as EE 634).
B. Optical Physics & Devices

Foundation and basis of operation of solid state opto-electronic devices.

**555 Introductory Quantum Mechanics I**

3 hrs.

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, PH 351 or CH 343, MA 244, 324. (Same as PH 451, PH 551, CH 553, MTS 651.) Fall.

**655 Applied Quantum Mechanics**

3 hrs.

Application of quantum mechanics in solid state, electronics, materials science and optics. Topics to include: Hydrogen atom and molecule, excitons, phonons, Bloch’s theorem, periodic boundary conditions, electrons and holes, band structure of simple semiconductors, dipole transitions, optical constants, absorption and emission processes, introduction to device physics. Prerequisite: PH 551 or OSE 555, spring of odd numbered years (Same as PH 652.)

**755 Quantum Devices**

3 hrs.

Quantum aspects of optical, electronic, and semiconductor devices approached from a phenomenological/physical point of view. Topics will include: Quantum well devices, optical modulators, optical detectors, quantum Stark effects, electrooptic devices, high speed optical devices, frequency chirping in high speed devices and system applications. Prerequisite: PH 652 or OSE 655. Fall of odd numbered years. (Same as PH 733.)

C. Optical Engineering

Multi-disciplinary application of optics to the controlled propagation of light, imaging systems, and optical instrumentation.

**656 Lens Design**

3 hrs.

Design of refractive imaging systems. Skills acquired include thin lens pre-design, first and third order analytical methods, and computer-based design using Zemax. Designs include: Wollaston and Chevalier landscape lenses, a 10X microscope objective, the Rapid Rectilinear and Celor lenses, Cooke triplet and Petzval portrait lenses, and a telephoto lens. Prerequisite: OSE 541. Fall.

**670 Optomechanical Design and Fabrication**

3 hrs.

Practical aspects of optomechanical design, material selection, fabrication and integration of precision optical components and systems for commercial, space, and military application. Topics include: fixture design, tolerance analysis, machining methods, thermal stabilization, integrated computer-aided design and analysis, diamond machining, finishing and plating techniques. Prerequisite: OSE 541. (Same as PH 670.)

**710 Optical System Design**

3 hrs.

Integrated view of what it actually takes to build a real optical system. All the tools of the “trade” are utilized, including conceptual design and computer modeling (optical and mechanical), control system design, fabrication issues, cost/schedule and system testing. Use of geometric and physical optics, radiometry, sources and detectors, electro-optics controlled positioning and feedback, environmental influences, optical systems architecture, opto-mechanical design, precision optics fabrication technologies, optical metrology, and operational and survivability testing. Prerequisite: OSE 670.

**690/790 Selected Topics in Optical Science & Engineering**

3 hrs.

Sample topics include optical thin films and optical instrument systems analysis.
This “brown bag” monthly seminar series is conducted jointly with the Huntsville Electro-Optical Society which sponsors the speakers. Presentations are given on a diverse range of optics and optics-related topics. All OSE students are expected to attend three of these seminars per semester until they pass their Qualifying Exam. There is no credit for this seminar.

**799 Doctoral Dissertation**

3, 6, or 9 hrs

Required each semester student is enrolled and receiving direction on a doctoral dissertation.

The following optics courses are also available to students in the OSE program. See listings under indicated departments.

**Electrical Engineering**
- EE 532 Optical System Design 3 hrs.
- EE 633 Electro-Optical Engineering 3 hrs.
- EE 634 Optical Communications 3 hrs.
- EE 733 Nonlinear Optical Devices and Applications 3 hrs.
- EE 734 Fiber Optics 3 hrs.
- EE 735 Statistical Optics 3 hrs.
- EE 738 Optical Transform & Pattern Recognition 3 hrs.

**Physics**
- PH 544 Opto-Electronics 3 hrs.
- PH 570 Optical and Photonic System Design 3 hrs.
- PH 645 Lasers (quantum treatment) 3 hrs.
- PH 733 Quantum Devices 3 hrs.
- PH 745 Quantum Electronics 3 hrs.

**Mechanical Engineering**
- MAE 546 Solar Energy Systems 3 hrs.
- MAE 677 Optical Techniques in Solid Mechanics 3 hrs.
- MAE 757 Optical Techniques in Fluid Mechanics 3 hrs.
COLLEGE OF ADMINISTRATIVE SCIENCE

202 Administrative Science Building
Telephone: (256) 824-6735
Email: deanadsc@uah.edu

Degrees:
Master of Accountancy
Master of Science in Management Information Systems
Master of Science in Management

Dean: C. David Billings, B.S., Ph.D., Professor of Finance
Associate Dean: J. Daniel Sherman, B.S., M.A., Ph.D., Professor of Management

Accounting and Information Systems
126 Administrative Science Building
Telephone: (256) 824-6159
Email: acc-mis@uah.edu.
Chair: Jatinder Gupta, Professor

Professor:
Gupta, J.; supply chain management

Associate Professors:
Bryson, R.E., Jr.; financial accounting
Pendley, J.; accounting information systems

Assistant Professors:
Kile, C.; financial statement analysis, accounting theory
Li, X.; management information systems
Maddocks, P.M.; auditing, accounting information systems
Mok, W.Y.; management information systems
Reed, D.; financial accounting, not-for-profit and government accounting

Economics and Finance
333 Administrative Science Building
Telephone: (256) 824-6590
Email: wilhitea@uah.edu
Chair: Allen Wilhite, Professor

Professors:
Billings, C.D.; government financial management, systems analysis
Bond, M.S. (Emeritus); comparative economic systems and history of economic thought
Evans, D.A.; behavioral finance
Paul, C.W. II (Emeritus); applied microeconomic theory, public choice
Schnell, J.F.; industrial relations, labor economics
Schoening, N.C.; regional economics
Stafford, E.F., Jr.; production scheduling, systems simulation, manufacturing
Wilhite, A.W.; computational economics, agent-based modeling

Associate Professors:
Allen, W.D.; applied microeconomics, labor economics
Burnett, J.E.; investments
Tseng, F.T.; management science, production/operations management

76
Assistant Professor:
Hall, T.; financial institutions and regulation

Lecturer:
Ballenger, J.P.; software engineering

Management and Marketing
355 Administrative Science Building
Telephone: (256) 824-6680
Email: mgt-mkt@uah.edu
Chair: James T. Simpson, Professor

Professors:
Gramm, C.L.; industrial and labor relations, human resource management
Graves, B.B. (Emeritus); strategic management
McCollum, J.K. (Emeritus); labor relations, organizational theory
Rhoades, R.G.; management of R & D
Sherman, J.D.; organizational behavior, theory, management of innovation
Simpson, J.T.; marketing channels, marketing high technology products
Souder, W.E. (Emeritus); management of technology

Associate Professors:
Berkowitz, D.; marketing strategy, new product development
Wren, B.M.; market research, sales, business-to-business marketing

Assistant Professors:
Bao, Y.; consumer behavior, international marketing
Weatherly, E.W.; human resource management, strategy

Accreditation and Membership
The Bachelor of Science in Business Administration (B.S.B.A.), the Master of Accountancy (M.Acc.), the Master of Science in Management (M.S.M.), and the Master of Science in Management Information Systems (M.S.M.I.S.) programs offered by the College of Administrative Science are accredited by AACSB International - The Association to Advance Collegiate Schools of Business.

The AACSB International 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 International is the premier accrediting agency for bachelor’s, master’s and doctoral degree 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.

Mission
The College of Administrative Science strives to meet the educational needs of our students by being the premier business school in north Alabama and a superior center for research in business including management of science and technology.
Center for the Management of Science and Technology (CMOST)
350 Administrative Science Building
Telephone: (256) 824-6407
Email: cmost@uah.edu

The Center for the Management of Science and Technology’s broadest goal is to improve the state-of-the-art in the management of organizations that are substantially impacted by science and technology. Specifically, CMOST is devoted to the development of new practices appropriate for the management of high technology commercial and governmental organizations. CMOST conducts research to develop new management strategies, techniques and competencies to help firms manage the high risks and uncertainties that characterize Huntsville’s high technology industry. In addition, the Center’s staff does contract research on business, management and economic problems for governmental organizations and private industry.

Center for Management and Economic Research (CMER)
350 Administrative Science Building
Telephone: (256) 824-6407
Email: cmer@uah.edu

The center stimulates expansion of North Alabama’s economy by helping local managers define and realize growth opportunities and solve specific problems. It serves individuals and organizations through management and technical assistance, dissemination of economic and socio-economic information, and conducting research studies. Special emphasis is placed on businesses in technological fields.

Assistance areas include computer information systems, accounting, marketing, business strategy, human resource management, labor relations, organizational behavior, and organizational development.

CMER offers customized training programs for business and organizations. Training areas include microcomputer applications, accounting information systems, marketing, finance, competitive positioning, communication, strategic management, organizational design, and international business.

The center conducts research studies for organizations. Typical studies include economic impact studies, benefit cost analysis, fiscal impact analysis, and technology assessment.

NorthEast Alabama Regional Small Business Development Center
225 Church Street
Telephone: (256) 535-2061
Email: smallbus@hsvchamber.org

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, P. O. Box 168, Huntsville AL 35804-0168; FAX: (256) 535-2050.

**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 offers an interactive blend of management educational programming ranging from one-session seminars on specific problems to a substantial sequence of classes custom tailored for corporate and governmental audiences. For more information, contact the Executive Education Program Office. Mail: ASB 202, UAH, Huntsville AL 35899. Phone: (256) 824-6735. FAX: (256) 824-6328. Email: executiv@uah.edu.

**Master of Science in Management**

**Purpose**

The Master of Science in Management (M.S.M.) 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 technology-impacted organizations in the Huntsville region and beyond.

The M.S.M. 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 M.S.M. program is recognized internationally through accreditation by AACSB-The International Association for Management Education and nationally 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 M.S.M. 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 technology-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 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 objectives of the organization.

Admission Procedures

Individuals who are interested in obtaining application forms and information concerning admission procedures should contact the College’s Associate Dean, Room 102, Administrative Science Building. The telephone number is (256) 824-6024. The email address is gradbiz@uah.edu. The College’s home page can be accessed through:

http://www.uah.edu/colleges/adminsci/

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 approved institutions. Individuals with baccalaureate degrees in any field of study are eligible to apply to the M.S.M. program. Students may have backgrounds in such diverse fields as engineering, business, liberal arts, education, science, and healthcare. Highly qualified science and engineering students seek the M.S.M. degree to broaden their educational backgrounds and to prepare for careers in management. Highly qualified business students seek the M.S.M. degree to prepare for technology-based or technology-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.

The GMAT is a Computer Adaptive Test (CAT) given throughout North America and at many international sites. The test is administered through individually scheduled appointments. 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. Other points of contact are: Phone (609) 771-7330; email gmat@ets.org; and their website: http://www.gmat.org. Applications to take the GMAT may be obtained from the College’s Associate 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 institution code for UAH is 1854.

In order for applicants to receive full consideration from the admissions committee, all applications materials (graduate application, official copies of all transcripts, and official GMAT score report) should be received in a timely manner. Use the following dates as a guideline:

<table>
<thead>
<tr>
<th>For admission in</th>
<th>Preferred date for all materials</th>
<th>The latest date for all materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall semester</td>
<td>June 1</td>
<td>August 10</td>
</tr>
<tr>
<td>Spring semester</td>
<td>October 1</td>
<td>December 10</td>
</tr>
<tr>
<td>Summer term</td>
<td>March 1</td>
<td>May 1</td>
</tr>
</tbody>
</table>

There is no guarantee that materials received after the latest guideline dates will be processed in time for enrollment in the next semester. Incomplete applications that cannot be processed will be considered for the next semester. Applicants should allow about three weeks from the date the GMAT is administered for official scores to reach the College. Adequate lead time should also be allowed for the receipt of official transcripts from other universities.
Admission Requirements

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. Successful applicants may be admitted in one of the following two categories:

1. Unconditional Admission

Applicants will be considered for unconditional admission if they obtain a GMAT total score of at least 450, and an index of at least 1000 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 requirements are not guaranteed admission into the M.S.M. program. In making the admission decision the Admissions Committee also considers the applicant's baccalaureate program of study, verbal skills, quantitative skills, writing skills, and work experience.

2. Conditional Admission

An applicant whose scholastic record does not fully meet the requirements for unconditional admission may, upon recommendation of the faculty admissions committee and with approval of the graduate dean, be admitted on a conditional basis. Conditionally admitted students must still obtain a GMAT total score of at least 450 to show high promise of success in graduate management study, but they may have a deficiency in an important academic area. If the deficiency can be remedied with additional coursework, a student admitted on a conditional basis may be required to complete additional undergraduate coursework in the area of deficiency during the first semester of study. Coursework must be completed with a minimum grade of B.

Students who are admitted conditionally and fail to obtain an overall grade average of B (3.0) by the end of the semester in which they complete 12 hours of graduate coursework will be dismissed from the College's graduate programs.

International Students

International students must meet further admission requirements in addition to those listed above. International students whose native language is not English must score at least 550 (213 computer-based) on the TOEFL examination and at least 18 on the verbal section of the GMAT. Exceptions to this requirement are made for international students already possessing an undergraduate or graduate degree from a U.S. university.

If admitted, most international students whose native language is not English must take an English Language Placement Test when they arrive. Any English language deficiencies must be remedied through required English as a Second Language (ESL) courses. For exceptions to this requirement, see the section on Graduate Admissions Information.

All international students must have their transcripts evaluated by a foreign credential evaluation service to determine the U.S. equivalency of their degrees and coursework. Several services provide these evaluations, including World Education Services (WES), P.O. Box 745, Old Chelsea Station, New York, NY10113-0745. Applicants should request both an evaluation of degree equivalency and a course-by-course evaluation.

International students should begin the application process at least six months prior to the desired enrollment date.

Advisement and Registration Procedures

After being admitted to the program, each student should meet with the M.S.M. Program Advisor to outline a degree program, including choice of electives. Each student must file a Program of Study before the completion of 12 hours of graduate work. Before enrolling in any course, students should be aware of the prerequisites for the course and make sure they have completed them.

A major premise underlying counseling at the graduate level in the College of Administrative Science is that each student will act in his/her 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 may wish to take a departmental 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.

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.

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 M.S.M. 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 “C”. At the time a student is admitted to the program, the transcript is reviewed to determine if these courses have been satisfied. The M.S.M. 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 Requirements

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 – M.S.M. 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 – M.S.M. 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 MGT 698 with a grade of A or B.
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 M.S.M. curriculum. The following list constitutes the courses at UAH most frequently used to provide students with basic skills in the three areas:

- EH 101 and 102 (English Composition) 6 hrs.
- MA 120 (Math Applications II) 3 hrs.
- MSC 287 (Statistics) 3 hrs.
- MIS 146 (Computer Usage) 3 hrs.
- 15 hrs.

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 M.S.M. student must be proficient with basic computer skills that include the use of operating systems, word processing, spreadsheet, and presentation 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 appropriate computer courses 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 M.S.M. 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 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:

- ACC 600 Foundations of Accounting for Managers 3 hrs.
- ECN 600 Foundations of Economics 3 hrs.
- MGT 600 Organizational Theory, Behavior & Environment 3 hrs.
- MKT 600 Survey of Marketing Management 3 hrs.
- MSC 600 Operations Management 3 hrs.
- 18 hrs.

Any part of this business administration core areas curriculum requirement, except for FIN 601, may be completed at the undergraduate level. A student may be waived from a core area course by having completed approved substitute undergraduate coursework with a minimum grade of "C". At the time a student is admitted to the program, the transcript is reviewed to determine if any of the core area courses have been satisfied.

Core Area Course | UAH Courses Needed to Waive
--- | ---
ACC 600 | ACC 211 and ACC 212
FIN 601 | Cannot Be Waived
ECN 600 | 6 hours of economics
MGT 600 | BLS 211 and MGT 301
MKT 600 | MKT 301
MSC 600 | MSC 288 and MSC 385

83 College of Administrative Science
E. Advanced Curriculum

The advanced curriculum focuses on the management of technology, and consists of the following courses plus FIN 601:

- ACC 602 Managerial Accounting 3 hrs.
- ECN 626 Managerial Economics & Technology 3 hrs.
- MGT 601 Introduction to Technology Development 3 hrs.
- MGT 622 Management of Technical Professionals 3 hrs.
- or
- MGT 698 Strategic Management 3 hrs.
- MIS 634 Management of Information Technology 3 hrs.
- MKT 604 New Product Development 3 hrs.
- MKT 606 Marketing in a High Technology Environment 3 hrs.
- Electives
  - Students following Plan I select 6 hours of thesis
  - Students following Plan II select 6 hours of graduate electives

F. Areas of Specialization

Electives are available for specializing in a specific functional area or for generalizing across several functional areas. Areas of specialization in the M.S.M. program are Management Information Systems (MIS), Human Resource Management (HRM), and Marketing. An area of specialization has a maximum of twelve semester hours. Courses required to fulfill each area of specialization are listed below.

The area of specialization in Management Information Systems includes MIS 634 and three of the following: MIS 500, 597, 520, 540, 560, 565, 580, 640, 655, 660, 670.

The area of specialization in Human Resource Management includes MGT 622, 631, and two of the following: MGT 560, 561, 562.

The area of specialization in Marketing includes MKT 604, MKT 606 and two of the following: MKT 515, 570, 580, 602, 611, 650.

G. Strategic Management Requirement

Formally the curriculum includes two courses, Introduction to Technology Development (MGT 601) and Strategic Management (MGT 698) as the primary means of integrating the core areas and applying cross-functional approaches to organizational issues. 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.

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, multi-functional, 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.

**Course Scheduling**

Classes in the fall and spring semesters meet one night per week from 5:30 P.M. to 8:20 P.M. The summer term consists of two successive five-week sessions. In each session, classes meet two nights per week from 5:30 P.M. to 8:50 P.M. Periodically updated course rotation schedules are available from the M.S.M. Program Advisor.

A proper sequence of courses is necessary to ensure 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 M.S.M. Program Advisor 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 acquired by completing undergraduate courses, presenting prior experience or by passing departmental validation examinations;
2. Complete the courses in the business administration core areas;
3. Complete MGT 601, Introduction to Technology Development, in the first semester that advanced courses are scheduled;
4. Complete MKT 604 after MGT 601, and before MKT 606;
5. MGT 698, Strategic Management, 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 begin the program in the fall or spring semester or the summer term.

**MD/MSM Leaders in Medicine**

Offered through the University of Alabama School of Medicine and the College of Administrative Science, the MD/MSM Leaders in Medicine program provides individuals seeking the MD degree with the competencies needed to manage a group practice, develop a health program for industry or federal/state governmental agencies, or serve as a senior manager in a hospital, clinic, or large clinical department.

For students receiving their baccalaureate degree from UAH through the MSM/Premed Student Scholar Program, the program allows them to complete both the M.S.M. and M.D. degrees in a total of five years beyond the baccalaureate instead of the six years normally required. Other models are available for students who do not receive their baccalaureate degree from UAH, students who have previously received a baccalaureate degree and have decided to return to medical school, and medical students who wish to obtain the M.S.M. degree after entering medical school.

Interested students should contact the M.S.M. Program Advisor, ASB 102, 824-6024.

**Master of Accountancy**

**Purpose**

The purpose of the M.Acc. program is to provide students with the background necessary to enter a career in public, private, or government accounting. The program is also designed to satisfy the 150 semester hours required by the Alabama State Board of Public Accountancy for Certified Public Accountant (CPA) examination candidates. The program exceeds the educational requirements for membership in the American Institute of Certified Public Accountants (AICPA), as well as those to sit for the Certified Management Accountant (CMA) and Certified Internal Auditor (CIA) examinations.
Reflective of the academic environment of UAH and the Department of Accounting and Information Systems, distinguishing features of the program include an information systems emphasis and a focus on understanding the role of accounting in managing business processes. Highly qualified undergraduate accounting graduates may be able to complete the requirements for the M.Acc. degree in one additional year of full-time course work beyond the bachelor's level. Individuals interested in the M.Acc. program should contact the M.Acc. Program Advisor in Room 102, Administrative Science Building, or call (256) 824-6577.

Application Procedures and Criteria

Admission procedures are the same as for the M.S.M. program. Successful applicants may be admitted in one of the following two categories:

1. Unconditional Admission

The minimum criteria for unconditional admission include the completion of prerequisite course and grade requirements obtaining a GMAT total score of at least 450, and obtaining an index of at least 1000 based on the formula: 200 times the overall undergraduate grade point average (based on a 4.0 scale) plus the GMAT total score. Applicants meeting the formula are not guaranteed admission into the M.Acc. program. Other factors include the pattern of grades in specific courses, work experience, program capacity, and verbal, quantitative, and writing skills. Students are also required to have a minimum grade of "C" in all specific prerequisite courses.

2. Conditional Admission

Requirements for conditional admission are the same as those for the M.S.M. program.

International Students

Requirements for conditional admission are the same as those for the M.S.M. program.

Program Prerequisites

Students must have a minimum grade of "C" in prerequisite courses, which are as follows:

### Basic skills and business core:

- Written and oral communications: 6 hrs.
- Calculus: 3 hrs.
- Microcomputing: 3 hrs.
- Statistical analysis: 3 hrs.
- Legal environment of business: 3 hrs.
- Principles of economics: 6 hrs.
- Principles of finance: 3 hrs.
- Principles of marketing: 3 hrs.
- Operations management: 3 hrs.
- Organizational theory, behavior, and environment: 3 hrs.

### Accounting:

- Accounting information systems: 3 hrs.
- Intermediate financial accounting I and II: 6 hrs.
- Income tax I: 3 hrs.
- Cost accounting: 3 hrs.
- Auditing: 3 hrs.

Students planning to sit for the CPA examination should complete at least one of the following as an undergraduate: ACC 432-Advanced Auditing; ACC 413-Corporation, Partnership, and Estate Taxes; ACC 417-Government (Fund) Accounting. Students desiring to develop an emphasis in information systems are encouraged to take a programming course as an undergraduate.
Degree Requirements

The M.Acc. program normally consists of 33 semester hours of graduate coursework. The program includes 15 to 21 semester hours of accounting (including at least 15 at the 600-level) and 12 to 18 semester hours in other disciplines (including at least 9 at the 600-level). The accounting theory class, ACC 680, should be taken toward the end of the student's program, and must be completed with a grade of A or B. A maximum of 6 semester hours of graduate work may be transferred from another institution or taken at another institution while enrolled at UAH. A sample program is presented below.

Accounting: 600-level

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC 614 Cost Management</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>ACC 607 Advanced Accounting Information Systems</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>ACC 600 level elective or thesis</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>ACC 600 level elective or thesis</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Total accounting 600-level</td>
<td>15 hrs.</td>
</tr>
</tbody>
</table>

Non-Accounting: 600-level

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIS 634 Management of Information Technology</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Non-accounting 600-level electives</td>
<td>6 hrs.</td>
</tr>
<tr>
<td>Total non-accounting 600-level</td>
<td>9 hrs.</td>
</tr>
</tbody>
</table>

Electives at any level*

<table>
<thead>
<tr>
<th>Elective</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non accounting elective</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Free electives (may be accounting)</td>
<td>3-6 hrs.</td>
</tr>
<tr>
<td>Total electives at any level</td>
<td>6-9 hrs.</td>
</tr>
<tr>
<td>Total for program</td>
<td>30-33 hrs.</td>
</tr>
</tbody>
</table>

*Students planning to sit for the CPA examination must complete the subject matter of the following: (At least one of these accounting courses should be completed before entering the program.)

- BLS 511 - Business Law for Accountants
- ACC 513 - Corporation, Partnership, and Estate Taxes
- ACC 517 - Governmental (Fund) Accounting
- ACC 532 - Advanced Auditing

Information Systems Audit and Control (ISAC) Track

ISAC is a track within the existing UAH M.Acc. program. It provides a focal point of study for students with an undergraduate degree in accounting (or the equivalent) who have an interest in graduate education in accounting and information technology. Because the ISAC track requires extensive coursework in information systems, it may not be possible for students electing this track to complete the coursework required to sit for the CPA examination within the framework of 33 semester hours of graduate coursework. While students can develop a M.Acc. program of study to meet their particular background and career goals, it is useful to view the ISAC track as an alternative to the CPA track in the M.Acc.

Although not required, it is recommended that UAH undergraduate accounting majors interested in the ISAC track select ACC 432 Advanced Auditing as one of their accounting electives and MIS 420 Electronic Commerce as a non-accounting elective within the College of Administrative Science. Also recommended, but not required, are BLS 411 Business Law for Accountants as a non-accounting elective within the College, and two programming courses (CS102 Introduction to C Programming and CS104 Introduction to Computer Science (JAVA)) as electives from outside the College of Administrative Science. A sample program for the ISAC track is presented below:
ACC: 600 level requirements (15 semester hours)

ACC 614 Cost Management 3 hrs.
ACC 607 Advanced Accounting Information Systems 3 hrs.
ACC 642 Advanced Internal and Operational Auditing 3 hrs.
ACC 6XX Accounting Elective 3 hrs.

MIS: 600 level (12 semester hours)

MIS 634 Management of Information Technology 3 hrs.
MIS 640 Relational Database Management Systems 3 hrs.
MIS 660 Information Security Management 3 hrs.
MIS 670 Business Contingency Planning 3 hrs.

MIS: 500 level (6 semester hours)

MIS 597 Information Systems Design 3 hrs.
MIS 560 Data Communications and Distributed Processing 3 hrs.


Thesis Option

A thesis option requiring 30 semester hours of graduate work, including 6 hours of thesis credit is available. Students interested in this option should contact the Director of the M.Acc. Program before completing 12 hours of graduate study.

Advising and Registration Procedures

After being admitted to the program, each student will meet with the Director of the M.Acc. Program to outline a degree program. Each student must file a Program of Study before completing 12 hours of graduate work. Before enrolling in any course, students should be aware of the prerequisites for the course and make sure they have completed them. To ensure course availability, students are encouraged to pre-register for classes during the priority registration period.

Transfer Credit

Up to 12 semester hours of graduate credit taken at other universities may be transferred to meet M.Acc. degree requirements. The acceptability of specific courses is determined by the Director of the M.Acc. Program.

Master of Science in Management Information Systems (M.S.M.I.S.)

Purpose

The purpose of the M.S.M.I.S. program is to provide students with advanced preparation as a specialist to enter a professional career involving the use, definition, analysis, design, implementation, and operation of management information systems. While the program will provide students with the background to enter the information technology (IT) profession in a wide variety of positions, the overall structure of the program is designed to provide students with the educational framework appropriate for a career leading to an executive level position in IT. Program prerequisites are kept to a minimum and the program is designed to meet the needs of students with a wide variety of educational backgrounds. Applicants with an undergraduate degree in M.I.S. will likely have completed all course prerequisites.

Application Procedures

Admissions procedures are the same as for the M.S.M. program. Keep in mind that space in the

College of Administrative Science 88
M.S.M.I.S. program is limited and it is possible that all available seats will be filled before the latest date for review of application materials.

1. Unconditional Admission

The minimum criteria for unconditional admission include the completion of prerequisite course and grade requirements, obtaining a GMAT total score of at least 450, and obtaining an index of at least 1000, based on the following formula: 200 times the overall undergraduate grade point average (based on a 4.0 scale) plus the GMAT total score. Applicants meeting the formula are not guaranteed admission into the M.S.M.I.S. program. Other factors include the pattern of grades in specific courses, work experience, program capacity, and verbal, quantitative, and writing skills. Students are also required to have a minimum grade of “C” in all specific prerequisite courses.

2. Conditional Admission

Requirements for conditional admission are the same as those for the M.S.M. program.

Program Prerequisites

Program prerequisites include a bachelor's degree in any field and computer proficiency in an operating system and an office suite. While the proficiency can be achieved through self-study or non-credit training courses, the expected level of proficiency is comparable to that obtained by students completing MIS 146-Computer Applications in Business. The remaining course prerequisites are:

- One semester of graduate, or two semesters of undergraduate, accounting.
- One semester of computer programming (any language).
- One semester of economics which includes microeconomics.
- One semester of calculus.
- One semester of statistics.
- One semester of business communications.

The business communication requirement may be fulfilled by a professional writing or speaking course beyond the freshman or sophomore level. It cannot be fulfilled by a freshman composition or speech course. The key is advanced organizational skills for communications with professionals. Hence communications courses intended for professional groups, such as engineers, managers, or scientists are acceptable. UAH courses meeting the communications requirement include CM 313 Business and Professional Communication, EH 300 Strategies for Business Writing, and EH 301 Technical Writing.

Applicants with an undergraduate degree in MIS will likely have completed all prerequisites. Applicants with degrees in other areas will likely have completed two or three of these course prerequisites. Applicants lacking adequate background will be required to complete the M.S.M.I.S. program prerequisites prior to enrolling in 600 level MIS courses.

Degree Requirements

The M.S.M.I.S. program normally consists of 33 semester hours of graduate coursework. The program includes 21-24 semester hours of MIS (including at least 15 at the 600-level) and 9 to 12 semester hours in other disciplines (including at least 9 at the 600-level). MIS 680 Enterprise Resource Planning (ERP) Systems is a capstone course and should be taken toward the end of the student's program, and must be completed with a grade of A or B. A sample program is presented below.

MIS: 600 level (15 semester hours)
- MIS 634 Management of Information Technology
- MIS 640 Relational Database Management Systems
- MIS 655 Advanced Databases and Applications Development for Management
- MIS 680 Enterprise Resource Planning (ERP) Systems
- MIS 6xx Elective
Non MIS: 600 level (9 semester hours)

ACC 602 Managerial Accounting
MSC 600 Operations Management
FIN 601 Financial Decisions Under Uncertainty

Electives at 500 or 600 level, at least two of which must be MIS electives (9 semester hours)

MIS Elective
MIS Elective
Elective

Recommended electives. M.S.M.I.S. students must take courses identified with an asterisk (*) if they have not had previous courses in these areas.

ACC 607 Advanced Accounting Information Systems
ECN 626 Managerial Economics and Technology
*MIS 597 Information Systems Design
*MIS 520 Electronic Commerce
MIS 540 Web Programming and Database Integration
*MIS 560 Data Communication and Distributed Processing
MIS 565 Web Server Environment and Internet Technologies
MIS 570 Management of the Microcomputer Environment
MIS 580 Seminar in Management Information Systems
MIS 650 Selected Research Topics
MIS 660 Information Security Management
MIS 670 Business Contingency Planning (and disaster recovery).
MIS 675 Information Resource Management.
MIS 699 Master’s Thesis
MGT 600 Organizational Theory, Behavior and Environment
MGT 622 Management of Technical Professionals.

Graduate Certificate in Information Assurance

The College of Administrative Science collaborates with the Department of Electrical and Computer Engineering and the Department of Computer Science to offer an interdisciplinary graduate certificate program in Information Assurance. Contact the College for further details.

Thesis Option

A thesis option requiring 30 semester hours of graduate work, including 6 hours of thesis credit, is available. Students interested in this option should contact the M.S.M.I.S. Program Advisor before completing 12 hours of graduate study.

Advising and Registration Procedures

After being admitted to the program, each student will meet with the M.S.M.I.S. Program Advisor to outline a degree program. Each student must file a Program of Study before completing 12 hours of graduate work. Before enrolling in any course, students should be aware of the prerequisites for the course and make sure they have completed them. To ensure course availability, students are encouraged to pre-register for classes during the priority registration period.

Transfer Credit

Up to 12 semester hours of graduate credit taken at other universities may be transferred to meet M.S.M.I.S. degree requirements. The acceptability of specific courses is determined by the M.S.M.I.S. Program Advisor.
Other Information for all Masters Programs in the College of Administrative Science

Course Load
The usual course load for a full-time graduate student is from 9 to 12 semester hours. Students who are employed full time should seek counsel from their Program Advisor before enrolling in more than 6 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 3 courses during each 12-month period following admission.

Graduate Assistantships
A limited number of graduate assistantships are available on a competitive basis to full-time students. Students interested in a graduate assistantship are encouraged to apply by the preferred date for all materials. Graduate Teaching Assistantships (GTA) in the College of Administrative Science generally require quarter time (10 hours per week) service to the College. GTAs are assigned to departments in the College and support the department's teaching program by assisting faculty with activities such as grading, course preparation, coordination of laboratories, etc. Quarter-time GTAs receive a stipend and have 6 hours of their tuition paid by the School of Graduate Studies. Graduate Research Assistantships (GRA) in the College are either internally funded, or made available through an externally funded grant or contract. They may require up to half-time (20 hours per week) service to the College, carry a stipend, and have 9 hours of their tuition paid. GRAs do research under the supervision of a faculty member. Because GTAs and GRAs assist faculty with specific instructional or research activities, the ability of applicants to assist with these specific activities is considered when awarding assistantships. Assistantship applications are available from the Associate Dean of the College.

Time Limit
All requirements for the masters degrees in the College of Administrative Science must be completed in 6 years or less. In the event a student does not complete the degree requirements in 6 years, the student may petition for an exception for courses completed at UAH over six years ago but within the last 10 years. The petition must be approved by the College's Graduate Curriculum Committee (GCC) and by the Dean of the Graduate School.

If an exception is granted, any course completed at UAH more than 6 years but less than 10 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 6-year period.

Instead of requesting an exception for a course more than 6 years old, the student may substitute another course taken within the 6-year limit, subject to approval by the Program Advisor and Associate Dean. If a course is substituted, a new program of study must be filed.

Business Practice Opportunities
Students who have no meaningful work experience or who would like to enhance their work experience have several options to do so while they are in the College's graduate programs.

In an internship students earn credit for working approximately 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 Associate Dean for the requirements to participate, and the Office of Career Services, 117 Engineering Building, for opportunities.
Co-operative Education is designed to provide relevant paid employment experiences that integrate, complement, and enhance the student's academic program. Students are placed in co-op positions in a variety of business settings, including government agencies, financial institutions, social agencies, accounting firms, entrepreneurial companies, and many others. The Co-op Office is responsible for placing qualified students with qualified employers. 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, 117 Engineering Building, 824-6741, or through the World Wide Web at http://www/uah/edu/coop/.

Through MGT 540 (Small Business Counseling) the NorthEast Alabama Regional Small Business Development Center (NEAR SBDC) provides opportunities for students to provide valuable assistance to small business owners. Teaming arrangements are available in many areas including business planning, marketing, commercialization, human resource management, government procurement, and accounting. Students earn credit for working about 10 hours per week with the small business. For additional information, contact the Associate Dean of the College.

Graduate Division Courses

Only students admitted to the graduate school may enroll in 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 enroll in courses numbered 600 and above in the College of Administrative Science unless they have been admitted to the Graduate School.

Graduate Courses in Accounting (ACC)

513 Corporation, Partnership, and Estate Taxes 3 hrs.
Tax accounting for partnerships, corporations, Sub chapter S corporations, estates, and trusts. Tax administration and research are emphasized. Prerequisite: ACC 313. F, Sp.

515 Advanced Financial Accounting 3 hrs.
Analysis of financial accounting issues and alternatives concerning business combinations, intercorporate investments, international business, and partnerships. Prerequisite: ACC 311. F.

517 Governmental (Fund) Accounting 3 hrs.
Fund accounting and local governments, hospitals, and universities. Special accounting principles, budgeting, accounting for various funds and account groups are emphasized. Prerequisite: ACC 211 or equivalent. F, Sp.

532 Advanced Auditing 3 hrs.
Practical application of auditing concepts and standards. An understanding of auditing principles is reinforced and expanded by exposure to problems and cases. Prerequisite: ACC 431. Sp, Su.

570 Seminar in Contemporary Accounting Issues 3 hrs.
Current topics in professional accounting. Prerequisite: ACC 431.

590 Special Projects 3 hrs.
Independent study in the field of accounting which is of interest to a student. Prerequisite: Permission of the Accounting Advisor. Sp.

595 Internship in Accounting 1-3 hrs.
Internship with a business or government agency that has particular relevance to the educational goals of the program. Students must keep a log and submit a report on their internship. Prerequisite: Permission of the Accounting Advisor.

College of Administrative Science 92
600 Foundations of Accounting for Managers
Graduate level introduction to the accounting framework and how it is used in evaluating economic conditions and success in decision-making in organizations. Financial statements, accounting reports, and accounting terminology that constitutes the language of business. Introduces the use of accounting information for decision-making, coordinating, motivating, and evaluating. Pre- or Co-requisite: MIS 146. F, Sp.

602 Managerial Accounting
Examines the managerial uses of accounting information but is primarily non-technical. The focus is on gaining a comprehensive understanding of accounting concepts and the accepted methods of applying these concepts in decision-making, planning, and control. Prerequisite: ACC 600 or equivalent. F, Sp, Su.

603 Financial Statement Analysis
Concepts and techniques of financial statement analysis, together with related institutional background. Topics considered include elements of financial statements, basics of analysis, short and long term debt-paying ability, analysis of profitability, problems in analyzing specialized industries, forecasting, business valuation, and equity security analysis. Case analysis is used to integrate theory with decision-making. Prerequisites: Completion of all M.Acc. program prerequisites, or ACC 602 and FIN 601.

607 Advanced Accounting Information Systems
In-depth examination of accounting information systems. Emphasis on computer-oriented systems and current developments in systems. Prerequisite: ACC 307.

614 Cost Management
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 or ACC 212 and ACC 314.

615 Advanced Financial Accounting
Analysis of issues and alternatives in advanced problem areas including partnerships, intercorporate investments, business combinations, and foreign exchange. Prerequisite: ACC 311.

642 Advanced Internal and Operational Auditing
Introduction to the methodology of internal and operational auditing and to the utilization of results of the audit by management in decision making. Prerequisite: ACC 431.

659 Selected Topics in Accounting
An in-depth examination of a topic relative to accounting by one student or a group of students. Prerequisites: ACC 602.

680 Financial Accounting Theory
A capstone course that includes a study of the historical development and theoretical structure of accounting followed by an appraisal of selected pronouncements of professional accounting organizations. Prerequisites: Completion (or concurrent enrollment) of all required courses. Normally taken during the last semester of a student’s program. Sp.

699 Master’s Thesis
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.

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.

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. Prerequisite: FIN 301.

575 Economics of Labor Markets and Human Resources 3 hrs.
Economic analysis of labor markets and institutions, focusing primarily on understanding two general types of choices: (1) the labor market choices of individuals which have implications for human resource management; and (2) the choices made by organizations in the management of their human resources and the implications of those choices for employee behavior. Specific topics include: individual decisions to supply labor, compensating wage differentials, human capital investments, discrimination in labor markets, pay and productivity, collective bargaining and strikes. Prerequisites: ECN 142 and 143 or equivalent.

600 Foundations of Economics 3 hrs.
This course provides the economic foundations necessary to understand the environment in which businesses operate. It examines the basic theory behind the output and pricing decisions of firms operating in various market structures. The central features of consumer and producer choice at the micro level are developed; and then macroeconomic issues, such as unemployment and inflation, are studied using the microeconomic underpinnings. Government policy is also addressed: efficient regulation to correct market failures at the micro level and monetary and fiscal policy at the macro level. The global economic environment is addressed by introducing students to the principles of comparative advantage and gains from trade.

626 Managerial Economics and Technology 3 hrs.
The principles of microeconomics are used to formulate and analyze problems. These principles are then applied to business decisions. The course includes an introduction to regression analysis and forecasting. Basic international economic concepts and the importance of technology are explicitly introduced. Prerequisite: ECN 600 and MSC 600.

Graduate Courses in Finance (FIN)

500 Investment Practicum 1, 2, or 3 hrs.
Small number of students work closely with faculty to invest real funds in the stock market. Emphasis is placed on individual stock selection and management of the portfolio to meet objectives. Prerequisites: FIN 301 (or its equivalent) and permission of the instructor. F, Sp, Su.

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. Prerequisites: FIN 301.
554 International Finance  
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.

561 Portfolio Management  
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. Prerequisite: FIN 361.

570 Commercial Bank Management  
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. Prerequisite: FIN 352.

578 Long-term Capital Management  
Financial theory as it relates to corporate policy, the efficient market hypothesis, capital structure theory, long-term financing and dividend policies. Prerequisite: FIN 301.

601 Financial Decisions Under Uncertainty  
Designed to introduce students to the concepts of financial decision-making in uncertain domestic and global markets, as well as providing them with a set of tools and techniques for use in financial analysis. Associated topics include financial statement analysis, financial assessments of potential capital investments, cost of capital, and risk and return. Prerequisites: ACC 600 and ECN 600.

Graduate Courses in Management (MGT)

504 Negotiation Techniques  
Develops principles, skills, and techniques for effective negotiation and conflict resolution. Describes common mistakes in negotiation and provides a framework to prepare students for business or personal negotiation sessions.

505 New Venture Strategies  
Theory and application of strategies for start-up, operation, and control of new ventures. Role of entrepreneurship in the economy. Case studies of corporate and independent new ventures. Prerequisite: MGT 301 or equivalent, or permission of instructor.

540 Small Business Counseling  
Practical exposure to problems and opportunities of small business firms. Serve as a consultant to assist local business managers with identification of problems and formulation of alternative solutions, as well as identification of areas of market opportunity. Experience gained under the supervision of the Director of the Small Business Development Center. Prerequisites: Permission of the Department Chair and approval of the SBDC Director.

550 International Business  
A cross-discipline course combining theoretical and practical aspects of doing business in the global market. Three modules consisting of international management, marketing and economics/finance cover topics including the legal, socio-political environment, negotiation/diplomacy, import/export mechanics, international distribution, balance of payments, hedging, trade agreements (GATT), and international business strategy.

560 Employee Staffing and Development  
Study of the fundamental concepts, issues and tools of employee staffing and development. Topics include forecasting staffing needs, recruitment strategies, development and validation of selection procedures, placement, socialization and development of employees, and the utilization of contingent workers.
561 Strategic Compensation Management
Introduction to the management of employees' compensation. Provides an overview of compensation practices, behavioral and economic theories of compensation, and research on compensation programs. Prerequisites: MGT 301 or equivalent.

562 Employment Law for Managers
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 separations, discrimination, compensation, occupational safety and health, privacy, union-management relations, and other terms of employment.

570 Special Topics in Technology Management
In depth study of a selected special topic relevant to the management of technology. Different sections of this course may address different topics. Prerequisite: none.

595 Internship in Management
Under the direction of a faculty advisor, student gains experience with an entrepreneur in a small business firm or a manager in a large firm. Prerequisite: Approval of department chair.

600 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.

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 the management of technology.

610 Introduction to Strategic Management of High Technology Firms
Introduction to the strategic management of technology. Topics include value chain and competitive advantage, competitor analysis, competitive strategies, vertical and horizontal diversification, and strategic management of high tech professionals. Prerequisite: Permission of Department Chair. Not available to M.S.M. or M.Acc. or M.S.M.I.S. students.

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. Emphasizes creating an organizational climate for increasing both individual and organizational innovation. Topics include incentive systems and motivation of technical professionals, problems in team decision making, job design, evaluating performance of technical professionals, leadership in the R&D organization, and career development for technical professionals. Prerequisite: MGT 600 or equivalent.

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 600 or equivalent.
629 Leadership: Theory and Practice 3 hrs.
The course explores what is known about leadership with particular emphasis on those attributes and skills that allow leaders to be effective in a variety of organizational situations. The theories of leadership are explored in a framework that includes the relationship of the leader to followers and situations. Frequent appearances by guest speakers who are themselves leaders provide the critical linkage to real world practice and allow for student interaction. Prerequisite: MGT 600 or equivalent.

631 Strategic Human Resource Management in a Technological Environment 3 hrs.
Examines the major functions of human resource management—planning, staffing, compliance with laws regulating employment relations, training and development, 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 600 or equivalent.

640 Principles of Project Management 3 hrs.
Conceptual foundation and organization of project management. The project life cycle, planning, control, marketing, utilization of human resources, and financial management.

650 Selected Research Topics 3 hrs.
Research in a particular topic relevant to a business discipline 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. Prerequisites: completion of 15 MSM credit hours and permission of the instructor.

690 Seminar in Technology Management 3 hrs.
Special topics in the management of technology. Prerequisite: Permission of instructor.

698 Strategic Management 3 hrs.
Administrative decision making with emphasis on analyzing a complex business situation, evaluating historical trends, current operational conditions, and environmental settings, in order to establish a unifying strategy; implementation of integrated functional policies; and a plan of action to achieve established objectives. Prerequisite: Completion of all required courses (or concurrent enrollment in final courses).

699 Master’s Thesis 3 hrs.
Required each semester the student is working and receiving direction on a master’s thesis. A maximum of 6 hours credit may be applied toward degree. Prerequisite: Permission of M.S.M. Advisor.

770 Organizational Research Methods 3 hrs.
Theory and practice of research methodology for study of administrative, industrial, and consumer behavior and organizations; questionnaire, field, and laboratory experimentation and statistical analysis of pre-gathered time-series and cross-sectional data; and examples of good and poor research in business disciplines. A completed individual research project of potentially publishable nature is formally presented in class. Prerequisite: ISE 790 or equivalent.

Graduate Courses in Management Information Systems (MIS)

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. Prerequisites: MIS 301 or equivalent.
520 Electronic Commerce
Explores the benefits, capabilities, and related information technologies that comprise the current state of electronic commerce. Examines how to design, develop and operate electronic commerce transaction processing based applications. Primary emphasis of the course is on web-based e-commerce systems; and the associated business models. Prerequisite: MIS 301 or database management skills.

540 Web Programming and Database Integration
Explores the use of scripting languages, such as Java Script, Active X controls, and Java Applets in web site development. Examines the use of relational databases to create dynamic web sites. Extensive exposure in lecture and laboratory to web-based application development tools. Students will develop a full-featured web based business application that is interactive and requires database integration. Prerequisite: MIS 146, or MIS 520 or the equivalent.

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. Prerequisite: MIS 301 or equivalent.

565 Web Server Environment and Internet Technologies
Examines the Internet telecommunications technologies required to implement, manage, and maintain an organization’s web site. Topics include: TCP/IP; IP addressing, subnet masks, routers, configuration and maintenance of web and DNS servers, and security issues. Prerequisite: MIS 301 or 520.

570 Management of the Microcomputer Environment
Examines management issues, such as hardware and operating system selection, associated with operating in a distributed computing business environment. Emphasis is on microcomputers using the Intel architecture and their operating systems. The course is designed for end user managers or professionals who need to understand hardware and software components and their implications without necessarily wanting to build or maintain microcomputers. Prerequisite: MIS 301 or equivalent.

580 Seminar in Management Information Systems
Selected topics reflecting contemporary issues and current technological advancements which impact the development, implementation, and management of effective information systems in organizations. Prerequisite: MIS 301 or equivalent and approval of the instructor.

595 Internship in Information Systems
Under the direction of a faculty advisor, student gains experience with information systems and technology professionals in industry. Prerequisite: Approval of Department Chair.

597 Information Systems Design
Advanced coverage of strategies and techniques of structured systems development. Emphasizes information analysis and logical specifications of the system. Students prepare exercises and case studies to develop proficiency in information analysis techniques. Integrates computer technology, system analysis, system design, and organizational behavior in designing large-scale application or decision support system. Prerequisites: MIS 310 and MIS 340, or equivalent.

634 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.
640 Relational Database Management Systems  
Explores the theories, features, and capabilities of relational database management systems in a business environment. Examines how to read and interpret database design documents and how to query database driven business applications. Emphasizes the use of database management systems in real-world business settings and how this technology can be applied effectively to solve business problems. Extensive exposure, in lecture and laboratory, to producing queries and reports from a relational database. Prerequisite: ACC 600.

650 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. Prerequisite: MIS 634.

655 Advanced Databases and Applications Development for Management  
In-depth investigation of data modeling, system development, and data administration in a database environment. Involves a course project in development and documentation of significant business applications. Emphasizes the development and use of database management systems in real-world business settings and how this technology can be applied effectively to solve business problems. Prerequisite: MIS 640 or the equivalent.

660 Information Security Management  
Examines management issues associated with the control and audit of information systems. Specific emphasis is on IT controls and their evaluation, computer-based auditing techniques, encryption, and security policies. Recent developments in IT, such as client-server systems and the Internet, and their impact on auditing, control, and security, are also considered. Prerequisite: MIS 634 or the equivalent.

670 Business Contingency Planning  
Introduces the theories and concepts of business contingency planning through risk analysis and disaster recovery planning. This course is designed to provide a greater understanding of the assessment and management of risk and disaster recovery within the organization. The course will emphasize the nature of risk, risk assessment, risk management, and disaster recovery and how these concepts can be addressed effectively through business contingency planning. Prerequisite: MIS 634 or the equivalent.

675 Information Resource Management  
Overview of the management of information systems resources of the firm. Prerequisite: MIS 497.

680 Enterprise Resource Planning Systems  
A capstone course examining the analysis, design and operation of enterprise resource planning (ERP) systems that integrate all aspects or an organization into one information system. Specific attention is given to how ERP systems facilitate the flow of information supporting core business processes and the organizations' supply chain. The course will emphasize the use of ERP systems in real-world business settings and how this technology can be applied effectively to solve business problems. Prerequisites: Completion (or concurrent enrollment) of all required courses. Normally taken during the last semester of a student's program.

699 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 MS-MIS Advisor.
Graduate Courses in Management Science (MSC)

Analysis of information support systems which aid the manager in the decision making process. Prerequisite: MIS 301 or equivalent.

600 Operations Management 3 hrs.
Survey of the concepts, processes, and institutions involved with the production function of the firm, and of the basic quantitative tools used to solve production problems. Topics include quality management, learning curves, assembly lines, linear programming, waiting lines, inventory, and others selected from operations scheduling, project management, facilities location, layout, and supply chain management. Prerequisites: MSC 287 or equivalent. Sp.

650 Selected Research Topics 3 hrs.
Research in a particular topic relevant to management science by one student or a group of students. Each student's research paper must be an original contribution showing a research design and results that meet the highest standard of management science research. Prerequisites: MSC 600 and permission of the instructor.

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 M.S.M. Advisor.

Graduate Courses in Marketing (MKT)

515 International Marketing 3 hrs.
Procedures and problems associated with establishing and carrying out marketing operations in or with foreign countries and 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.

570 Marketing in an Electronic Environment 3 hrs.
This course focuses on the strategic implications of electronic commerce for both the consumer and business-to-business marketplace. Through a combination of lectures, readings, and application exercises the impact of the Internet and related technological developments are explored in relation to their effect on the firm’s marketing activities. Topics for discussion include: advertising and selling on the Internet, the use of web sites to provide service and support to customers, supply chain management in the digital world, and data mining. Prerequisite: MKT 301 or equivalent.

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. Prerequisite: MKT 301 or equivalent.

600 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 produce pricing, promotion, and distribution strategies. Prerequisite: none.

602 Market Research Design 3 hrs.
Application based course exploring the principles and purposes of marketing research. Covers research design, questionnaire development, sample selection, data collection, data analysis, and report generation. Focus is on the gathering and use of information for better decision making. Prerequisite: MKT 600.
604 New Product Development 3 hrs.
Practical management of new product development methods and techniques from current research and successful industrial practice. An in-depth review of concepts, empirical findings, and paradigms that collectively form the foundation for the design and marketing of new products. An overview of emerging concepts, analytical techniques, empirical findings and paradigms that alter the nature, scope, and practice of marketing emerging technologies. Prerequisites: MKT 600 or equivalent and FIN 601.

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. Prerequisite: MKT 604.

611 Global Product and Brand Management 3 hrs.
Exploration of issues associated with product management, with an emphasis on managing the brand as a strategic asset. Students learn to apply analytic decision tools, write product marketing plans, and select and implement marketing strategies. Prerequisite: MKT 604.

650 Selected Research Topics 3 hrs.
Research on a particular topic relevant to marketing 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. Prerequisites: 15 hours in MSM program and approval of instructor.
COLLEGE OF ENGINEERING
102 Engineering Building
Telephone: (256) 824-6474
Email: dean@eb.uah.edu
Web page: http://www.eng.uah.edu

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

Dean: Jorge I. Auñón, B.S.E.S., M.S.E., Sc.D., Professor of Electrical and Computer Engineering
Associate Dean: Richard M. Wyskida, B.S.E.E., M.S.I.E., Ph.D., Professor of Industrial and Systems Engineering
Assistant Dean: Vacant

Mission
The mission of the College of Engineering at The University of Alabama in Huntsville is to provide students with a quality educational experience that includes engineering theory, design, experimentation and application. The College is dedicated to achieving national and international recognition for excellence in engineering education, research and service. (Approved by the College of Engineering Faculty on April 24, 2002 and by the College of Engineering Industrial Advisory Board on November 2, 2002.)

Preliminaries
Engineering is the profession that 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. An equipment fee (presently $19 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 Software Engineering, Master of Science in Operations Research, and Doctor of Philosophy. Research areas for the M.S.E. and Ph.D. are:

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 College of Engineering also participates in a Ph.D. level Biomedical Engineering program in collaboration with the University of Alabama at Birmingham (UAB). Also, a joint Ph.D. program in Civil Engineering exists with UAB. Finally, a shared Ph.D. program in Computer Engineering exists with UAB. Within UAH the College of Engineering participates in the Ph.D. level Optical Science and Engineering program, and the Ph.D. level Biotechnology Science and Engineering program. These programs are described in this catalog 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 average of B in all undergraduate work attempted and in all engineering courses, (2) to have scored at least 1500 on the aptitude portion of the GRE (for GRE tests taken after October 1, 2002 the score on the analytical portion is obtained by taking 100 times (raw score +2), or have passed the NCEES Fundamentals of Engineering Examination, 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. Outstanding (3.5 GPA) students from other technical fields may gain admittance to the College of Engineering by completing certain undergraduate courses.

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 non-degree postgraduate but denied admission to graduate school because of a deficiency in grade-point 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

Master of Science in Software Engineering

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 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, excluding Master’s Project for Plan II. Under certain conditions students may satisfy the degree requirements by satisfactorily completing 36 hours. A comprehensive final examination may be required.

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.E. 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 is a written and oral test of the student’s knowledge in the major and minor fields of study and must be administered by the Supervisory Committee within one year of the date the student completes the formal coursework on the Program of Study. The Qualifying Examination is conducted in two distinct stages that may be separated by a length of time deemed appropriate by the supervisory committee. The first stage is the demonstration that the student is proficient in the subject matter on the Program of Study. The following must be completed before taking the Qualifying 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) Supervisory Committee’s assurance of adequate preparation in the major and minor fields. Upon the recommendation of the department, a student who fails the first stage of the Qualifying Examination may repeat it after a lapse of three months. The first stage of the Qualifying Examination may not be taken more than twice. The second stage is the dissertation proposal review in which the student prepares a written report and makes a subsequent oral presentation describing the proposed research. Both the research topic and the expected approach(es) must be clearly delineated to the committee’s satisfaction in order for a pass to be granted. The oral research proposal presentation may be attempted only twice. The student must pass both stages of the Qualifying Examination to be admitted to candidacy for the Ph.D. degree.

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

Supervisory Committees
A faculty advisor who is a full member of the graduate faculty is appointed by the chair of the department and directs a student’s work until the preliminary examination is successfully completed. Thereafter the student immediately chooses a Supervisory 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 chair must be a Full Member of the graduate faculty and a member of the full-time UAH faculty. The Supervisory Committee must meet annually and submit a progress report to the student’s departmental file.

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 Supervisory Committee. One of the minors must be mathematics, and/or engineering mathematics as defined by the student's department.

All students must complete at least 60 semester hours of graduate coursework, except mechanical engineering which requires (depending on the M.S.E. coursework) a minimum of 48 hours of coursework (excluding seminars) and 18 hours of dissertation coursework. At least 33 semester hours must be in work within related departments, including credits for the major. Of these 33 semester hours, at least 18 must be within a defined major. Of the remaining 27 semester hours, a minimum of 15 semester hours of work is required for the first minor and a minimum of 12 semester hours for the second.

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

Residence Requirements
Residence may be established through either (1) being enrolled as a full-time student (at least 9 graduate semester hours) either for one continuous academic year, or for Spring and Fall semesters in the same calendar year, or (2) being enrolled in at least 6 hours of graduate course work in at least three of the four 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.

Distance Learning
Several engineering graduate programs are available to qualified graduate students through the College of Engineering Distance Learning program. Civil and Environmental Engineering (CEE) department, and Industrial and Systems Engineering and Engineering Management (ISEEM) department, have options of the M.S.E. degree available to students who cannot attend on campus classes. The ISEEM Department also has options of the departmental Ph.D. program available by distance learning. For information about the availability of other Distance Learning programs, contact the Distance Learning Office at (256) 824-6976.

Collaborative Programs with the University of Alabama at Birmingham (UAB)
A collaborative 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 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 Program within Existing Ph.D. Programs

The Ph.D. degree with an option in chemical and materials engineering is available under a cooperative program with the Department of Mechanical and Aerospace Engineering.

CHEMICAL AND MATERIALS ENGINEERING

130 Engineering Building
Telephone: (256) 824-6810
Email: chegrad@uah.edu

Degree: Master of Science in Engineering

Chair: Ramon L. Cerro, Professor

Professors

Cerro, R.L.; theoretical and experimental fluid mechanics, heat, mass transfer, physicochemical hydrodynamics, drops and bubble dynamics, ultra-thin film deposition, nanotechnology.
Chen, C.P.; multiphase transport, spray combustion, computational fluid dynamics, turbulence modeling of chemically reacting flows, MEMS and electronic packaging.
Chittur, K.K.; blood materials interactions through infrared spectroscopic (FT-IR/ATR) techniques, biological process monitoring techniques, and expression profiling with cDNA arrays.
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:

Banish, M.; diffusivity in metals, space flight hardware development
Hayes, D.G.; enzymatic reactions in nonaqueous media, protein behavior at interfaces, colloids and surfactants, lipid chemistry, utilization of agricultural commodities, and biological separations.
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 Professors:

Agarwal, A. (Adjunct); metallurgical analysis and research, plasma, and laser techniques
Chiang J. (Adjunct); printed circuit manufacture and assembly
Scholz C. (Adjunct); biosurfaces, biomaterials, and polymers

The Department of Chemical and Materials 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, the Biotechnology Science and Engineering Program, or the option in Chemical Engineering of the Mechanical 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, material processing and biotechnology. 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 (256-824-6810) or visit the CHE homepage at http://www.eb.uah.edu/che/ for further details.

**Graduate Courses in Chemical Engineering (CHE)**

**540 Physical Properties of Fluids**
3 hrs.
Theoretical, experimental, and correlation methods for determining and predicting the thermodynamic and transport properties of various fluids. Critical properties, equations of state, vapor pressure and latent heat, heat capacity. Viscosity, thermal conductivity, diffusion coefficient, phase equilibrium, heat and free energy for formation. Prerequisite: CHE 342.

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

**549 Introduction to Environmental Engineering**
3 hrs.
Engineering aspects of air, water, and thermal pollution. Hydrologic cycle, water sources and uses; industrial and other sources of primary and secondary pollutants. Transport process in environmental problems and in their control. Prerequisite: CHE 442. (Same as CE 549.)

**550 Environmental Control**
3 hrs.
Engineering design and synthesis of environmental control systems. Control of multi-phase systems with application to air and water pollution control. Prerequisite: CHE 442. (Same as CE 449, CHE 449, CE 550.)

**559 Selected topics in CHE**
Credit to be arranged

**560 Introduction to Bioprocess Engineering**
3 hrs.
Application of engineering principles to the analysis of and the development and design of processes using biological catalysts including enzymes, plant and animal cells, and genetically engineered cells. Other topics include fermentation and biological mass transport processes. Prerequisites: CH 361, 362. (Same as CHE 460.)

**561 Bioseparations, Recombinant Techniques, and Protein Engineering**
3 hrs.
General characteristics of separation processes used in the biotechnology industry, including removal of insolubles, isolation and purification of thermally sensitive products for final use by the customer. Application of unit operation principles for biological separations, recombinant DNA techniques, protein engineering. Prerequisites: CH 361, 362, CHE 460. (Same as CHE 461.)

**570 Mechanical Behavior of Engineering Materials**
3 hrs.
Structure, properties, and behavior of materials. Structural defects and their influence on mechanical properties, point defects, dislocation and lattice imperfection in crystals, elastic 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.

**594 Applied Materials Engineering**
3 hrs.
Synthesis and processing methods of materials for engineering applications. Selection and use of materials performance factors for design of structural and functional components. Use of computational methods in solving open-ended design problems that depend on an understanding of the nature and properties of materials will be emphasized. All classes of materials are covered. Prerequisites: CHE 294, 347, and either CH 342 or 348. (Same as CHE 494.)

**595 Polymer Engineering**
3 hrs.
Engineering principles of polymers and their role in manufacturing processes. Aspects of polymer phenomena and their relationship to processing of structural and functional components. Prerequisites: CHE 344, 352, and CH 332. (Same as CHE 495.)
641 Advanced Thermodynamics 3 hrs.
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 3 hrs.
Treatment of electrokinetic phenomena, axial dispersion, convective diffusion in liquids, Brownian motion, flows driven by surface tensions, capillary motion.

644 Introduction to Electrochemical Systems 3 hrs.
Thermodynamics, transport, and kinetics of electrodes and cells. Systems analysis of batteries, fuel cells, porous electrodes, electroplating, electrowinning, and corrosion processes. Convective diffusion at high Schmidt numbers. Prerequisite: CHE 443.

646 Thermodynamics of Materials 3 hrs.
Treatment of thermodynamic topics as they apply to behaviors observed in metallic and nonmetallic materials. Prerequisite: CH 341. (Same as CH 646, MTS 646.)

649 Transport Phenomena 3 hrs.
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 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 CH 650 and MTS 650.)

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. (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 1-9 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**  
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 and 651. (Same as MAE 749.)  

**757 Optical Techniques in Fluid Mechanics**  
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: EE 542. (Same as MAE 757.)  

**799 Doctoral Dissertation**  
Required each semester student is enrolled and receiving direction on doctoral dissertation.

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**CIVIL AND ENVIRONMENTAL ENGINEERING**

S201 Technology Hall  
Telephone: (256) 824-6854  
Email: ceegrad@uah.edu

**Degree:** Master of Science in Engineering

**Chair:** James F. Cruise, Professor

**Professor:**  
Cruise, J.F.; hydrologic modeling, stochastic hydrology, remote sensing and GIS applications, sediment transport modeling, steady and unsteady free surface flow.

**Associate Professors:**  
Leonard, K.; environmental engineering, water quality control, groundwater contamination, hazardous waste remediation, environmental assessment, hydraulics and modeling, remote fiber optic chemical sensing, hydrologic systems.  
Toutanji, H.; advanced testing techniques and novel construction materials concepts with emphasis on cementitious composites, non-destructive testing, high strength concrete, advanced composite materials, and advanced structural analysis.

**Assistant Professors:**  
Anderson, M.; travel modeling and simulation, application and deployment of Intelligent Transportation Systems, Geographic Information Systems and Global Positioning Systems for transportation, advanced transportation systems, urban planning, and travel demand analysis.  
Schwartz, L.; geotechnical engineering, ground improvement, engineering properties of modified soil, soil-structure interaction, colloid migration and filtration in porous media, constitutive behavior of unsaturated soil, extraterrestrial in-situ resource utilization.

The Civil and Environmental Engineering Department offers coursework and research leading to the M.S.E. and Ph.D. degrees. The Ph.D. program is offered jointly with the Department of Civil and Environmental Engineering at the University of Alabama at Birmingham (UAB). 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 and structural materials, geotechnical engineering, engineering mechanics, environmental engineering,
hydraulics and hydrologic processes, transportation planning, intelligent transportation systems, experimental mechanics/applied optics and natural hazard mitigation.

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. Courses are also available by IITS from faculty at UAB. Support is available at attractive levels for qualified students in the form of assistantships. 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, high technologically-oriented degree. The M.S.E. degree granted by the department is equivalent to those available in traditional civil and environmental engineering programs.

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 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 consisting of 24 semester credit hours; (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 consisting of 24 semester hours; (b) successfully complete an approved extended program of study consisting of a minimum of 9 additional semester hours of graduate coursework; (c) submit an acceptable independent research paper for which 3 semester hours of credit may be obtained by registering for CE 697; and (d) pass a final oral examination.

The department cooperates with the CEE Department at UAB to offer students a program leading to a doctoral degree. Courses are offered jointly by faculty from both departments and are available in real time via IITS. The doctoral work is supervised by an experienced researcher and recognized authority in the field. The Supervisory Committee is made up of faculty from both UAH and UAB and a minimum number of course hours must be taken from each campus. Coursework, written and oral examinations, and the dissertation are all essential components of the doctorate. 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)

511 Introduction to Geographical Information Systems 3 hrs.
Introduces vector, raster and tabular concepts, emphasizing the vector approach. Topics include: spatial relationships, map features, attributes, relational database, layers of data, data ingesting, digitizing from maps, projections, output, applications, and availability of public data sets. Prerequisite: Senior standing or instructor's approval. (Same as CE 411, ES 411/511, ATS 411/511.)

520 Urban Transportation Planning 3 hrs.
Planning of highway systems and terminals as part of a complete planning approach; public transportation system planning; transportation planning studies, projection analysis, plan formulation, and programming. Prerequisite: CE 321. (Same as CE 420.)

522 Traffic Engineering 3 hrs.
Driver, pedestrian, and vehicle characteristics. Principles of traffic flow for improved highway traffic service and safety. Examines freeways, rural roads, urban streets, traffic signals, signs, channelization, and other traffic control measures. Prerequisite: CE 321. (Same as CE 422.)
541 Open Channel Hydraulics
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 441.

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. Prerequisites: MAE 341 and parallel MAE/CHE 352. (Same as CE 449 and CHE 449/549.)

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

551 Industrial Waste Treatment
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/CHE 549.

553 Environmental Systems Sampling and Analysis
Experimental design, sensitivity analysis, water sampling, flow monitoring, and chemical reactions for environmental systems. Students will use standard EPA sampling and statistical methods to determine reaction rate kinetics, and appropriate models to determine effects of human activities on watersheds. Field investigations and sampling exercises included. Prerequisites: CE 555, 549.

554 Solid and Hazardous Waste Management
Waste characterization, minimization, collection, treatment, transport, and disposal. Landfill design and incineration options. Leachate characteristics and potential groundwater contamination. Prerequisite: CE 449/549. (Same as CE 454.)

555 Water Quality Laboratory
Properties of natural water sources and laboratory methods associated with water and wastewater treatment systems. Students design and demonstrate a water treatment system to bring a water sample into compliance with drinking water standards. Prerequisite: MAE/CHE 352. (Same as CE 455.)

556 Water Quality Control Processes
Principles of public water supply design. Source selection, collection, purification, and distribution for municipal use. Collection of waste waters, their treatment, and disposal. Prerequisite: CE/CHE 549. (Same as CE 456.)

557 Hydrology
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.)

558 Environmental Engineering Design
Engineering design and project management of environmental quality/restorations 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 or parallel: CE 449. (Same as CE 458.)

559 Selected Topics in Civil Engineering
Credit to be arranged

College of Engineering
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>561</td>
<td>Vibrations of Elastic Systems</td>
<td>3 hrs.</td>
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<tr>
<td>570</td>
<td>Mechanical Behavior of Engineering Materials</td>
<td>3 hrs.</td>
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<tr>
<td>571</td>
<td>Advanced Soil Mechanics</td>
<td>3 hrs.</td>
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<tr>
<td>572</td>
<td>Soil Dynamics</td>
<td>3 hrs.</td>
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<tr>
<td>574</td>
<td>Applied Mechanics of Solids</td>
<td>3 hrs.</td>
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<tr>
<td>577</td>
<td>Experimental Techniques in Solid Mechanics</td>
<td>3 hrs.</td>
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<tr>
<td>578</td>
<td>Matrix Methods in Structural Mechanics</td>
<td>3 hrs.</td>
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<tr>
<td>580</td>
<td>Civil Engineering Materials</td>
<td>2 hrs.</td>
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<tr>
<td>583</td>
<td>Reinforced Concrete Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>584</td>
<td>Steel Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>585</td>
<td>Foundation Engineering</td>
<td>3 hrs.</td>
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</tbody>
</table>

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.)

Structure, properties, and behavior of materials. Structural defects and their influence on mechanical properties, point defects, dislocation and lattice imperfection in crystals, elastic 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.

Continuum mechanics applied to soil behavior. Theoretical approaches to consolidation, shear strength, slope stability and soil stabilization. Prerequisite: CE 372. (Same as CE 471.)

Behavior of soils under dynamic, earthquake and blast loading. Analysis of foundation vibration and isolation. Prerequisite: CE 372. (Same as CE 472.)

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

A study of the performance properties and selection criteria of various materials used in the practice of civil engineering. These include aggregates, Portland cement, concrete, bituminous materials, and timber. Emphasis will be placed on standard methods of testing and characterization. Includes a three hour weekly lab. Prerequisites: CE 370, 372, 373. (Same as CE 480.)

Theory and practice of reinforced concrete design. Theory and design of high strength concrete mixes. Design of reinforced concrete beams, slabs, and columns using the ultimate strength design code of the American Concrete Institute. Prerequisite: CE 381. (Same as CE 483.)

Principles of the design of steel structures using ASD methods. Analysis and design of structural elements including beams, columns, connection details. Prerequisite: CE 381 or consent of instructor. (Same as CE 484.)

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 583. (Same as CE 485.)

113 College of Engineering
586 Advanced Cementitious and Composite Materials 3 hrs.
Concrete structures, rheology, mechanical properties, environmental durability, dimensional stability, advanced concrete technologies (such as high strength, fiber reinforced, and fracture mechanics), advanced fiber polymer composites, and repair/rehabilitation of concrete structures. Prerequisite: CE 381. (Same as CE 486.)

The following courses are open to graduate students only:

603 Advanced Concrete Design 3 hrs.
Design of concrete columns; bond, anchorage and reinforcing details; design of two-way slabs; design and analysis of multistory building frames; introduction to prestressed concrete; design of prestressed cross-sections for moment. Prerequisites: CE 481, 483/583.

611 GIS in Civil Engineering 3 hrs.
Advanced topics in geographical information systems (GIS) with civil engineering applications. Emphasis will be placed on spatial/temporal data analyses using digitized maps and database information in an area of CE specialization. Research project will be required. Prerequisite: CE 511.

646 Erosion and Sedimentation 3 hrs.
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 441, 541.

650 Environmental Impact Analysis 3 hrs.

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. (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.

657 Advanced Hydrology 3 hrs.
Hydrologic cycle, including interrelationships between classical and statistical methods of hydrology. Evaluation of governing equations, linearizations, analytical approximations and numerical solution techniques for various boundary conditions. Stochastic hydrologic modeling in both temporal and spatial domains. Prerequisites: CE 557, MAE 586, MAE 693, ISE 690; or permission of instructor.
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; governing partial differential equations from first and second laws of thermodynamics; 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.

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: CE 577. (Same as MAE 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: CE 671, 672. (Same as MAE 678.)

679 Hypervelocity Impact Phenomena  3 hrs.
Fundamental principles of penetration mechanics. Analytical and numerical approaches to perforation and penetration problems. Shock jump conditions, hugoniot, and equations of state; low, high, and hypervelocity impacts of finite and thin targets. Prerequisites: CE 574, 671, or permission of instructor.
683 Graduate Seminar
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. Students will be 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 MAE 683.)

697 Master’s Project for Plan II
Application-oriented student project designed to show competence in an area of civil engineering.

699 Master's Thesis
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.

756 Hazardous Waste Remediation
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.

759 Selected Topics in Civil Engineering Credit to be arranged

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: CE 660. (Same as MAE 762.)

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

772 Theory of Structural Stability 3 hrs.
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. (Same as MAE 772.)

773 Theory of Shells 3 hrs.
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 3 hrs.
Advanced topics in finite element analysis: application to nonlinear partial differential equations in continuum mechanics; theoretical studies of convergence and stability of solutions. Prerequisite: CE 674. (Same as MAE 774.)

778 Fracture Mechanics 3 hrs.
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 3 hrs.
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

272 Engineering Building
Telephone: (256) 824-6316
Email: ecegrad@uah.edu

Degrees:
- Master of Science in Engineering
- Master of Science in Software Engineering
- Doctor of Philosophy

Chair: Reza R. Adhami, Professor
Graduate Coordinator: N.F. Audeh, Professor
Assistant Chair: C. Corsetti, Lecturer

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

Professors:
- Adhami, R.R.; digital signal processing, medical imaging, digital systems design
- Audeh, N.F. (Emeritus); electromagnetics, antenna, microwaves, numerical methods
- Aunon, J.I.; statistical communication, biomedical engineering
- Budge, M.C. Jr. (Adjunct); signal processing, communications, radar
- Fork, R.; photonics, optical communications
- Gilbert, S.M. (Adjunct); radar
- Ho, F.D.; microelectronic devices and integrated circuits, photovoltaic devices, electronic materials
- Jarem, J.M.; electromagnetics, antenna theory, microwave theory, optics
- Kulick, J.H.; computer design, computer-generated holography, medical image processing
- Lindquist, R.; photonics, liquid crystal, VLSI.
- Moore, J.D. (Adjunct); communications
- Nordin, G.P.; volume holography, opto-electronics, diffractive optics
- Poularikas, A.D.; statistical optics
- Shen, D.; electrical materials and devices, thin film deposition
- Shtessel, Y.; automatic control theory, sliding modes, multicriteria control
- Singh, N.; electromagnetics, plasma, space research
- Stensby, J.; communication systems and signal processing

Associate Professors:
- Berinato, R. (Adjunct); signal processing, communication systems
- Boykin, T.B.; theory and modeling of nanostructures, solid state devices
- Gaede, R.K.; computer architecture, performance analysis, and design for testability
- Jovanov, E; ASICS, biomedical systems
- Schneider, K. (Adjunct); communications
- Wells, B. E.; computer architecture, parallel processing, real time systems
- Yoo, S. M.; parallel computer architecture, wireless networks, computer security

Assistant Professors:
- Coe, D.; VLSI design and MEMS devices
- English, J. M.; microelectromechanical devices and systems
- Joiner, L.L.; error control coding, communication systems
Milenkovic, A.; computer architecture and organization, embedded systems, VLSI, parallel and distributed technology, and computer networks  
Pan, D. W.; variable complexity algorithms, VLSI architectures for signal processing, video coding and communications  

The Department of Electrical and Computer Engineering offers the following graduate degrees:  
M.S.E. - option in computer engineering  
M.S.E. - option in electrical engineering  
M.S.E. - option in computer engineering with concentration in software engineering  
M.S.E. - option in optics and photonics technology  
M.S.S.E. (software engineering)  
Ph.D. - in computer engineering  
Ph.D. - in electrical 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. 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 of optical and opto-electronic technology. Details of this area are available in the departmental office.  

The Department of Electrical and Computer Engineering also collaborates with the Department of Computer Science and the College of Administrative Science to offer an interdisciplinary graduate certificate program in Information Assurance. Contact the Department for further details.  

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.ece.uah.edu, which provides descriptions of faculty research interests, research facilities, and academic programs. The department’s e-mail address is eceinfo@ece.uah.edu.

Degree Requirements  
The M.S.E. degree program has two options: Plan I requires 24 semester hours of course work plus a thesis, or Plan II, 36 semester hours including the ECE capstone course package (CM 601, EE 691, and EE 692) totaling 3 semester hours. In both plans, one of the minors in the basic plan of study must be in mathematics or mathematical methods in engineering, usually a two-course sequence approved by the student’s advisor. For Plan I, the student must defend their thesis as a final examination. For Plan II, the advisory committee may require a final comprehensive examination. Based on the student’s performance in the M.S.E. program, the advisory committee may recommend waiving all or part of the required preliminary examination for the PhD. program.  

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. Finally, a student must write an acceptable dissertation which must be defended in front of the supervisory committee. An ECE Department Student Doctoral Dissertation will NOT be approved unless at least one refereed journal or refereed national conference article has been accepted for publication. If the article has appeared, a copy or reprint from the refereed journal or refereed national conference proceedings must be submitted along with the dissertation. If the paper has not yet appeared, then the letter of acceptance from the Editor or Conference Proceedings Editorial board together with a preprint of the accepted paper must be submitted with the dissertation.  

Computer Engineering  
Students applying for the master’s program in computer engineering are expected to have an undergraduate background in computer engineering. All entering students must demonstrate knowledge of the material covered in the foundation requirements described below.

College of Engineering  

118
Foundation (or Immigration) Courses

EE 315: Introduction to Electronic Analysis and Design
CS 317: Introduction to Design and Analysis of Algorithms
CPE 336/CS 490: Operating Systems
CPE 421/CPE 521: Microcomputers
CPE 431/CPE 531: Introduction to Computer Architecture
EE 420/500 or ISE 390: Random Signals and Noise or Probability and Statistics

An entering student can demonstrate knowledge of the material in one of the following ways: completing the courses at UAH, completing similar courses at another institution, or evidence based on employment experience. A student may be required to successfully pass a placement exam to demonstrate their knowledge of the material. Up to 6 credit hours from CPE 521, CPE 531, or EE 500 may be applied towards a student’s graduate program under the following conditions:

The student has completed the immigration courses at UAH as a part of their graduate program.

The student is enrolled in Plan II (non-thesis) MSE in the CPE program.

Note: Any course taken during an undergraduate program and applied to the undergraduate degree cannot be used for a graduate degree program.

Coursework requirements for MSE Degree Programs in Computer Engineering

In addition to the department coursework requirements for the MSE degree, the MSE degree in Computer Engineering has the following coursework requirements for I) math minor, II) CPE core courses, III) engineering minor, and IV) thesis (Plan I students) or supporting courses (Plan II students).

I. Math Minor

Students must complete an approved 2-course sequence with mathematical or theoretical foundation for Computer Engineering graduate studies. The courses must be approved by the student’s academic advisor.

Recommended Course Sequences.

1. MA585 Probability
2. MA540: Combinatorial Enumeration
3. MA640: Graph Theory
4. EE 528: Analytical and Computational Methods in EE I
5. CS 555: Formal Program Development

CPE 619: Modeling and Analysis of Computer and Communication Systems
MA640: Graph Theory
MA740: Combinatorial Algorithms
EE 628: Analytical and Computational Methods in EE II
CS 603: Formal Languages and Automata Theory

II. CPE Core

Students must complete all of the following courses. Students who have completed these or similar courses elsewhere may request course substitutions. All substitutions must be approved by the student’s academic advisor.

CPE 512: Introduction to Parallel Programming
CPE 526: VLSI Design Using Hardware Description Languages, Modeling, and Synthesis
CPE 631: Advanced Computer Systems Architecture

III. Engineering Minor

Students must select an approved 2-course sequence from one of the following areas of specialization or from an approved engineering department. At least one should be at 600 level. The selected courses must be approved by the student’s academic advisor.
AREAS OF SPECIALIZATION

1. Computer Communications and Networked Systems
2. Computer Systems (including Architecture, OS and Compilers)
3. Hardware and VLSI Systems
4. Parallel and Distributed Processing Systems and Theory of Computation
5. Real-Time and Embedded Systems
6. Digital Signal Processing and Image Processing

IV. Thesis or Supporting Courses

For Plan I, one more course is required preferably at the 600 level, and the student must complete a thesis.

For Plan II, Student must select 4 additional supporting courses, including the ECE capstone course package (CM 601, EE 691 and EE 692). At least 2 must be at 600 level. A student may complete CPE 695: Projects in Computer Engineering as one of the courses. All courses must be approved by the student’s academic advisor.

Master of Science in Software Engineering

The Master of Science in Software Engineering in the Department of Electrical and Computer Engineering unconditional admission requirements are: A Bachelor’s degree from an ABET or CSAB accredited program with a minimum of 3.0 average on a 4.0 scale, a GRE score of 1700 (for GRE tests taken after October 1, 2002 the score on the analytical portion is obtained by taking 100 times [raw score +2]), and a, for international students, a TOEFL score of 600 (213 computer-based test). Conditional admission may be granted to individuals who fail to meet one or more requirements for unconditional admission.

Prerequisites:

Coursework or demonstration of knowledge in:

- Programming in C, C++, or Java (CPE 112)
- Data Structures (CPE 212)
- Discrete Structures (CS 214)
- Algorithm Design and Analysis (CS 317)
- Operating Systems (CPE 336)
- Computer Architecture (CPE 431)

Experience in the development of a large scale, industrial strength software system is highly desirable.

Program Requirements:

I. Software Engineering Core (12 hours):

- CS 650 – The Software Engineering Process

Plus one of the three course sequences:

- CS 652 – System and Software Requirements Methods
- CS 654 – Software Design Techniques and Tools
- CS 658 – Software Project Management and Quality Assurance
- CS 551 – Object Oriented Software Modeling
- CS 552 – Advanced Object Oriented Design
- CS 658 – Software Project Management and Quality Assurance

II. ECE Department Capstone Courses (3 hours):

- CM 601 – Communication for Engineers
- EE 691 – Graduate Seminar I
- EE 692 – Graduate Seminar II
III. CPE Software Design Studio (6 hours):
   CPE 656 – Software Engineering Studio I
   CPE 658 – Software Engineering Studio II

IV. CPE Core Courses (12 hours, no more than 6 at 500 level):
Four courses taken from the following list or approved by the Supervisory Committee:
   CPE 538 – Real Time and Embedded Operating Systems
   CPE 536 – Internals of a Modern Operating System
   CPE 512 – Introduction to Parallel Programming
   CPE 548 – Introduction to Computer Networks
   CPE 551 – Software Design and Engineering
   CPE 561 – Translation Systems
   CPE 628 – Testing of Hardware Systems
   CPE 631 – Advanced Computer Systems Architecture
   CPE 633 – Fault-Tolerant Computing Systems
   CPE 648 – Advanced Computer Networks
   CPE 661 – Code Optimizations
   CPE 726 – Algorithms for VLSI Design Tools
   CPE 731 – Distributed Shared Memory Systems
   CPE 735 – Selected Topics in Operating Systems
   CPE 760 – Selected Topics in Compiler and Translation Systems

Software Engineering Concentration
The Master of Science in Engineering with a Software Engineering Concentration requires the student to fulfill a major in computer engineering (CPE) and a concentration in software engineering. The concentration in software engineering must include CS 650 and four courses selected from the following list: CS 550, CS 551, CS 552 or CS 652, CS 555, CS 654, CS 656, CS 658 or CS 750. The CPE major requires an approved additional 21 hours, 15 in CPE, one of which must be CPE 512 and 6 hours of mathematics, engineering analysis, or with prior approval of the Supervisory Committee, two additional courses in formal methods. This program is Plan II only (36 hours of coursework). For the purposes of defining majors and minors within computer engineering, the following areas of specialization are available:

<table>
<thead>
<tr>
<th>Specialization</th>
<th>Entry Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLSI/Electronics</td>
<td>CPE 526</td>
</tr>
<tr>
<td>Systems Architecture</td>
<td>CPE 531</td>
</tr>
<tr>
<td>Parallel Processing</td>
<td>CPE 512</td>
</tr>
</tbody>
</table>

Doctor of Philosophy
The Ph.D. in Computer Engineering in the Department of Electrical and Computer Engineering unconditional admission requirements are:

a. A Bachelor’s degree from an accredited electrical or computer engineering program or a bachelor’s degree in a related program acceptable to the CPE graduate faculty.
b. A score of at least 550 on each of the two sections (verbal, quantitative), and a 550 (3.5 for tests taken after October 1, 2002) on the analytical portion of the GRE.
c. A score of at least 500 (173 computer-based test) on the TOEFL exam for international students whose native language is not English.
d. An overall grade point average of at least 3.0 on a 4.0 scale, or at least 3.0 for the last 60 semester hours completed.
e. Three letters of evaluation concerning the applicant’s previous academic and professional work.
Conditional admission may be granted to individuals who fail to meet one or more requirements for unconditional admission. Students having a bachelor’s degree in a field not related to electrical or computer engineering may be required to complete prerequisite courses in such areas as:

- Programming in C, C++, or Java (CPE 112)
- Data Structures (CPE 212)
- Discrete Structures (CS 214)
- Algorithm Design and Analysis (CS 317)
- Operating Systems (CPE 336)
- Computer Architecture (CPE 431)
- Probability and Statistics (ISE 390)
- Calculus (MA 201)
- Linear Algebra (MA 244)

The course of study leading to the Ph.D. in Computer Engineering will include the following elements:

a. A major consisting of a minimum of 18 semester hours of approved coursework in Computer Engineering;
b. A minor consisting of a minimum of 15 semester hours of approved coursework in mathematics, theoretical, or formal methods as related to Computer Engineering;
c. A minor consisting of a minimum of 12 semester hours of approved coursework in Electrical or Computer Engineering;
d. Additional coursework consisting of a minimum of 15 semester hours of approved coursework in supportive fields;
e. Successful completion of a Qualifying Examination with a presentation of the dissertation topic;
f. A research dissertation consisting of a minimum of 18 semester hours in Electrical and Computer Engineering;
g. Successful completion of a final examination consisting of a presentation of the dissertation.

Since this Ph.D. program is shared with the University of Alabama at Birmingham (UAB), one Supervisory Committee member must come from the UAB ECE Department.

**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.

College of Engineering 122
Among the organizations providing practicum experiences are NASA/Marshall Space Flight Center, U.S. Army Aviation and Missile Command, Oak Ridge National Laboratory, Dynetics, Inc., Hughes Danbury Optical Systems, Inc., SCI Systems, Inc., and Speedring, Inc.

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. 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.

Ph.D. Requirements

Course Work

Course requirements, including at least 60 hours of graduate coursework (excluding dissertation research), are defined in the Program of Study. A maximum of nine semester hours credit in thesis/research work from the master's degree may be allowed to count toward the 60 hour requirement. Students must also register for a minimum 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 one year after admission to the Ph.D. program. Once approved, the program may be amended only by the Supervisory Committee upon submission of the appropriate form.

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 Supervisory Committee. One of the minors must be mathematics, and/or engineering mathematics as defined by the student's department. All students must complete at least 60 semester hours of graduate coursework, and 18 hours of dissertation coursework. At least 33 semester hours must be in work within related departments, including credits for the major. All of these 33 semester hours, at least 18 must be within a defined major. Of the remaining 27 semester hours, a minimum of 15 semester hours of work is required for the first minor and a minimum of 12 semester hours for the second.

Degree Requirements

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. Finally, a student must write an acceptable dissertation which must be publicly defended in front of the Supervisory Committee.

Graduate Courses in Computer Engineering (CPE)

512 Introduction To Parallel Programming 3 hrs.
Introduction to processing in parallel and distributed computing environments. General concepts of parallel machine models, processes, mutual exclusion, process synchronization, message passing, and programming languages for parallel computing and scheduling. Design and analysis of parallel algorithms. Parallel programming environments: Pthreads for shared memory multiprocessor systems and PVM/MPI for distributed networked computers. Prerequisites: CPE 212 and CS 317. Recommended CPE 336 (Same as CPE 412.)

521 Microcomputers 3 hrs.
Microcomputer system design and use of microprocessors or single chip microcomputers as basic system components. Basic microcomputer design and the interface between the microprocessor and external devices. This course examines the software aspects of microcomputers using assembly language and C programming. Single chip microcomputers for embedded and power efficient
applications. Experiments performed in the Microcomputer Laboratory provide considerable experience, allowing students to develop programs in Assembly and C and download them into a target microcomputer. Prerequisites: CPE/EE 321. (Same as EE 421, CPE 421, EE 521.) Students enrolling in CPE 521 must enroll concurrently in CPE 521L.

521L Laboratory Component of Microcomputers

Students enrolling in CPE 521L must enroll concurrently in CPE 521.

522 Advanced Logic Design

Advanced concepts in Boolean algebra, use of hardware description languages as a practical means to implement hybrid sequential and combinational designs, digital logic simulation, rapid prototyping techniques, and design for stability concepts. Focuses upon the actual design and implementation of sizeable digital design problems using a representative set of Computer Aided Design (CAD) tools. Prerequisite: EE 202, 315. (Same as CPE/EE 422 and EE 522.) Students enrolling in CPE 522 must enroll concurrently in CPE 522L.

522L Laboratory Component of Advanced Logic Design

Students enrolling in CPE 522L must enroll concurrently in CPE 522.

526 VLSI Design Using Hardware Description Languages, Modeling, and Synthesis

Modern VLSI design techniques and tools, such as silicon compilers, (V)HDL modeling languages, placement and routing tools, synthesis tools, and simulators. Students will design, simulate, and layout using both programmable logic families and ASIC libraries. Prerequisites: EE 315, EE 202. (Same as CPE 426.)

527 VLSI Design I

Introduction to VLSI design using CAD tools, CMOS logic, switch level modeling, circuit characterization, logic design in CMOS, systems design methods, test subsystem design, design examples, student design project. Design project to be fabricated and tested in CPE 528. Prerequisites: EE 202 and EE 315. (Same as EE 427, CPE 427.) Students enrolling in CPE 527 must enroll concurrently in CPE 527L.

527L Laboratory Component of VLSI Design I

Students enrolling in CPE 527L must enroll concurrently in CPE 527.

528 VLSI Design II

Advanced experience with CAD tools for VLSI design, IC testing. Design project from CPE 527 will be fabricated and tested. Implementation and verification of test programs, IC testing and troubleshooting, legal, economic, and ethical design issues. Oral presentations and written reports are required. Prerequisites: CPE 527. (Same as EE 428, CPE 428.) Students enrolling in CPE 528 must enroll concurrently in CPE 528L.

528L Laboratory Component of Microcomputers

Students enrolling in CPE 528L must enroll concurrently in CPE 528.

531 Introduction to Computer Architecture

Existing computer structures. Computer organization with emphasis on busing systems, storage systems, and instruction sets. Special purpose architecture, performance models and measures, VLSI influence on architecture. Prerequisite: CPE/EE 321. (Same as CPE 431.)

536 Internals of a Modern Operating System

In depth study of the design of modern operating systems such as Unix, NT, and Linux. Emphasis on the internals and implementation details of interrupt processing, real-time clocks, device independent I/O, process management, memory management, file management. Prerequisite: CPE 336 (Same as CPE 436.)
538 Real Time and Embedded Systems  
Study of design methodologies for reliable real time systems. Prerequisite: CPE 336. (Same as CPE 438.)  

548 Introduction to Computer Networks  
Introduction to the concepts and architecture of computer networks. Review of communication protocols using the Internet and the TCP/IP model as major examples. High-speed networking, congestion control, data compression, security and distributed processing. Prerequisites: CPE 112, CPE/EE 321. (Same as EE 468, CPE 448, EE 548.)  

551 Software Design & Engineering  
Basic concepts of Software Engineering. Software project management including specification, design, implementation, testing, and documentation. Software tools for project management. Includes a multi-student software project. (Same as CPE 451.) Prerequisites: CPE 212, CS 317.  

561 Translation Systems  
Grammars, parsers, and lexical analyzers; implementation of translators via top-down and bottom up techniques; grammar analysis to identify ambiguities. Practical applications of translators including conversion of file formats and compilation of traditional computer languages. Prerequisites: CPE 212 and CPE 321. (Same as CPE 461.)  

590 Selected Topics in Computer Engineering  
Credit to be arranged  

612 Parallel Algorithms  
Introduction to metrics describing the performance and scalability of parallel algorithms. Performance analysis of parallel algorithms for performing sorting, matrix multiplication, solving linear equations, and FFT. Prerequisite: CPE 512.  

619 Modeling and Analysis of Computer and Communication Systems  

621 Advanced Microcomputer Techniques  
Advanced hardware interfacing techniques, complex interfaces, direct memory access, memory design and management, cache memory, fault tolerance issues, parallel processing with emphasis on hardware issues. Prerequisites: CPE 521.  

625 CMOS Analog Integrated Circuit Design  
Analog circuit design in CMOS technology. CMOS processing technology. MOS transistor modeling. Basic current mirrors and single-stage amplifiers. Noise analysis and modeling. Basic OPAMP design and compensation. Advanced current mirrors and OPAMPS. Bandgap references. Oscillators. CMOS technology characterization for radio-frequency (RF) design. Prerequisite: EE 416. (Same as EE 625.)  

626 Advanced VLSI Design  
Advanced VLSI Design. Case study of the VLSI design of a modern RISC processor using a Hardware Description Language. Prerequisite: CPE 526.  

628 Testing of Hardware Systems  
Introduction to testing of digital electronic circuits and systems. Topics include: fault modeling, testing problems, testing schemes, test generation for combinational and sequential circuits, the complexity of testing, design for testability, built-in self-testing and boundary scan. Prerequisite: CPE 422 or CPE 522.
631 Advanced Computer Systems Architecture 3 hrs.
Study of architectural features of modern processors, including cache memories and memory systems, pipeline designs, branch prediction techniques. Design of superscalar, multithreaded VLIW processors, code optimization for such systems will be studied. Quantitative evaluation of architectural features are emphasized throughout the course. Prerequisites: CPE 512, CPE 531.

Analysis and design of very high reliability and availability systems. Fault types, reliability techniques, and maintenance techniques. Case studies of high-availability long-life, life-critical systems. Both hardware and software techniques for achieving fault-tolerance will be studied. Prerequisites: CPE 531, CPE 526, EE 500.

635 Systolic Array Processing 3 hrs.
Systolic structure of fast algorithms and switchable array realizations. Prerequisite: CPE 512.

645 Computer Network Security 3 hrs.
Principles and concepts of computer network security. Introduction to cryptography, confidentiality, authentication, digital signatures, E-mail security, IP security, web security, intruders, malicious software, firewall, and other network security-related issues. Prerequisites: CPE 448/548.

648 Advanced Computer Networks 3 hrs.
Advanced principles and concepts of general-purpose computer networks, with a special emphasis to internetworking and Internet. Transport and higher level protocols emphasis. Programming issues. High-speed networking, congestion control, data compression, security and distributed processing will be covered. Prerequisite: CPE 548.

656 Software Engineering Studio I 3 hrs.
This is the first course in a two course studio series required for the MSSE degree in the College of Engineering. Students will work in small design teams on medium sized software projects. Activities include developing requirements, designing and constructing system prototypes, developing and implementing test and verification plans, and presenting the project for evaluation. The practice of software design and evaluation will be conducted in an iterative cycle using best software engineering practices, so that design and execution can be refined over the lifecycle of the project. Prerequisite: CS 650 and completion of 24 credits in the MSSE program.

658 Software Engineering Studio II 3 hrs.
This is the second course in a two course studio series required for the MSSE degree in the College of Engineering. Students will continue to work in small design teams on medium sized software projects. Activities include software metrics, project metrics, risk analysis, tracking, mitigation, developing requirements, designing and constructing system prototypes, developing and implementing test and verification plans, and presenting the project for evaluation. The practice of software design and evaluation will be conducted in an iterative cycle using best software engineering practices, so that design and execution can be refined over the lifecycle of the project. Prerequisite: CPE 656.

661 Code Optimizations 3 hrs.
Discussion of methods to improve the performance of code generated by compilers. Data-flow and dependence analysis, peep-hole optimizations, instruction scheduling, and parallelism enhancing transformations. Techniques to improve the utilization of registers, instruction level parallelism, and memory hierarchies in modern computer systems. Prerequisites: CPE 561 and CPE 631.

690 Selected Topics in Computer Engineering 3 hrs.
Prerequisite: Graduate Standing.

695 Project in Computer Engineering 3 hrs.
Prerequisite: Graduate Standing.
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 9 hours credit is awarded upon successful completion of master's thesis.

710 Selected Topics in Parallel Processing
Prerequisite: CPE 612.
3 hrs.

715 Selected Topics in Computational Theory
Prerequisite: CS 603.
3 hrs.

720 Selected Topics in VLSI Design
Prerequisite: CPE 626.
3 hrs.

726 Algorithms for VLSI Design Tools
Tools for VLSI Design. This course is concerned with the algorithms found VLSI design tools. Prerequisite: CPE 526
3 hrs.

730 Selected Topics in Computer Architecture
Prerequisite: CPE 631.
3 hrs.

731 Distributed Shared Memory Systems
Study issues related to performance, granularity of sharing, multithreading, cache coherence, memory consistency models, pull vs push caching, false sharing, thread migration. Case studies systems, including DASH, FLASH ThreadMarks, SHRIMP, Calypso, Alewife to understand these issues. Prerequisite: CPE 631.
3 hrs.

735 Selected Topics in Operating Systems
Prerequisites: CPE 631, CPE 536.
3 hrs.

740 Selected Topics in Computer Networks
Prerequisites: CPE 648.
3 hrs.

749 Neural Networks and Their Application
Elements of threshold logic and discriminant functions; pattern classification and general mappings with feedforward networks; training algorithms and self-organization; Hopfield model and Boltzmann machine computations, selected topics. Prerequisite: EE 604 or CPE 512. (Same as EE 749.)
3 hrs.

760 Selected Topics in Compilers & Translation Systems
Prerequisites: CPE 661.
3 hrs.

790 Selected Topics in Computer Engineering
Credit to be arranged

795 Research in Computer Engineering
Credit to be arranged

799 Doctoral Dissertation
3, 6, or 9 hrs.
Required each semester student is enrolled and receiving direction on doctoral dissertation.

Graduate Courses in Electrical Engineering (EE)
Courses at the 500-level are taken by seniors and first year graduate students. Courses at the 600- and 700-level are open only to graduate students.

500 Random Signals and Noise
3 hrs.
Random variables and probabilistic description of signals. Introduction to random processes: autocorrelations, cross correlations, power spectral density. Noise analysis: thermal, shot, white, colored. Response of electrical systems to random inputs. Prerequisite: EE 382. (Same as EE 420.)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>504</td>
<td>Introduction to Data Communication Networks</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Overview of historic development of modern telephone and data communication systems, system architecture, standards, broadband switching systems, multi-rate switching, asynchronous transfer function mode (ATM), integrated services for digital networks (ISDN, B-ISDN), modems, protocols, satellite communications, personal and mobile communications. Prerequisite: EE 383. (Same as EE 424.)</td>
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<tr>
<td>505</td>
<td>Introduction to Control and Robotic Systems</td>
<td>3 hrs.</td>
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<td></td>
<td>The basic theories and analytical techniques for modeling, analysis and control of dynamical systems. Transfer functions, block-diagrams, frequency response, stability criteria, series and feedback controller design, digital control. Introduction to the dynamic analysis and control of robotic systems. Prerequisite: EE 382 or permission of instructor. (Same as EE 425.)</td>
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<tr>
<td>506</td>
<td>Communication Theory</td>
<td>3 hrs.</td>
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<td></td>
<td>Review of elementary signals and systems including the Hilbert transform, cross and auto correlation, power density spectrum, and the Wiener-Khintchine theorem. Butterworth and Chebyshev lowpass filters. Bandpass signals and systems. The lowpass equivalent of a bandpass signal/system. Commonly used forms of linear and nonlinear modulation. Demodulation methods and circuits. Phase lock and frequency feedback techniques. Prerequisite: EE 382 or permission of instructor. (Same as EE 426, OSE 506.)</td>
<td></td>
</tr>
<tr>
<td>510</td>
<td>Selected Topics in Electrical Engineering</td>
<td>Credit to be arranged</td>
</tr>
<tr>
<td>512</td>
<td>Advanced Senior Design Project in Electrical Engineering</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Individual design project under the direction of an EE faculty member. Prerequisite: Senior standing.</td>
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<tr>
<td>516</td>
<td>Digital Electronics</td>
<td>3 hrs.</td>
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<td></td>
<td>Introduction to digital electronics. The Metal-Oxide-Semiconductor (MOS) transistor, MOS inverter and gate circuits. Bipolar junction transistors, ECL inverters, and bipolar digital gates. Semiconductor memories. Circuit design for VLSI. Prerequisites: EE 202 and 315. Must parallel EE 439. (Same as EE 436.)</td>
<td></td>
</tr>
<tr>
<td>521</td>
<td>Microcomputers</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Microcomputer system design and use of microprocessors or single chip microcomputers as basic system components. Basic microcomputer design and the interface between the microprocessor and external devices. This course examines the software aspects of microcomputers using assembly language and C programming. Single chip microcomputers for embedded and power efficient applications. Experiments performed in the Microcomputer Laboratory provide considerable experience, allowing students to develop programs in Assembly and C and download them into a target microcomputer. Prerequisites: CPE/EE 421. (Same as EE 421, CPE 421, CPE 521.) Students enrolling in EE 521 must enroll concurrently in EE 521L.</td>
<td></td>
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<tr>
<td>521L</td>
<td>Laboratory Component of Microcomputers</td>
<td>0 hrs.</td>
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<tr>
<td></td>
<td>Students enrolling in EE 521L must enroll concurrently in EE 521.</td>
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</tr>
<tr>
<td>522</td>
<td>Advanced Logic Design</td>
<td>3 hrs.</td>
</tr>
<tr>
<td></td>
<td>Advanced concepts in Boolean algebra, use of hardware description languages as a practical means to implement hybrid sequential and combinational designs, digital logic simulation, rapid prototyping techniques, and design for stability concepts. Focuses upon the actual design and implementation of sizeable digital design problems using a representative set of Computer Aided Design (CAD) tools. Prerequisite: EE 202, 315. (Same as CPE/EE 422 and CPE 522.) Students enrolling in EE 522 must enroll concurrently in EE 522L.</td>
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</tr>
<tr>
<td>522L</td>
<td>Laboratory Component of Advanced Logic Design</td>
<td>0 hrs.</td>
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<tr>
<td></td>
<td>Students enrolling in EE 522L must enroll concurrently in EE 522.</td>
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</tr>
</tbody>
</table>
527 Electromagnetic Waves

Review of Maxwell’s equations, uniform plane waves in different types of media, reflection and transmission of uniform plane waves, transmission lines, waveguides, antennas. Prerequisites: EE 307, 313. (Same as EE 447.)

528 Analytical & Computational Methods in Electrical Engineering I

Analytical and numerical solutions to problems arising in electrical engineering. Dynamic analysis of circuits and systems, matrix algebra approach, sequences and series with applications in signal analysis, complex variables and functions, vector differential operators and their applications. Prerequisite: EE 382. (Same as EE 448.)

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 447, 527, or PH 432. (Same as OPE 454, OSE 534, and EE 454.)

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-ynu 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 PH 541.) Fall.

542 Physical Optics

Scalar and electromagnetic waves, polarization, coherence, reflection and refraction; two beam and multiple beam interference, interferometers, Fabry-Perots, thin films, diffraction, and absorption and dispersion. (Same as OSE 542 and PH 542.) Fall, Spring.

548 Introduction to Computer Networks

Introduction to concepts and architecture of computer networks. Review of communication protocols using the Internet and the TCP/IP model as major examples. High-speed networking, congestion control, data compression, security and distributed processing. Prerequisites: CPE 112, CPE/EE 321. (Same as EE 468, CPE 548, CPE 448.)

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.

603 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 on systems with noisy excitation. Prerequisite: EE 500 or 420.

604 Digital Image Processing

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 synthesis of lead, lag, lead-lag, etc. compensators; tuning of PD and PID controllers; error budgets; use of commercial CAD software for classical control design and performance evaluation; digital simulation techniques. CAD laboratory sessions. Prerequisite: EE 425/505.

606 Statistical Communications Theory 3 hrs.

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 control. Prerequisite: EE 425/505.

609 Electromagnetic Field Theory 3 hrs.
Mathematical approach to electromagnetic phenomena. Basic field concepts. Radiation and propagation. Waveguides and simple radiating and scattering systems. Perturbation and variational techniques. Prerequisite: EE 527 or 447.

610 Selected Topics in Electrical Engineering Credit to be arranged.

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 Lasers 3 hrs.

615 Analog Circuit Design 3 hrs.
Use of operational amplifiers to synthesize special-purpose filters and circuits for analog signal processing and conditioning; linear and switching power supplies; high-frequency effects; circuits for transmitters and receivers; digital circuits from an analog viewpoint; A/D and D/A converters; selected topics. Prerequisite: EE 414.

616 Microelectronic Devices and Integrated Circuits 3 hrs.

617 Very Large Scale Integration Devices 3 hrs.
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. Prerequisite: EE 516.

618 Very Large Scale Integrated (VLSI) Circuits 3 hrs.
619 Introduction to Radar Systems 3 hrs.
Topics include radar equation, CW radar, MTI and pulse Doppler radar, tracking radar, major systems components, detection in the presence of noise and clutter, ambiguity, and resolution. Prerequisite: EE 500/420.

625 CMOS Analog Integrated Circuit Design 3 hrs.
Analog circuit design in CMOS technology. CMOS processing technology. MOS transistor modeling. Basic current mirrors and single-stage amplifiers. Noise analysis and modeling. Basic OPAMP design and compensation. Advanced current mirrors and OPAMPS. Bandgap references. Oscillators. CMOS technology characterization for radio-frequency (RF) design. Prerequisite: EE 416. (Same as CPE 625.)

628 Analytical & Computational Methods in Electrical Engineering II 3 hrs.
Analytical and numerical solutions to problems arising in electrical engineering. Visualization and representation techniques, approximation techniques, multidimensional operators and calculus for distributed system analysis. Prerequisite: EE 448 or 528.

632 Fourier Optics 3 hrs.
Introducing the optical system as an invariant linear system, convolution, Sommerfeld's diffraction integral, Fourier Transform, angular spectrum, coherent and incoherent imaging, optical transfer function. (Same as OSE 632 and PH 632.)

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

634 Optical Communications 3 hrs.
Optical communication systems; counting statistics; the optical detector response process; direct detection; heterodyne detection parameter estimation in optical communications; pointing, spatial acquisition and tracking. Prerequisite: EE 506/426. (Same as OSE 634.)

642 Data and Digital Communications 3 hrs.
Introduction to digital and data communications; transmission channels; modulation and coding; telephone networks; data communication standards; noise and distortion; computer interfacing; protocols. Prerequisite: EE 500/420.

648 Digital Signal Processing 3 hrs.
Theory and applications of signal processing by digital techniques. Difference equations, Z-transform theory, digital-filter design, fast Fourier transform, quantization effects, and discrete estimation. Applications in digital filtering, signal processing, data analysis and smoothing, and image processing. Prerequisite: EE 528/448.

672 Digital Processing of Random Signals I 3 hrs.
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. Prerequisite: EE 603 or equivalent.

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
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 447/527.

691 Graduate Seminar I
Seminar presentations by representatives from industry and/or faculty members to promote the skills required to organize and deliver oral and written presentations. Presentations introduce students to a wide variety of current topics relevant to the technical and career aspects of electrical, computer, and optical engineering. Students are required to present a summary of their research interests. Prerequisite: CM 601.

692 Graduate Seminar II
Written reports and oral presentations by students on individual research or on journal articles. Prerequisite: EE 691.

699 Master's Thesis
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
Classical and modern methods for analysis and design of sampled data-control systems; Z-transforms, transport lags, z and w plane analysis, state variables, and the transition matrix. Prerequisite: EE 701.

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

703 Modern Control Design
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
Classical and modern methods for analysis and design of nonlinear automatic control systems. State variables, phase plane, limit cycles, stability, describing functions, relay control, stabilization theory. Prerequisite: EE 701.

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

706 Kalman Filtering Techniques in Control and Signal Processing
Basic concepts of Kalman Filtering Theory with applications to: 1) analysis and design of control systems for dynamic processes with noisy sensors and random-type disturbance inputs, and 2) estimation, smoothing and prediction of information in noisy signals; Optimum Stochastic Control and the Separation Principle. Matrix Riccati Equation, Covariance Matrix, Orthogonal Projection Theorem. Prerequisite: EE 701.

707 Information Theory
Self-information, entropy, mutual information, and channel capacity, encoding, error detecting and correcting codes. Sampling theorem. Discrete and continuous channels. Prerequisite: EE 506/426.
709 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 603, 648.

710 Selected Topics in Electrical Engineering Credit to be arranged.

711 Antenna Theory 3 hrs.
Antennas and antenna arrays. Radiation patterns and impedance characteristics. Spheres, cylinders, horns, slots, microwave lenses, traveling-wave, and frequency independent antennas. Prerequisite: EE 609.

716 Device Modeling for Integrated Circuit Design 3 hrs.

717 Space Applications of Electromagnetics 3 hrs.
Plasma as a dielectric; dielectric functions for cold, warm, isotropic and anisotropic plasmas, body-plasma interaction; space craft electrodynamics, antennas in plasmas; mode of radiation, input impedance and radiation pattern, scattering problems involving plasmas. Prerequisite: EE 609 or MAE/PH 531 or permission of instructor.

718 Microwave Techniques 3 hrs.

719 Advanced Electromagnetic Field Theory 3 hrs.

720 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.

721 Robust and Adaptive Control 3 hrs.
Introduction to fundamental ideas of robust and adaptive control. Effects of parameter and disturbance uncertainties, H-infinity and mu-synthesis ideas; parameter estimation techniques; adaptive control algorithms; stability considerations; model-reference and linear adaptive control techniques. 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 603, 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 603.
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 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 506/426.

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, 609.

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 Coding Theory and Spread Spectrum 3 hrs.
Linear block coding techniques, convolutional codes and the Viterbi decoding algorithm, probability of error bounds, channels with intersymbol interference and additive Gaussian noise. Introduction to spread spectrum direct sequence and frequency hopping methods. Prerequisite: EE 642.

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 500, 505.

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 general mappings with feedforward networks, training algorithms and self-organization, Hopfield model and Boltzman machine computations, selected topics. Prerequisite: EE 604 or CPE 512. (Same as CPE 749.)

799 Doctoral Dissertation 3-6 hrs.
Required each semester student is enrolled and receiving direction on doctoral dissertation.
INDUSTRIAL AND SYSTEMS ENGINEERING
& ENGINEERING MANAGEMENT

N143 Technology Hall
Telephone: (256) 824-6256
Email: isegrad@uah.edu

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

Chair: J. J. Swain, Professor

Professors:
Dorsett, M.J. (Adjunct); operations research, statistics, logistics
Rhoades, R.G.; systems engineering, organizational design and behavior, management of technical professionals, management of change
Safie, F.M. (Adjunct); reliability, forecasting, and applied statistics
Schroer, B.J.; simulation, manufacturing processes
Swain, J.J.; applied statistics, computer simulation, quality engineering
Westbrook, J.D. (Emeritus); engineering management, organization structure and motivation, TQM, productivity and quality, and strategic management
Wybsika, R.M.; operations research, engineering economic analysis, systems modeling

Associate Professors:
Componation, P.J.; systems engineering, engineering economy, engineering management
Farrington, P.A.; manufacturing systems, quality engineering, engineering economy, computer simulation, integrated product development
Messimer, S.L.; manufacturing systems, optimization, applied statistics
Thomas, L.D. (Adjunct); operations research, statistics, systems modeling
Tippett, D.D.; engineering management, technical project management, management of technology, labor relations, collective bargaining, TQM
Utley, D.R.; engineering management, management systems analysis

Assistant Professors:
Fogle, F.R. (Adjunct); engineering economy, operations research
Gholston, S.; quality engineering, applied statistics, manufacturing

The Department of Industrial and Systems Engineering and Engineering Management offers major options and associated minors in the subject areas of operations research, systems engineering, and engineering management. 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. Students entering these graduate programs must have completed three hours of either applied or mathematical statistics and three hours of engineering economy.
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. Plan IIa 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 resulting in Plan IIb. A comprehensive oral examination is required for Plan IIb.

M.S.E. Options

The Engineering Management Option in the ISEEM 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. 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 Environmental Management Engineering Option is for persons possessing a bachelor of science degree in a traditional engineering area who have a desire to broaden their engineering background to enable them to function more successfully in the environmental management oriented aspects of engineering. This is accomplished by providing them with a broader understanding of the environmental management functions including the motivation and control of highly educated, creative individuals in an uncertain environment that requires flexible planning, policies, and procedures. Specific subject matter courses in the curriculum, such as air pollution, hazardous waste management, environmental law, water quality control, design of experiments, project management, engineering management theory, statistical methods and applications, systems engineering, and engineering economic analysis, will provide the individual additional analytical and management expertise to supplement the material comprehended in the baccalaureate engineering degree program.

The ISE option is offered for engineers who possess a B.S. in a traditional engineering discipline and who have the desire to broaden their engineering problem solving skills. This is accomplished by providing them with a better understanding of traditional and contemporary problem solving skills in the areas of operation research, quality control, computer integrated manufacturing, and simulation. The program is applications oriented and can be tailored to fit the individual needs of the student.

The Operations Research Option is for individuals with a bachelor's degree in a traditional engineering area who desire to broaden their background into the operations research aspects of engineering. Methods of problem identification, problem formulation, and problem solution techniques will be addressed. Specific subject matter courses in the curriculum include linear programming, optimization, queuing, Markov processes, and systems modeling.

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

College of Engineering 136
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 (M.S.O.R.)

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 and (2) mathematics through calculus (MA 201).

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.

Distance Learning

In addition to regular classroom instruction, courses in the Engineering Management, Industrial Engineering, and Systems Engineering options are available via distance learning in various media, serving students employed by organizations throughout the region.

Graduate Courses in Industrial & Systems Engineering (ISE)

502 Industrial and Organizational Psychology 3 hrs.
Application of basic principles of learning, motivation, and perception to typical industrial and organizational problems. Prerequisite: graduate standing. (Same as PSY 502.)

503 Human Factors Psychology 3 hrs.
Study of human performance in human-technology-environment systems. Consideration of human capabilities and limitations as related to controls and displays, and the role of human cognition in decision-making and training effectiveness. Prerequisite: graduate Standing. (Same as PSY 503.)

523 Statistical Quality Control 3 hrs.
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 3 hrs.
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 3 hrs.
Advanced topics in statistical experiments with emphasis on design aspect. Confounding, fractional replication, factorial and nested design. Prerequisite: ISE 391 or 690. (Same as ISE 426.)
530 Manufacturing Systems and Facilities Design 3 hrs.
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.)

533 Production and Inventory Control Systems 3 hrs.
Inventory models including classical optimal economic order quantity models, manufacturing resource planning (MRP) systems, master production scheduling, material requirements planning, and purchase order control. Manufacturing system revisions, including business process reengineering (BPR), and continuous process improvement. Prerequisites: Graduate standing, ISE 390 or 690. (Same as ISE 433.)

537 Electronics Manufacturing Processes 3 hrs.
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

547 Introduction to Systems Simulation 3 hrs.
Philosophy and elements of digital discrete-event simulation. Emphasis on modeling and analysis of stochastic systems, including probabilistic models, output analysis, and use of simulation software. Prerequisites: CPE 112, ISE 391 or 690. (Same as ISE 447.)

624 Human Factors in Systems Design 3 hrs.
Psychological, physiological, and anthropometric requirements for human beings and the integration of these requirements into the design of tools, machines, and systems. Prerequisite: Graduate standing.

626 Introduction to Operations Research 3 hrs.
Philosophy and methodology of operations research. Includes linear programming, game theory, sequencing, and networks. Prerequisite: ISE 390 or co-requisite: ISE 690.

627 Systems Engineering 3 hrs.
Fundamental considerations associated with the engineering of large-scale systems. Emphasis is on the development of a life-cycle model for systems engineering processes. Specific focus on system methods and tools, system methodology, and system management. Prerequisite: ISE 690 or instructor approval.

628 Human Factors in Systems Design 3 hrs.
Psychological, physiological, and anthropometric requirements for human beings and the integration of these requirements into the design of tools, machines, and systems. Prerequisite: Graduate standing.

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 physical, information, and managerial aspects of a manufacturing enterprise. Prerequisite: ISE 530.

635 Linear Programming 3 hrs.
Application of linear programming to complex allocation problems. Methods for determining maximum or minimum of objective functions whose variables are subject to constraints. Simplex methods, degeneracy, modified simplex, transportation problems, flows, goal programming, and sensitivity analysis. Prerequisite: ISE 626.
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>638</td>
<td>Engineering Reliability</td>
<td>3 hrs.</td>
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<td></td>
<td>Methodology of reliability prediction including application of discrete and continuous distribution models. Reliability estimation, reliability logic diagrams, life testing, and reliability demonstrations. Prerequisite: ISE 690.</td>
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<tr>
<td>639</td>
<td>Selected Topics in Industrial and Systems Engineering</td>
<td>Credit to be arranged</td>
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<tr>
<td>641</td>
<td>Advanced Quality Control</td>
<td>3 hrs.</td>
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<td>Advanced topics in statistical quality control including: short-run SPC techniques, autocorrelated data, multi-variate quality control charts, process capability analysis, and the use of evolutionary operations (EVOP) to improve and control process quality. Prerequisite: ISE 523.</td>
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<tr>
<td>647</td>
<td>Advanced System Simulation</td>
<td>3 hrs.</td>
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<td>Methods and procedures for simulation of large and complex systems. Discrete increment, continuous time and combined models. Comparison of discrete-event simulation languages. Model verification and validation. Statistical inference. Input data collection and analysis, output analysis, and comparison of alternatives. Prerequisites: ISE 547, 690.</td>
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<tr>
<td></td>
<td>Introduces the concepts and tools which support integrated products and process design. Particular attention is 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.</td>
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<td>690</td>
<td>Statistical Methods for Engineers</td>
<td>3 hrs.</td>
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<td></td>
<td>Application of probability and statistics. Descriptive statistics, theoretical distribution functions, point and interval estimates, and tests of hypotheses. Prerequisites: MA 201, ISE 390.</td>
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<td>697</td>
<td>Industrial and Systems Engineering Project I</td>
<td>3 hrs.</td>
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<td>Application oriented student project designed to show competence in Industrial and Systems Engineering.</td>
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<tr>
<td>698</td>
<td>Industrial and Systems Engineering Project II</td>
<td>3 hrs.</td>
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<td></td>
<td>Application oriented student project designed to show competence in Industrial and Systems Engineering. Continuation of ISE 697.</td>
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<tr>
<td>699</td>
<td>Master's Thesis</td>
<td>3, 6 or 9 hrs.</td>
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<tr>
<td></td>
<td>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.</td>
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<tr>
<td>723</td>
<td>Engineering Economic Analysis</td>
<td>3 hrs.</td>
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<td>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.</td>
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<tr>
<td>726</td>
<td>Systems Modeling</td>
<td>3 hrs.</td>
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<td>Philosophy and methodology for modeling probabilistic systems. Includes Markov processes, queuing theory, and inventory theory. Team project required. Prerequisites: ISE 390 or 690, ISE 626 or 627.</td>
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<tr>
<td>728</td>
<td>Optimization Methods in Operations Research</td>
<td>3 hrs.</td>
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<td>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.</td>
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</table>
729 Advanced Nonlinear Programming 3 hrs.
Continuation of ISE 728 with emphasis on development and application of nonlinear programming algorithms. SUMT algorithm, Zoutendijk’s method of feasible directions, Rosen’s gradient method, and selected algorithms from current literature. Prerequisite: ISE 728.

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

732 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.

734 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.

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

738 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.

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

741 Quality Engineering 3 hrs.
Application of quality engineering techniques to the design and improvement of products and processes. Topics include: multivariate analysis, Taguchi methods, mixture experiments, and response surface analysis. Prerequisites: ISE 526 and 690.

Development of applicable engineering management or industrial and systems engineering theory using classical concepts, contemporary studies and practices at successful technology-based organizations. Prerequisite: Permission of instructor.

Application of key qualitative and quantitative principles of engineering management or industrial and systems engineering to real-world case problems. Students work both in teams and as individuals to solve multidimensional problems which require an integrative point of view. Prerequisite: Permission of instructor.

790 Advanced Statistical Applications 3 hrs.
Continuation of ISE 690 with extension to regression models and nonparametric methods. Prerequisite: ISE 690.

799 Doctoral Dissertation 3, 6 or 9 hrs.
Required each semester student is enrolled and receiving direction on doctoral dissertation.
Graduate Courses in Engineering Management (EM)

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

661 Strategic Engineering Management/Industrial and Systems Engineering 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 Quality Systems Management 3 hrs.
Basic understanding of Quality Systems such as TQM and ISO 9000 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: EM 660.

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 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.

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.

760 Organization Structure for the Technical Enterprise 3 hrs.
Impact of various organization structures in relation to the goals of high technology enterprises. Use and effectiveness of contemporary organizational systems as related to the knowledge worker. Cases used to illustrate contemporary problems and environments. Prerequisite: EM 660 or permission of instructor.
761 Evolving Theory of Engineering Management/Industrial &
Systems Engineering 3 hrs.
Development of applicable engineering management or industrial & systems engineering using classical concepts, contemporary studies, and practices at successful technology-based organizations. Prerequisite: Permission of the instructor.

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 of Engineering Management/Industrial &
Systems Engineering 3 hrs.
Application of key qualitative and quantitative principles of engineering management or industrial & systems engineering to real-world case problems. Students work both as teams and as individuals to solve multidimensional problems which require an integrative point of view. Prerequisites: Permission of instructor.

779 Selected Topics in Engineering Management Credit to be arranged.

799 Doctoral Dissertation 3, 6, or 9 hrs.
Required each semester student is enrolled and receiving direction on doctoral dissertation.

MECHANICAL AND AEROSPACE ENGINEERING

N274 Technology Hall
Telephone: (256) 824-6154
Email: maegrad@uah.edu

Degrees:
Master of Science in Engineering
Doctor of Philosophy

Chair: Mark V. Bower

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:
Blackmon, J. (Research); terrestrial solar power, space power and thermal management, propellant management
Blair, J. (Adjunct); flight mechanics, system dynamics, design processes
Bower, M.V.; metallic and nonmetallic materials, solid and structural mechanics; fracture mechanics, CAEDM
Coleman, H. W.; propulsion, fluid mechanics, heat transfer, experimentation and uncertainty analysis
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
Karr, G.R.; fluid mechanics, heat transfer, cryogenic systems
Schutzenhofer, L. (Adjunct); dynamics, vibrations, fluid mechanics, acoustics, statistics, design processes
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:
Frederick, R.; propulsion, combustion diagnostics, real-time radiography, image processing
Frendi, K.; computational fluid mechanics, acoustics, numerical analysis, chemically reacting flows, transitional and turbulent flows
Landrum, D.B.; hypersonics, gas dynamics, aerodynamics, propulsion
Lin, M.; smart material systems, health monitoring of composite materials systems, micromechanics modeling of material

Assistant Professors:
Driessen, B.; dynamics, controls, modeling, optimization and scalability and robustness aspects of controls implementation (embedding) in distributed (mobile) systems
Moser, M. (Research); solid and liquid rocket combustion, laser-based diagnostics, instrumentation

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, acoustics, aerodynamics, thermodynamics, transport phenomena, propulsion, combustion, computational mechanics, experimental mechanics, dynamics and controls, and systems. The M.S.E. and Ph.D. degrees offered 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 (MAE) 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 MAE 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. Specialized areas include: acoustics, aerodynamics, propulsion, space structures, and space environment. Details concerning this program may be found in the MAE 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 including controls. MAE 671 is the required course for all graduate students. 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 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 one semester. 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.
Plasma kinetic theory including charged-particle and neutral collision, ionization, electronic excitation and recombination, motion of charged particles, macroscopic equations. Transport coefficients, gas discharges, instabilities, sheaths, electromagnetic waves. Prerequisites: PH 421, 432. (Same as PH 531.)

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. Prerequisite: MAE 454; 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. Prerequisite: MAE 446; MAE 454 recommended.

548 Energy Conversion and Power Generation 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.

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-lift 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 MAE 461 and 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. Stresses, vibrations, and stability of engineering structures. 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 457, 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

623 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.

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.
Combustion chemistry, introduction to mass transfer, chemical kinetics, reactors, simplified governing equations for chemically reacting flow, laminar diffusion and premixed flames. 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.

657 Helicopter Theory 3 hrs.
Vertical flight, forward flight, performance, design, mathematics of rotating systems, rotary wing dynamics, rotary wing aerodynamics, helicopter aeroelasticity, stability and control, stall, and noise. Prerequisite: MAE 580.
658 Rotordynamics 3 hrs.
Torsional and transverse rotor vibration, critical speed and stability analysis, response to unbalance, rotor balancing. Rotordynamic phenomena including: gyroscopic effects, fluid film bearings, annular seals, stiffness asymmetry. Prerequisite: MAE 488 or permission of instructor.

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 560.)

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, Piapunov exponents, bifurcation points, solitons, logistic maps, Poincare and Henon iterative maps, factals, Mandebrot and Julia sets, chaos in complex dynamical systems. Prerequisites: MA 244, and a 200 or 300 level Differential Equations course.

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.
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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>677</td>
<td>Optical Techniques in Solid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>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 permission of instructor. (Same as CE 677.)</td>
<td></td>
</tr>
<tr>
<td>678</td>
<td>Mechanics of Composite Materials</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>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.)</td>
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</tr>
<tr>
<td>683</td>
<td>Graduate Seminar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>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. Students will be 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 CE 683.)</td>
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</tr>
<tr>
<td>692</td>
<td>Graduate Engineering Analysis I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Ordinary differential equations (ODEs), linear algebra, simultaneous differential equations, application of ODEs to mechanical systems, Laplace transformations, Bessel functions, Legendre polynomials, vector analysis, integral theorems, and introduction to tensors. Prerequisite: 200 or 300 level Differential Equations course.</td>
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</tr>
<tr>
<td>693</td>
<td>Graduate Engineering Analysis II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Fourier series and integrals, partial differential equations (PDEs) and boundary-value problems, calculus of variations, analytical functions of a complex variable, Taylor and Laurent expansions, and the residue theorem. Prerequisites: 200 or 300 level Differential Equations course, MAE 692 or permission of Instructor.</td>
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</tr>
<tr>
<td>699</td>
<td>Master’s Thesis</td>
<td>3, 6, or 9</td>
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<tr>
<td></td>
<td>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. Requires thesis advisor permission.</td>
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</tr>
<tr>
<td>723</td>
<td>Computational Fluid Dynamics II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Continuation of Computational Fluid Dynamics I, advanced topics in finite difference, finite element, finite volume, and spectral element methods. Prerequisite: MAE 623.</td>
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<tr>
<td>724</td>
<td>Computational Fluid Dynamics III</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Grid generation techniques, adaptive methods, vectorization, parallel processing as applied to computational fluid dynamics. Prerequisite: MAE 623.</td>
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<tr>
<td>725</td>
<td>Computational Fluid Dynamics IV</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Application of FDM, FEM, FVM, and SEM in acoustics, turbulence, hypersonics, reacting flow, combustion, and radiative heat transfer problems. Prerequisite: MAE 623.</td>
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<tr>
<td>726</td>
<td>Rotorcraft Computational Fluid Dynamics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Full potential, Euler, Navier-Stokes approaches, structural and unstructured grids, wake capturing, turbulence, and acoustics. Prerequisite: MAE 651 or permission of instructor.</td>
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</tr>
<tr>
<td>740</td>
<td>Aerothermodynamics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>
741 Statistical Thermodynamics 3 hrs.

745 Combustion II 3 hrs.
Droplet evaporation and burning, introduction to turbulent flow, turbulent diffusion and premixed flames, burning of solids, pollutant emissions, and detonation. Prerequisite: MAE 646.

746 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.

748 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.

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. Prerequisites: MAE 643, 651. (Same as CHE 749.)

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, molecular interactions with light and diatomic spectroscopy needed fluorescence, Brillouin scattering, four wave mixing, CARS and other applications in optical fluid diagnostics. Prerequisite: EE 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. Prerequisites: 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.)

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

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

772 Theory of Structural Stability 3 hrs.
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. (Same as CE 772.)

773 Theory of Shells 3 hrs.
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.)

774 Finite Element Analysis II 3 hrs.
Advanced topics in finite element analysis; application to nonlinear partial differential equations in continuum mechanics; theoretical studies of convergence and stability of solutions. Prerequisite: MAE 674. (Same as CE 774.)

776 Theory of Finite Elasticity and Finite Viscoelasticity 3 hrs.
Theory of finite deformation analysis for elastic and viscoelastic materials. Constitute 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.

778 Fracture Mechanics 3 hrs.
Theory of crack propagation, stress intensity factors, mapping techniques, series expansion, asymptotic approximations, field singularities, integral transforms, numerical solutions. Prerequisite: MAE 672. (Same as CE 778.)
780 Theory of Acoustics 3 hrs.
Simple harmonic oscillators, damped and forced oscillators, 1-D wave equation, vibration of a string, 2-D wave equation, vibration of membranes, the acoustic wave equation, plane waves, cylindrical and spherical waves, reflection and transmission, radiation and reception of acoustic waves, absorption and attenuation of sound, cavities and wave guides, and architectural acoustics. Prerequisites: MAE 692, 693.

781 Nonlinear Effects in Plasma 3 hrs.
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.

782 Plasma Turbulence 3 hrs.
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.

799 Doctoral Dissertation 3, 6, or 9 hrs.
Required each semester student is enrolled and receiving direction on doctoral dissertation. Prerequisite: Permission of dissertation advisor.
COLLEGE OF LIBERAL ARTS

256 Morton Hall
Telephone: (256) 824-6200
Email: dean-la@uah.edu

Degree: Master of Arts

Dean: Sue W. Kirkpatrick, B.Sc., M.Sc., Ph.D., Professor of Psychology

Mission
The College of Liberal Arts is committed to excellence in teaching, research, and service in the following disciplines: fine arts, humanities, the social and behavioral sciences, and teacher education. For its own majors, as for those in the professional schools, the College strives to provide superior liberal arts education characterized by close interaction between teachers and learners. Its goals are to impart to each student a spirit of intellectual curiosity, critical thinking skills, abilities in writing and oral communication, aesthetic awareness and creativity, familiarity with human history and behavior, a knowledge of languages and cultures, and an understanding of the bases of ethical behavior and the duties of citizenship. Believing in the centrality of liberal learning to the mission of a university, the College is committed to maintaining a diverse community of teacher-scholars of the highest quality and to providing an environment that encourages personal and professional growth. It considers teaching and research mutually enriching activities and strives to make its knowledge and expertise available to professional programs on campus and to the educational needs of society. Through its graduates and programs, the College contributes to the cultural, intellectual, and economic growth of the state and nation.

Accreditation
The University of Alabama in Huntsville is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools, and the College of Liberal Arts thus offers baccalaureate and master's programs under the auspices of that accrediting body. In addition, The University of Alabama in Huntsville is an accredited institutional member of the National Association of Schools of Music. Teacher education programs 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.

Facilities
The College of Liberal Arts utilizes the facilities and resources of the entire university. However, the College is housed primarily in two buildings, namely Morton Hall and Roberts Hall. Critical to study of the liberal arts is the Salmon Library, located in close proximity to both Morton and Roberts Halls. Supporting facilities include the Writing Center located on the second floor of Morton Hall, a student computer laboratory on the first floor of Morton Hall, an instructional computer laboratory on the second floor of Salmon Library, an art gallery in the University Center, and Union Grove Gallery and Meeting Hall, an historic church moved to campus in 1974 and currently used as an art gallery and a meeting place for students and faculty.
The Humanities Center

The Humanities Center was established in 1991 with the aid of an award from the National Endowment for the Humanities (NEH). The NEH award took the form of a challenge grant that was subsequently matched by funds from other sources, including public, corporate, and private giving, to create the three endowments that support the Center’s activities in five areas: hiring of eminent and visiting scholars, library enhancement grants, public programming grants, faculty travel, and faculty research. The Humanities Center is located on the third floor of Roberts Hall.

Degrees And Programs

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. 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 in English, History, Psychology, and Public Affairs. Class A teacher certification is available with degree programs in English and History, as well as the disciplines of Biology, Chemistry, Mathematics and Physics (offered within the College of Science).

Teacher certification may be achieved through either traditional (including the Strengthened Subject Matter Option or the Technology Option) or non-traditional “fifth year” approaches. Those students who have earned graduate degrees in appropriate disciplines may be eligible for certification only programs.

Discipline Graduate Programs

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Degree</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>M.A.</td>
<td>Literature, Teacher Preparation, Teaching English to Speakers of Other Languages, Technical Communication</td>
</tr>
<tr>
<td>History</td>
<td>M.A.</td>
<td>American History, European History, Teacher Preparation</td>
</tr>
<tr>
<td>Public Affairs</td>
<td>M.A.</td>
<td>Public Policy, Public Administration</td>
</tr>
<tr>
<td>Psychology</td>
<td>M.A.</td>
<td>Experimental: Developmental, Social/Personality, Biopsychology, Applied Psychology, Cognition</td>
</tr>
</tbody>
</table>

Teacher Preparation Graduate Programs

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Degree</th>
<th>Focus</th>
<th>Teacher Certification</th>
<th>Possible Teacher Certification Routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>M.A.</td>
<td>Reading Specialist</td>
<td>P-12</td>
<td>Traditional: Strengthened Subject Matter Option</td>
</tr>
<tr>
<td>English as a Second Language</td>
<td>M.A.</td>
<td>P-12</td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td>English Language Arts</td>
<td>M.A.</td>
<td>6-12</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>History</td>
<td>M.A.</td>
<td>6-12</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Biology**</td>
<td>M.S.</td>
<td>6-12</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Chemistry**</td>
<td>M.S.</td>
<td>6-12</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mathematics**</td>
<td>M.A.</td>
<td>6-12</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Physics**</td>
<td>M.S.</td>
<td>6-12</td>
<td>Yes</td>
<td>Yes</td>
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* For those who have already earned appropriate graduate degrees, but who seek teacher certification

** Offered within the College of Science

153 College of Liberal Arts
COMMUNICATION ARTS

Chair: Clarke Rountree, Associate Professor

The Department of Communication Arts offers a comprehensive program of study leading to a Bachelor of Arts degree in Communication Arts. It also offers the following courses for graduate students in technical communication and engineering.

Graduate Courses in Communication Arts (CM)

Explores the relationships between common practices in technical communication and the theories that legitimize those practices. Introduces students to research and theories about fundamental issues in technical communication. May then become the basis for further graduate study in technical communication. Prerequisites: advanced undergraduate standing, CM 301 and 302 are strongly recommended. (Same as EH 501).

505 Advanced Media Writing 3 hrs.
Introduces and investigates a variety of media writing genres through generation of advertising, public relations, and multimedia copy.

601 Communication for Engineers 1 hr.
The course provides an introduction to technical presentations for advanced engineering students. Students are briefly introduced to rhetorical theory, provided training in oral communication skills, and given the opportunity to practice rhetorical communication. The class meets for 7 two-hour class periods.

EDUCATION

232K Morton Hall
Telephone: (256) 824-6180
Email: educ.grad@uah.edu

Degree: Master of Arts

Chair: M. L. Piersma, Associate Professor

Associate Professors:
- Enger, S.; science education
- Piersma, M.L.; reading and elementary education

Assistant Professors:
- Confer, C.; special education
- Goodson-Espy, T.; educational psychology, math education

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

College of Liberal Arts
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. The education program at UAH was officially approved in spring 1968, 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.

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 in Morton Hall where current teaching materials are available. The Institute for Science Education, a resource center for teaching and research in science and mathematics, is also located in Morton Hall. Technology classes are scheduled in the Salmon Library computer laboratory.

Services

In addition to its teaching function, the Department of Education provides in-service 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 Services

The Office of Career Services, 117 Engineering Building, 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. Transfer students will have their credits evaluated on an individual basis to determine course equivalency. 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 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. 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. Education students, however, are required to repeat teaching field and professional education courses at UAH. This is in compliance with the Alabama State Code of Education, but differs from the UAH course repeat policy in this regard. See the School of Graduate Studies section of this catalog for the UAH course repeat policy.

Program Completion. If a student does not complete requirements for the graduate degree within a period of seven 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.

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) may 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) An undergraduate program with as many hours as those required for a Class B certification program in the teaching field at UAH;
(c) General studies courses at the undergraduate level, with some work in each of four areas: humanities, social science, science, and mathematics;
(d) Admission into the School of Graduate Studies and to subject field programs (see Graduate Admissions section);
(e) Submission of proper application forms with documentation of items (a)-(d) above to the certification officer. Completed applications will be forwarded to the appropriate departments;
(f) An appropriate grade point average (B or better) on all work attempted in teaching field;
(g) Passing score on the Alabama Prospective Teacher Test (APTT);
(h) Completion of ED 301;
(g) A satisfactory interview(s) with faculty in the Department of Education;
(h) 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

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;
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 with no grade lower than a “C”. This grade-point average is consistent with requirements for student teaching and certification;
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;
5. 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;
6. Reported or observed behavior that is inappropriate or unprofessional may result in immediate dismissal from the Teacher Education Program.

Practicum Requirements
The Department of Education requires that a student seeking certification at the master’s level must engage in observation/practicum experiences in schools and communities as specified by the instructors of the professional education courses in his/her degree program. For further details, check with the instructor of the respective education course as to the practicum requirements. All students enrolled in the Nontraditional Fifth Year program are required to complete an extended field experience (ED 301) during their first year in the program. Contact the Chair of Education for information.
Internship Semester

Students in the Nontraditional Fifth Year Program are required to make formal application for the Internship Semester. Applications are available in the certification office. In order to accommodate students with appropriate clinical settings, the following priority dates for applications have been established. January 31 for the following Fall Semester and June 30 for the following Spring Semester. Please note that student teaching is offered only in the Fall and Spring Semesters, and must be taken the last semester before graduation. All grade point average requirements must be met at the time of application for student teaching. Students in the P-12 certification program must also make formal application for the Internship. The January 31 and June 30 deadlines are also in place for P-12 students. Specific internships will be designed to meet the needs of the individuals enrolled in the P-12 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 of 15 weeks. Students enrolled for an internship should not expect to be enrolled in other courses while interning.

Eligibility Requirements for the Internship Semester

1. Admission into the Teacher Education Program;
2. A completed Program of Study on file in the Education Department;
3. A minimum grade point average of 3.0 on all work attempted in the teaching field(s) with no grade lower than “C”;
4. A minimum grade point average of 3.0 on all work attempted in professional education courses, with no grade lower than a C’;
5. Satisfactory completion of all appropriate professional studies: ED 604, 606, 607, 608, ED 593 and a technology course (ED 520, 560, or 620);
6. Completion of at least two-thirds 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. Most internship placements are in the Huntsville-Madison County area, in order to facilitate supervision of students by UAH faculty. Nontraditional fifth year students seeking certification in grades 6-12 will complete a middle and a high school assignment during the 15-week internship. P-12 reading specialist and ESL candidates will complete assignments in both elementary and secondary settings. Individuals who wish to add an endorsement in another teaching field or at another level must hold a valid baccalaureate certificate. An abbreviated internship will be required for any additional endorsements. Individuals should contact the chair of the Education Department to make arrangements for the abbreviated internship.

Exit Examinations.

All students seeking Class A certification must take comprehensive written exit examinations in their teaching field and professional education. 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; (3) Students must take a comprehensive examination over their teaching field coursework. These examinations are designed by the teaching field department and use a variety of assessment techniques: oral examinations, multiple choice tests, performance assessments, and written examinations. Students should contact their teaching field department(s) to schedule these examinations.
Students enrolled in a traditional certification program, Option A—the technology option or Option B—the strengthened subject matter option should consult their teaching field department regarding their comprehensive examinations. They should also consult their education advisor about the written education examination.

Graduation
The student must have met all teaching field and education program requirements as outlined in the catalog. The student must have maintained a 3.0 grade point average in all teaching field courses and a 3.0 in all professional education courses and passed all exit examinations, including the Alabama Prospective Teacher Test (APTT), professional education and teaching field comprehensive written examinations.

Application for Certification
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 an appropriate certificate be awarded. (Completion of program requirements, however, does not automatically guarantee recommendation for certification.) 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’ certification requirements.

Requirements for Alabama Certification
1. 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.
2. To be eligible for a recommendation for an Alabama certificate, the candidate must earn a passing score on all exit examinations which cover the content of the teaching field and professional education courses.
3. No grade below “C” in the teaching field or professional studies may be used to meet certification requirements.
4. The applicant must submit a finger print card to the Alabama State Department of Education (the appropriate fee in the form of a money order or cashier’s check made payable to the Alabama Department of Education must accompany the finger print card) and successfully pass a background review conducted by the Alabama Bureau of Investigation and the Federal Bureau of Investigation.
5. Individuals who obtain background clearance through the ABI will not be required to obtain another background clearance for additional certification as long as they hold a valid Alabama certificate. Individuals who obtain background clearance for the issuance of an Alabama certificate and allow their certificates to lapse for more than 90 days (holding no Alabama certificate for that 90-day period) will be required to obtain another background clearance for the issuance of any certificate or license. Individuals who hold a valid Alabama substitute license will be required to submit a copy of that license along with other certification application paperwork.

6. Anyone convicted of a felony and/or misdemeanor other than a minor traffic violation may be denied certification or have certification revoked by the State Department of Education.

Initial Certification
Successful completion of the master's program in teacher education leads to Alabama Class A certification which is valid for five years. This certification may be renewed upon verification of successful teaching for four of the five years and completion of an approved professional development program.

Ensuring the Competence of Graduates
For a period of two years after program completion and recommendation for certification, The University of Alabama in Huntsville, through the Department of Education, shall warranty and provide remediation at no cost to students who are evaluated to be unsatisfactory of deficient in any area of preparation. Remediation in professional education and/or teaching field departments will be based upon recommendations from the performance evaluations conducted by public school administrators who use the Alabama Professional Education Personnel Evaluation (PEPE) or comparable evaluation recognized and approved by the State Board of Education. This policy is consistent with the Alabama State Code of Education.

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 baccalaureate level. A nontraditional fifth year program is also available for individuals without prior certification. Certification for all programs is available in the following areas:

1. Secondary/High School (6-12 Certification)
   - Biology Master of Science
   - English Language Arts Master of Arts
   - Mathematics Master of Arts
   - Chemistry Master of Science
   - History Master of Arts
   - Physics Master of Science

2. P-12 Certification
   - English as a Second Language - Master of Arts in English option
   - Reading Specialist - Master of Arts in English option
Master of Arts or Master of Science Traditional Programs

Strengthened Subject Matter Option

6-12 Certification

Biology, Chemistry, English Language Arts, History, Math, Physics

Basic Requirements

ED 604 - Contributions of Psychology to Education 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 607 - Educator as Evaluator 3 hrs.
A technology course: ED 520, 560, or 620 3 hrs.
ED 593 - Education of Exceptional Children and Youth 3 hrs.*

*Required for students who have not previously satisfied the Special Education requirement.

Teaching Field Requirements 24 hrs.

By advisement of the faculty in the major, select 24 semester hours from your chosen teaching field. A student may transfer no more than six semester hours in the teaching field.

A minimum GPA of 3.0 is required for coursework in the teaching field and in all professional education courses with no grade lower than a “C”. Transfer credit cannot be used to raise the GPA in the teaching field course work to the required 3.0. Students must hold a valid baccalaureate level Alabama teacher certificate with an endorsement in the same or broader field of study for which the Class A certification is sought. Teacher certification in English as a single field is no longer an option in Alabama. Individuals seeking certification to teach English will be required to meet the state standards for English Language Arts instead.

Students entering the English Language Arts program must complete at least one course in each of the following two areas, drama, journalism, or speech to satisfy the state standards for the undergraduate language arts program. CM 221 - Acting and CM 205 and 405 Advanced Media Writing I and II or their equivalents are recommended.

At the graduate level, students are encouraged to take a drama and a writing course to satisfy the standards for English Language Arts certification.

Students pursuing English as a Second Language as a teaching field must have an undergraduate degree with total hours that represent the average of other related programs.

33-36 Semester Hours Required for the Degree Programs
Master of Arts (P-12 Certification)

Strengthed Subject Matter Option

Teaching English as a Second Language (P-12 Certification)**

The ESL Certification Program is designed to prepare teachers to assist and support second language learners in P-12 school settings.

**Basic Requirements (21 hours)**

- ED 604 - Contributions of Psychology to Education 3 hrs.
- ED 606 - Principles of Curriculum Development 3 hrs.
- ED 607 - Educator as Evaluator 3 hrs.

**A technology course: ED 520, 560, or 620**

- ED 593 - Education of Exceptional Children and Youth 3 hrs.*
  *Required for students who have not previously satisfied the Special Education requirement.
- ED 605 - Reading Research and Instruction OR 3 hrs.
- ED 375 - Teaching Reading in the Elementary School 3 hrs.
- ED 699 - P-12 Internship 6 hrs.

**Teaching Field Requirements (18 hours)**

- EHL 509 - Special Topics in Applied English Linguistics, or EH 601 - Writing Pedagogy 3 hrs.
- EHL 610 - Practicum in TESOL: Applied English Linguistics VI 3 hrs.

The English as a Second Language program is an option within the English Master's degree program. Students pursuing English as a Second Language as a teaching field must have an undergraduate degree with total hours that represent the average of other related baccalaureate level programs. Students must have a valid baccalaureate level certificate.

A minimum GPA of 3.0 is required in the teaching field and in all professional education courses with no grade lower than "C".

Internships for students enrolled in the P-12 English as a Second Language program will be individually tailored to the needs of the individual; however, students will be required to demonstrate their teaching knowledge and skills at the P-12 levels.

39 Semester Hours Required for the Degree Programs
Master of Arts or Master of Science
Technology Option
6-12 Certification
Biology, Chemistry, English Language Arts, History, Math, and Physics

Basic Requirements
ED 603 - Sources of American Educational Thought 3 hrs.
ED 604 - Contributions of Psychology to Education 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 607 - Educator as Evaluator 3 hrs.
ED 620 - Curriculum Integration Technology 3 hrs.
ED 593 - Education of Exceptional Children and Youth* 3 hrs.
*Required for students who have not previously satisfied the Special Education requirement.

Other Requirements
ED 520 - Computer-Based Instructional Technologies 3 hrs.
ED 560 - Current and Emerging Instructional Technologies 3 hrs.

Teaching Field Requirements 24 hrs.
By advisement, of the faculty in your major, choose 24 hours in your chosen teaching field. A student may transfer no more than six semester hours in the teaching field.

A minimum GPA of 3.0 is required in the teaching field and in all professional education courses with no grade lower than “C”. Transfer credit cannot be used to raise the GPA in the teaching field course work to the required 3.0.

Students must hold a valid baccalaureate level Alabama teacher certificate with an endorsement in the same or broader field of study for which the Class A certification is sought.

Teacher certification in English as a single field is no longer an option in Alabama. Individuals seeking certification to teach English will be required to meet the state standards for English Language Arts instead.

Students entering the English Language Arts program must complete at least one course in each of the following two areas, drama, journalism, or speech to satisfy the state standards for the undergraduate language arts program. CM 221 - Acting and CM 205 and 405 Advanced Media Writing I and II or their equivalents are recommended.

At the graduate level, students are encouraged to take a drama and a writing course to satisfy the standards for English Language Arts certification.

45-48 Semester Required for the Degree Programs
Master of Arts (P-12 Certification)
Technology Option

Teaching English as a Second Language (P-12 Certification)**

The ESL Certification Program is designed to prepare teachers to support and assist second language learners in P-12 school settings.

Basic Requirements (30 hours)
- ED 603 - Sources of American Educational Thought 3 hrs.
- ED 604 - Contributions of Psychology to Education 3 hrs.
- ED 606 - Principles of Curriculum Development 3 hrs.
- ED 607 - Educator as Evaluator 3 hrs.
- ED 620 - Curriculum Integration Technology 3 hrs.
- ED 593 - Education of Exceptional Children and Youth* 3 hrs.
  *Required for students who have not previously satisfied the Special Education requirement.
- ED 605 - Reading Research and Instruction OR
- ED 375 - Teaching Elementary Reading 3 hrs.
- ED 699 - P-12 Internship 6 hrs.

Other Requirements:
- ED 520 - Computer-Based Instructional Technologies 3 hrs.
- ED 560 - Current and Emerging Instructional Technologies 3 hrs.

Teaching Field Requirements (18 hours)
- EHL 509 - Special Topics in Applied English Linguistics 3 hrs., OR
- EH 601 - Writing Pedagogy 3 hrs.
- EHL 610 - Practicum in TESOL: Applied English Linguistics VI 3 hrs.

Teaching English as a Second Language is an option available within the English Master's degree program. Students pursuing English as a Second Language as a teaching field must have an undergraduate degree with total hours that represent the average of other related baccalaureate level programs. Students must have a valid baccalaureate level certificate.

A minimum GPA of 3.0 is required in the teaching field and in all professional education courses. Internships for students enrolled in the P-12 English as a Second Language program will be individually tailored to the needs of the individual; however, students will be required to demonstrate their teaching knowledge and skills at the P-12 levels.

48 Semester Hours Required for this Degree Program
Master of Arts (P-12 Certification)

Reading Specialist (P-12 Certification)

The Reading Specialist Program (P-12) is designed to serve certified, practicing teachers and will prepare them to become a reading specialist for schools systems or to return to the classroom with greater knowledge of effective, research-based reading instruction.

Basic Requirements (6-9 hours)

ED 603 - Sources of American Educational Thought 3 hrs.
ED 604 - Contributions of Psychology to Education, OR a technology course (ED 520, 560, or 620)
ED 607 - Educator as Evaluator 3 hrs.
ED 593 - Educating Exceptional Children and Youth 3 hrs.
*Required for students who have not previously satisfied the Special Education requirement.

Teaching Field Courses (21 hours)

EH 601 - Writing Pedagogy 3 hrs.
EH/ED 613 - Children’s and Adolescent Literature 3 hrs.
ED 605 - Reading Research and Instruction 3 hrs.
ED 608 - Expanding Reading Ability through Content Area Instruction 3 hrs.
ED 612 - Reading Diagnosis and Acceleration 3 hrs.

Capstone Courses

ED 691 - Portfolio Seminar and Symposium 1 hr.
ED 699 - P-12 Internship 6 hrs.
*Linguistics courses may be used to meet the language requirement for M.A. students in English.

Admission Requirements

In addition to meeting the general requirements for graduate admission to the UAH School of Graduate Studies, the students must meet the following prerequisite requirements for admission into the Teacher Education Program.

1. Program of Study on file in the Education Department;
2. A baccalaureate level certification in an area of education;
3. Two years of successful classroom teaching experience; AND
4. Certification in Early Childhood Education, Elementary Education, or Collaborative Teacher (K-6 or 6-12); OR completion of two reading courses including an introductory reading course.

Exit Requirements

1. Complete a 300-hour internship in a public school setting;
2. Present a research-quality paper/project at the graduate symposium;
3. Submit the research paper/project to a professional organization for possible presentation;
4. Develop and submit a portfolio with evidence documenting compliance with SDE and institution standards;
5. Pass a comprehensive written examination covering the content of the curriculum

34-37 Semester Hours Required for this Degree Program
Master of Arts or Master of Science: Alternative Fifth Year Certification Programs

The Alternative Fifth Year Program is available to individuals who have completed a baccalaureate degree from a regionally accredited institution in a field other than teacher education. Students eligible for this program do not have a Class B (baccalaureate level) teaching certificate. Students should contact the Teacher Certification Officer and the advisor in the chosen teaching field for an individual evaluation concerning undergraduate deficiencies prior to initial registration in this program.

Degree Programs Offered

1. Secondary/High School (6-12 Certification)
   - Biology: Master of Science
   - English Language Arts: Master of Arts
   - Mathematics: Master of Arts
   - Chemistry: Master of Science
   - History: Master of Arts
   - Physics: Master of Science

2. P-12 Certification

   English as a Second Language - Master of Arts in English option
Alternative Fifth-Year Program (6-12 Certification)
Master of Science
Major: Biology

Prerequisite for Admission

ED 301 - Introduction to Education 1 hr.

Required Courses

ED 593 - Education of Exceptional Children and Youth 3 hrs.
ED 604 - Contribution of Psychology to Education 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 607 - The Educator as Evaluator 3 hrs.
ED 608 - Expanding Reading Ability through Content Area Instruction 3 hrs.
A technology course - ED 520, 560, or 620 3 hrs.
ED 690 - Seminar in Teaching 1 hr.
ED 698 - High School Internship 6 hrs.

Teaching Field Requirements (24 hours)

By advisement, of the faculty in your major, choose 24 hours in biology. A student may transfer no more than six semester hours in biology. A minimum GPA of 3.0 is required in the teaching field and all professional education courses with no grade lower than a “C”. Transfer credit may not be used to raise the GPA in biology to the required 3.0.

49 Semester Hours Required for this Degree

Undergraduate Requirements: 36 hours of undergraduate courses in biology are required.

Additional hours of related ancillary courses may also be required.

Undergraduate Program for Biology

BYS 119 - Principles of Biology 4 hrs.
BYS 120 - Organismal Biology 4 hrs.
BYS 219 - Genetics 4 hrs.
BYS 312 - Principles of Ecology 4 hrs.
BYS 321 - General Microbiology 4 hrs.
BYS 340 - Cell & Developmental Biology 4 hrs.
BYS 490 - Senior Seminar 2 hrs.
BYS 300+ - Electives 10 hrs.
TOTAL: 36 hours

Ancillary requirements:

Chemistry:

CH 121, 125 - General Chemistry I & Lab I 4 hrs.
CH 123, 126 - General Chemistry II & Lab II 4 hrs.
CH 331, 335 - Organic Chemistry I & Lab 4 hrs.
CH 332, 336 - Organic Chemistry II & Lab 4 hrs.
CH 361, 362 - General Biochemistry & Lab 4 hrs.

Physics:

PH 111, 114 - Physics with Calculus I & Lab 4 hrs.
PH 112, 115 - Physics with Calculus II & Lab 4 hrs.
Alternative Fifth-Year Program (6-12 Certification)
Master of Science
Major: Chemistry

Prerequisite for Admission
ED 301 - Introduction to Education 1 hr.

Required Courses
ED 593 - Education of Exceptional Children and Youth 3 hrs.
ED 604 - Contribution of Psychology to Education 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 607 - The Educator as Evaluator 3 hrs.
ED 608 - Expanding Reading Ability through Content Area Instruction 3 hrs.
A technology course: ED 520, 560, or 620
ED 690 - Seminar in Teaching 1 hr.
ED 698 - High School Internship 6 hrs.

Teaching Field Requirements (24 hours)
By advisement, of the faculty in your major, choose 24 hours in chemistry. A student may transfer no more than six semester hours in chemistry. A minimum GPA of 3.0 is required in the teaching field in all professional education courses with no grade lower than a “C”. Transfer credit may not be used to raise the GPA in chemistry to the required 3.0.

49 Semester Hours Required for this Degree
Undergraduate Requirements: 31 hours of undergraduate chemistry courses required including the following. Additional hours from the ancillary courses may also be required.

Undergraduate Program for Chemistry
CH 121/125 - General Chemistry I & Lab 4 hrs.
CH 123/126 - General Chemistry II & Lab 4 hrs.
CH 223/224 - Quantitative Analysis & Lab 4 hrs.
CH 315 - Chemical Demonstrations 2 hrs.
CH 331/335 - Organic Chemistry I & Lab 4 hrs.
CH 332/336 - Organic Chemistry II & Lab 4 hrs.
CH 347 - Biophysical Chemistry I 3 hrs.
CH 348 - Biophysical Chemistry II 3 hrs.
CH 361/362 - General Biochemistry I & Lab 4 hrs.
TOTAL: 32 hours

Ancillary Courses:
PH 111/114, 112/115, 113/116 - General Physics with Calculus 12 hrs.
MA 171, 172, 201 - Calculus A, B, C 12 hrs.
BYS elective minimum of one course in GER 4 hrs.
Alternative Fifth-Year Program (6-12 Certification)

Master of Arts

Major: English Language Arts

Prerequisite for Admission

ED 301 - Introduction to Education 1 hr.

Required Courses

ED 593 - Education of Exceptional Children and Youth 3 hrs.
ED 604 - Contribution of Psychology to Education 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 607 - The Educator as Evaluator 3 hrs.
ED 608 - Expanding Reading Ability through Content Area Instruction 3 hrs.
A technology course: ED 520, 560, or 620 3 hrs.
ED 690 - Seminar in Teaching 1 hr.
ED 698 - High School Internship 6 hrs.

Teaching Field Requirements (24 hours)

By advisement, of the faculty in your major, choose 24 hours in English Language Arts. A student may transfer no more than six semester hours in English Language Arts. A minimum GPA of 3.0 is required in the teaching field and in all professional education courses with no grade lower than a "C". Transfer credit may not be used to raise the GPA in English to the required 3.0. At the graduate level, students are encouraged to take a drama and a writing course to satisfy the standards for English Language Arts certification.

49 Semester Hours Required for this Degree

Undergraduate Requirements: 21 semester hours of undergraduate course work in English beyond the sophomore level are required. Students entering the English Language Arts program must complete at least one course in two of the following three areas - drama, journalism, or speech - to satisfy the state standards for the undergraduate language arts program. CM 122 - Acting and CM 405 - Advanced Media Writing or their equivalents are recommended.

Undergraduate Program for English Language Arts

Sophomore Survey (as described in the GER) 6 hrs.
Shakespeare (EH 307) 3 hrs.
Structure of Modern English (EH 307) 3 hrs.
Composition Studies for Teachers (EH 400) 3 hrs.
American Literature (EH 330, 331, 339, 430, 431, 530, 532, 533) 3 hrs.
Literature before 1800 (EH 380, 381, 450, 460, 470, 492, 551, 571, 572) 3 hrs.
Literature after 1800 (EH 330, 331, 390, 391, 418, 421, 430, 431, 493, 500, 3 hrs.
520, 522, 533, 592)
Literature elective (must be 300 level or above) 3 hrs.
One course in creative writing (EH 310, 311, or 412) may serve as the literature elective.
TOTAL: 21 hours
Introduction to Rhetorical Communication (CM 113) 3 hrs.
Communication Arts Elective (CM 309, 310, or 315) 3 hrs.
Drama and Theatre (CM 122 and 221) 6 hrs.
Journalism and Media Writing (CM 205 and 405) 6 hrs.
Note: One course devoted entirely to the novel.
Two courses in 400 or 500-level courses.
No more than one creative writing course may count toward major.
**Students entering this program with a B.A. in English are required to take some courses in drama, journalism, and speech. (CM 221 - Theatre and CM 305-Media Writing - recommended)
Alternative Fifth-Year Program (6-12 Certification)

Master of Arts

Major: History

Prerequisite for Admission
ED 301 - Introduction to Education 1 hr.

Required Courses
ED 593 - Education of Exceptional Children and Youth 3 hrs.
ED 604 - Contribution of Psychology to Education 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 607 - The Educator as Evaluator 3 hrs.
ED 608 - Expanding Reading Ability through Content Area Instruction 3 hrs.
A technology course: ED 520, 560, or 620 3 hrs.
ED 690 - Seminar in Teaching 1 hr.
ED 698 - High School Internship 6 hrs.

Teaching Field Requirements (24 hours)
By advisement, of the faculty in your major, choose 24 hours in history. A student may transfer no more than six semester hours in history. A minimum GPA of 3.0 is required in the teaching field and in all professional education courses with no grade lower than “C”. Transfer credit may not be used to raise the GPA in history to the required 3.0.

49 Semester Hours Required for this Degree

Undergraduate Requirements: 24 hours of undergraduate history courses beyond the 100 level are required.

Undergraduate Program for History
HY 101, 102 - Western Civilization 6 hrs. (GER)
HY 221, 222 - American History 6 hrs.
HY 225 - Alabama History 3 hrs.
HY 300 + electives 9 hrs.
HY 400 + electives 3 hrs.
HY 490 - Research Seminar in History 3 hrs.
Note requirements for electives:
6 hours of American history beyond 221, 222
6 hours of non-American history beyond 101, 102
15 hours must be at the 300+ level
Alternative Fifth-Year Program (6-12 Certification)
Master of Arts
Major: Mathematics

Prerequisite for Admission
ED 301 - Introduction to Education 1 hr.

Required Courses
ED 593 - Education of Exceptional Children and Youth 3 hrs.
ED 604 - Contribution of Psychology to Education 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 607 - The Educator as Evaluator 3 hrs.
ED 608 - Expanding Reading Ability through Content Area Instruction 3 hrs.
A technology course: ED 520, 560, or 620 3 hrs.
ED 690 - Seminar in Teaching 1 hr.
ED 698 - High School Internship 6 hrs.

Teaching Field Requirements (24 hours)
By advisement, of the faculty in your major, choose 24 hours in Mathematics. A student may transfer no more than six semester hours in Mathematics. A minimum GPA of 3.0 is required in the teaching field and in all professional education courses with no grade lower than “C”. Transfer credit may not be used to raise the GPA in mathematics to the required 3.0.

49 Semester Hours Required for this Degree

Undergraduate Requirements: 39 hours of undergraduate courses in mathematics including the following will be required. Additional hours from the ancillary courses listed below may also be required.

Undergraduate Program for Mathematics Certification (B.A.)
Mathematics courses:
- MA 171 - Calculus A 4 hrs.
- MA 172 - Calculus B 4 hrs.
- MA 201 - Calculus C 4 hrs.
- MA 244 - Linear Algebra 3 hrs.
- MA 330 - Foundations of Math 3 hrs.
- MA 385 - Intro. to Probability 3 hrs.
- MA 442 - Algebraic Structures With Applications 3 hrs.
- MA 452 - Intro. to Real Analysis 3 hrs.
- MA 333 - Intro. to Geometry 3 hrs.
- MA 500+ elective 3 hrs.
TOTAL: 31 hours

Ancillary Courses:
- CS 121 - Computer Science 3 hrs.
- PH 111/114 and 112/115 Physics 8 hrs.
Alternative Fifth-Year Program (6-12 Certification)
Master of Arts
Major: Physics

Prerequisite for Admission
ED 301 - Introduction to Education 1 hr.

Required Courses
ED 593 - Education of Exceptional Children and Youth 3 hrs.
ED 604 - Contribution of Psychology to Education 3 hrs.
ED 606 - Principles of Curriculum Development 3 hrs.
ED 607 - The Educator as Evaluator 3 hrs.
ED 608 - Expanding Reading through Content Area Instruction 3 hrs.
A technology course: ED 520, 560, or 620 3 hrs.
ED 690 - Seminar in Teaching 1 hr.
ED 698 - High School Internship 6 hrs.

Teaching Field Requirements (24 hours)
By advisement of the faculty in your major, choose 24 hours in physics. A student may transfer no more than six semester hours in physics. A minimum GPA of 3.0 is required in the teaching field and in all professional education courses. Transfer credit may not be used to raise the GPA in physics to the required 3.0.

49 Semester Hours Required for this Degree

Undergraduate Requirements: 33 hours of undergraduate physics including the following are required. Additional related courses may also be required.

Physics Courses:
PH 110 - Frontiers in Science 3 hrs.
PH 111, 114 - Physics with Calculus I 4 hrs.
PH 112, 115 - Physics with Calculus II 4 hrs.
PH 113, 116 - Physics with Calculus III 4 hrs.
AST 106 - Exploring the Cosmos I 4 hrs.
AST 107 - Exploring the Cosmos II 4 hrs.
PH 337 - Electronics 4 hrs.
PH 351 - Introduction to Modern Physics 3 hrs.
PH 499 - Physics Practicum 3 hrs.
TOTAL: 33 hours

Ancillary courses:
MA 171, 172, 201 - Calculus 12 hrs.
EH 301 - Technical Writing 3 hrs.
CS 102 or 103 - Computer Science 3 hrs.
MA 324 - Differential Equations 3 hrs.
Alternative Fifth-Year Program

Master of Arts

Major: English

P-12 Certification: Teaching English as a Second Language option

The ESL Certification Program is designed to prepare teachers to assist and support second language learners in P-12 school settings.

**Required Courses**

- ED 593 - Education of Exceptional Children and Youth 3 hrs.
- ED 604 - Contribution of Psychology to Education 3 hrs.
- ED 606 - Principles of Curriculum Development 3 hrs.
- ED 607 - The Educator as Evaluator 3 hrs.
- ED 608 - Expanding Reading Ability through Content Area Instruction 3 hrs.
- A technology course: ED 520, 560, or 620 3 hrs.
- ED 690 - Seminar in Teaching 1 hr.
- ED 698 - High School Internship 6 hrs.

**Teaching Field Requirements (18 hours)**

- OR EHL 509 - Special Topics in Applied English Linguistics 3 hrs. OR EH 601 - Writing Pedagogy 3 hrs.
- EHL 610 - Practicum in TESOL: Applied English Linguistics VI 3 hrs.

Teaching English as a Second Language is an option within the English master’s degree program. Students pursuing English as a Second Language as a teaching field must have an undergraduate degree with total hours that represent the average of other related baccalaureate level programs. A minimum GPA of 3.0 is required in the teaching field and in all professional education courses.

Internships for students enrolled in the P-12 English as a Second Language program will be individually tailored to the needs of individual students; however, students will be required to demonstrate their teaching knowledge and skills at the P-12 levels.

**43 Semester Hours Required for this Degree**
Graduate Courses in Education (ED)

500 Special Problems in Education 3 hrs.
Independent study, special projects, and special in-service programs. Prerequisite: Senior standing.

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: $40. (Same as CS 520.)

532 Space Orientation for Educators: Huntsville 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: $20. (Same as ES 532.) This course may not be used to meet degree requirements for UAH graduate programs.

533 Space Orientation for Educators: Washington 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: ED 532 or ES 532. (Same as ES 533.) This course may not be used to meet degree requirements for UAH graduate programs.

534 Space Orientation for Educators: Russia 3 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 Baikonur Cosmodrome, and various schools, institutes, ministries, and factories involved in aerospace education and industry in Moscow, Kiev, Leningrad, and Krasnoyarski. (Same as ES 534.) This course may not be used to meet degree requirements for UAH graduate 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. School-based practicum required.

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

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. School-based practicum required.
605 Reading Research and Instruction 3 hrs.
Elements of effective reading instruction for beginning readers as supported by current research and practice. Topics include balance, language-rich/print-rich environment, language development, phonemic awareness, print awareness, phonics, writing, spelling, and comprehension. Students participate in an intensive school-based practicum.

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. School-based practicum required.

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. School-based practicum required.

608 Expanding Reading Ability through Content Area Instruction 3 hrs.
Strategies to enhance reading comprehension when using materials in all subject areas. Teacher-directed, integrated instruction; extensive use of authentic printed materials; discussion at literal and higher levels of understanding, motivation, vocabulary, and writing. Students participate in an intensive school-based practicum.

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.

612 Reading Diagnosis and Acceleration 3 hrs.
Focuses on ways to address the needs of students who do not read at grade level. Intervention strategies such as on-going assessment and evaluation, explicit instruction in phonemic awareness and phonics, extensive practice, comprehension strategies, and writing, along with careful examination of standardized state assessment measures. An intensive school-based practicum is included.

613 Children's and Adolescent Literature 3 hrs.
Course content will include the study of various genres of children's and adolescent literature and their relationship to beginning reading, enhancement of reading comprehension, and intervention instruction in the various content areas. (Same as EH 613.)

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.)

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.

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.

175 College of Liberal Arts
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>661</td>
<td>Major Issues and Trends in Instructional Leadership</td>
<td>3 hrs.</td>
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<td>Designed to: stimulate student participation in the analytic process of examining issues and trends in the broad field of instructional leadership; serve as a vehicle for increasing proficiency in writing skills; refine participants' abilities to analyze, synthesize, and formulate a position relative to controversial educational issues and areas.</td>
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<td>662</td>
<td>Instructional Leadership</td>
<td>3 hrs.</td>
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<td></td>
<td>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.</td>
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<tr>
<td>690</td>
<td>Seminar in Teaching</td>
<td>1 hr.</td>
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<td>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.</td>
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<tr>
<td>691</td>
<td>Portfolio Seminars and Symposium</td>
<td>1 hr.</td>
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<td>The seminar will provide a forum in which the student’s culminating portfolio is refined and submitted for faculty review. The seminar will also serve as a mechanism to support the final writing stages of the required action research project or case study report. The student’s work will be approved and supervised by the faculty advisor(s). A symposium in which students present their research will be the culminating activity.</td>
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<tr>
<td>695</td>
<td>Supervised Teaching</td>
<td>1 hr.</td>
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<td></td>
<td>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.</td>
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<tr>
<td>698</td>
<td>High School Internship</td>
<td>6 hrs.</td>
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<td>Student teaching is learning the art of teaching with guidance and support from a mentor teacher. Student teachers are expected to integrate, synthesize, and apply theoretical knowledge from previous courses in realistic, planned, professional settings. They are expected to effect current research-based practices and strategies that provide for growth in pupil learning and growth in professional knowledge, skills, and dispositions of novice teachers. Candidates will complete middle and a high school teaching assignment. Students must complete a minimum of 100 clock hours of actual teaching as part of the 300 in-school hours required by the State Department of Education, including a minimum of 20 full-time teaching days, of which at least 15 must be consecutive. Prerequisites: Completion of all professional education courses and a minimum of two-thirds of the teaching field courses. ED 690 is to be taken concurrently with student teaching.</td>
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<tr>
<td>699</td>
<td>P-12 Internship</td>
<td>6 hrs.</td>
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<td>The purpose of the P-12 Internship is to provide teacher candidates seeking certification as a reading specialist or a teacher of ESL students with an opportunity to apply the knowledge and strategies required of them as a professional. They will be evaluated on their competency 1) to provide literacy services to children at the pre-school through grade 12 classroom levels, and 2) to assist other teachers with their students. Graduate students seeking the reading specialist or ESL teacher certification will be expected to work in variety of pre-school through grade 12 classroom settings. During the internship, students must accumulate a minimum of 300 total clock hours.</td>
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ENGLISH

222 Morton Hall
Telephone: (256) 824-6320
Email: ehgrad@uah.edu

Degree: Master of Arts

Chair: David S. Neff, Professor

Professors:
Mebane, J.S.; Renaissance literature
Neff, D.S.; Romantic period, criticism
Norman, R.; Technical writing, women’s studies

Associate Professors:
Bollinger, L.; American literature
Early, J.; Victorian literature
Moore, R.S.; American literature
Nelson, J.; Renaissance literature
Schenker, D.; Modern British literature
Szilagyi, S.; Augustan and eighteenth-century literature

Associate Professor Emeritus:
Munson, W.F.; Medieval literature

Assistant Professors:
Bell, D.; Rhetoric and composition pedagogy
Dillard, N.F.; Milton, seventeenth-century literature
Price, M.; Medieval literature
Youmans, M.; Linguistics, TESOL

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 (24-27 semester hours plus a thesis) or Plan II (33 semester hours). Except for specializations in Reading and English as a Second Language (pre-school through twelfth grade certification), both plans require a minimum of 18 semester hours in literature courses offered by the English Department. (EH 501, 502, 601, 602, and EHL courses do not count toward the literature requirement.) 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. 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, if applicable, on the thesis;
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. Nine semester hours 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. In lieu of the language requirement, additional graduate course work of three semester hours of English EHL 505 (Survey of General Linguistics), 507 (Advanced English Grammar Studies), or 508 (History of the English Language) or an approved course of similar nature is required. EHL 509 (Special Topics in Applied Linguistics) will sometimes be appropriate for approval, depending on the topic.

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 9 are in education. Under provisions for strengthened subject matter programs, English courses may be taken instead of education courses if certain requirements have been met at the undergraduate level.

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.

Class A Teacher Certification in English as a Second Language, Pre-school through Twelfth Grade

Prerequisites for the M.A. in English with Class A Teacher Certification in English as a Second Language (pre-school through twelfth grade) include the following:
1. Class B teaching certificate in any discipline;
2. ED 375, Teaching Elementary Reading, or equivalent.

In addition to the requirements for the M.A. in English (or in lieu of them as indicated below), a student seeking the P-12 Class A teaching certificate in English as a Second Language must meet the following requirements:
1. A 6-hour internship (ED699) must be a part of the M.A. program;
2. Fifteen hours of graduate courses in education as specified by the Education Department. These hours replace the thesis requirement; thus, of the 33 semester hours required, 18 are in English and 15 (including the 6-hour internship) are in education.
This curriculum option includes the following English courses: EHL505; 507; 508 or 601 or 509; 608; 609; and 610. Required education courses are ED 604, 606, 607 and 699. ED 593, Education of Exceptional Children and Youth, is required if no special education course has been taken at the undergraduate or graduate level prior to entering the program.

Students who have previously completed the 18-hour TESOL certificate program (see below) should consult with the Department of Education concerning transfer of credits into the P-12 certification program.

This curriculum option should be selected only by graduate students who seek P-12 teacher certification in ESL; students who wish to obtain Class A teacher certification in English must take a minimum of 18 semester hours in literature as part of their M. A. in English.

**Class A Teacher Certification as a Reading Specialist, Pre-school through Twelfth Grade.**

The Reading Specialist Program (P-12) is designed to serve certified, practicing teachers and will prepare them to become reading specialists for school systems or to return to the classroom with greater knowledge of effective, research-based reading instruction.

**Prerequisite requirements:**

In addition to meeting the general requirements for graduate admission to the UAH School of Graduate Studies, the student must meet the following prerequisite requirements for admission into the Teacher Education Program.

1. Program of Study on file in the Education Department;
2. A baccalaureate level certification in an area of education;
3. Two years of successful classroom experience; AND
4. Certification in Early Childhood Education, Elementary Education, or Collaborative Teacher (K-6 or K-12); OR
   Completion of two reading courses including an introductory reading course.

**Exit requirements:**

1. Complete a 300-hour internship in a public school setting, demonstrating competence to teach reading and assist other teachers with their students in the area of reading;
2. Present a research quality presentation at the graduate symposium as described in the ED 691 syllabus;
3. Develop and submit a portfolio with evidence documenting competence in meeting the ability standards set by the State Department of Education for the Reading Specialist Program;
4. Submit the research paper to a professional organization for possible presentation at a regional, state, or national/international conference;
5. Pass a comprehensive written examination covering the content of the curriculum.

**Program of Study**

**Professional Education Core:**

- ED 603 Sources of American Educational Thought, OR 3 hrs.
- ED 604 Contributions of Psychology to Education, OR
  a Technology Course (ED 520, 560, or 620)
- ED 607 Educator as Evaluator 3 hrs.
- ED 593 Education of Exceptional Children and Youth* 3 hrs.

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College of Liberal Arts
Teaching Field Courses:

- ED 605 Reading Research and Instruction
- ED 608 Expanding Reading Ability Through Content Area Instruction
- EH/ED 613 Children’s and Adolescent Literature
- ED 612 Diagnosis and Acceleration of Reading Ability

Capstone Courses:

- ED 691 Portfolio Seminar and Symposium
- ED 699 P-12 Internship

Total: 34 - 37 hrs.

* A special education survey is required for those individuals who have not previously taken an appropriate special education course.

** Linguistics courses may be used to meet the language requirement for M.A. students in English.

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, EHL 507, EHL 508 or EH 601 or EHL 509, EHL 608, EHL 609, and EHL 610. Students who wish to apply 500-level courses to the certificate must take these courses at the graduate level. EHL 505, 507, 508, and 509 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.

TESOL Certificate candidates must have completed at least one semester of foreign language study before receiving the TESOL Certificate. Equivalent experience such as study or work abroad may satisfy this requirement at the discretion of the TESOL Program Director; if you have such potentially equivalent experience, please see the TESOL Program Director. Note that this requirement does not substitute for the language requirement for students pursuing the M.A. in English. EHL 505, 507, 508, and 509 do not satisfy the TESOL Certificate language requirement.

B. Graduate Certificate in Technical Communication

The English Department offers an 15-credit-hour Certificate in Technical Communication. The certificate requires three specialty courses in technical writing and editing (EH 501, 502, and 601 or 602) and two specialty courses in an allied field (such as linguistics, psychology, education, cognitive science, 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, 601, and 602 may be applied to the M.A. degree in English.

No more than six credit hours taken at another institution may be applied to the certificate, and certificate courses taken at UAH must include EH 501 or 502 and EH 601 or 602. In some cases, a special topics course or independent study may be substituted for EH 601 or 602. Students wishing...
to write a thesis in technical communication may use the six allied field hours as thesis hours (EH 699).

**Graduate Courses in English (EH)**

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

**501 Theory and Practice in Technical Communication**
3 hrs.
Explores the relationships between common practices in technical communication and the theories that legitimize those practices. Introduction to research and theories about fundamental issues in technical communication which may then become the basis for further graduate study in technical communication. Prerequisites: graduate or advanced undergraduate standing; EH 301 and 302 are strongly recommended. (Same as CM 501.)

**502 Problems in Technical Editing**
3 hrs.
Advanced study of research and practice in common problems of technical editing, including documentation standards, document design, and management of complex editorial projects. Involves collaborative project with professional writers in industry. Prerequisites: EH 302 or 501.

**510 Advanced Fiction Writing**
3 hrs.
Workshop in advanced fiction writing. Prerequisite: approval of instructor.

**511 Poetry Writing**
3 hrs.
Workshop in advanced poetry writing. Prerequisite: EH 311 or approval or instructor.

**512 Special Topic in Creative Writing**
3 hrs.
A creative writing workshop in a selected topic. Prerequisite: 6 hours of sophomore literature or permission of instructor.

**520 Modern Poetry**
3 hrs.
American and British poetry from the 1890’s to the present: Yeats, Pound, Eliot, Frost, Stevens, and others. Poets will be studied against the background of the social, political and technological revolutions that characterize the modern world.

**522 Modern Novel**
3 hrs.
Considers responses to the experience of modernity; focus on English and American but in different years; texts will also be drawn from Continental, Latin American, Asian, or African traditions.

**525 Literature and Technology**
3 hrs.
Considers the relation between technology and culture as it has been understood since the classical period through a broad range of literary texts.

**530 Special Studies in American Literature**
1-3 hrs.
Topics announced in advance.

**532 Literature of the American South**
3 hrs.
Selected figures and movements from colonization to the present.

**533 William Faulkner**
3 hrs.
Critical study of the major novels.

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

**571 Renaissance Drama**
3 hrs.
Major plays of the sixteenth and early seventeenth centuries, including Marlowe, Jonson, and others. Excludes Shakespeare.
572 Seventeenth-Century Poetry 3 hrs.
Emphasis on major figures (Donne, Jonson, Herbert), their followers, and major themes and genres of the period. Excludes Milton.

592 The Literature of Transition 3 hrs.
Considers all genres, including intellectual and philosophic works, 1890-1915, to explore the transition from Victorianism(s) to Modernism.

601 Writing Pedagogy 3 hrs.
Analysis of and research on the teaching of writing. Prerequisites: to be specified as courses are announced.

602 Practicum in Technical Communication 3 hrs.
Designed to give technical communication graduate students on-the-job experience in industry or government, either through an internship or a major research project connected with an industry problem. Requires completion of a substantial internship report. Prerequisites: EH 501, 502, and instructor’s approval of a project prospectus.

613 Children’s and Adolescent Literature 3 hrs.
Course content will include the study of various genres of children’s and adolescent literature and their relationship to beginning reading, enhancement of reading comprehension, and intervention instruction in the various content areas. (Same as ED 613.)

618 Studies in Women and Literature 3 hrs.
Selected authors, genres, and issues.

629 Studies in Twentieth-Century Literature 3 hrs.
Selected poetry and prose with an emphasis on the Anglo-American Modernist tradition.

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

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

649 Special Studies 1-3 hrs.
Study of significant issues in literature, technical communication, or composition studies, 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.
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**

Extensive and intensive study of various early modern texts, with attention to interdisciplinary contexts.

**690 Studies in the Romantic Period**

Representative writing, selected from prose, poetry, or fiction, with attention to aesthetic theory and philosophical and psychological backgrounds.

**691 Studies in the Victorian Period**

Representative writing, selected from prose, poetry, or fiction, with emphasis on social and cultural changes that inform the literature.

**698 Independent Study**

Individual investigation into significant issues in linguistics, literature, technical communication, or composition studies under direct supervision of instructor. Prerequisite: written approval by the instructor and the department chair of a project prospectus.

**699 Master’s Thesis**

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)

**505 Survey of General Linguistics: Applied English Linguistics I**

Survey of phonology, morphology, and syntax, language universals and typology, history of English and other major world languages, topics in psycho- and socio-linguistics such as language acquisition, situational language change, and the study of regional and ethnic varieties as they reflect and construct the linguistic and cultural diversity of the United States.

**507 Advanced English Grammar Studies: Applied English Linguistics II**

In-depth study of English syntax within contemporary theoretical paradigms. Includes comparisons between modern syntactic analyses and traditional methods, comparisons between Standard American English and regional and ethnic varieties, the inevitable historical changes in English grammar, and pedagogical contexts/teaching issues. Prerequisite: EHL 307 or 505 recommended but not required.

**508 History of the English Language: Applied English Linguistics III**

History of English from the pre-Anglo-Saxon period to the contemporary period, focusing on analysis and description of the grammatical systems, including major aspects of the phonetic, phonological, morphological, syntactic, and semantic components of Old English, Middle English, and Modern English; overview of language acquisition and development as they relate to language change; analysis of mechanisms of language change; development of regional and ethnic dialects as expressions of cultural diversity in American and other former colonies of England; historical events that have influenced and surrounded the language. Prerequisite: EHL 307 or 505 (or the equivalent) recommended.

**509 Special Topics in Applied English Linguistics**

Special topics in linguistics. Particular focus and emphasis announced in advance. Some topics may meet the English M.A. language requirements; consult Department Chair.
An investigation of the process of language acquisition, both for first and second language learners, including a survey of language acquisition theory, with a focus on the innateness of human language, the elements considered essential in the acquisition process, and different contexts in which languages are acquired; collection and analysis of data; and integration of theoretical material with practical problems of learning and teaching. Acquisition of regional and ethnic varieties is also covered. Prerequisite: EHL 307, 505, or permission of instructor.

Designed to give current and future ESL instructors the foundation for informed and effective classroom teaching. Includes theoretical underpinnings of historical and contemporary ESL, instructional methods, analysis and critique of methodologies, and strategies for pedagogically sound classroom activity development and lesson planning within linguistically and culturally diverse instructional contexts. Prerequisite: EHL 307 or 505 suggested but not required.

610 Practicum in TESOL: Applied English Linguistics VI 3 hrs.
Current issues, techniques, and materials in teaching English to speakers of other languages (TESOL). Direct and supervised teaching of English to non-native speakers of English. Prerequisite: Graduate standing and EHL 609, or permission of the instructor.

HISTORY

409 Roberts Hall
Telephone: (256) 824-6310
Email: history.grad@uah.edu

Degree: Master of Arts

Chair: Philip P. Boucher, Distinguished Professor

Professors:
Boucher, P.P.; early modern Europe, early modern European expansion
Ellis, J.D. (Emeritus); 19th and 20th century Europe, modern France, social history of medicine
Gerberding, R.A.; ancient and medieval
Shields, J.N. (Emerita); U.S. social and cultural; early republic; old South
Williams, L.E., II; 20th-century U.S.; African-American; modern South

Associate Professors:
Martin, V.; Imperial Russia and Soviet Union
Severn, J.K.; French Revolution and Napoleon; 19th-century Europe, modern France
Waring, S.P.; Modern U.S., U.S. intellectual; U.S. labor and business

Assistant Professor:
Shuck, S. M.; Native American, 18th - and 19th-century U.S., Old South, U.S. Women's History

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. Each applicant must (1) have a minimum overall undergraduate GPA of at least 3.0 (A=4.0) or at least 3.0 for the last 60 hours of work; (2) score at least 1500 on the three aptitude portions of the GRE; *for GRE tests taken after October 1, 2002, the score on the analytical portion is obtained by taking the (raw score plus 2) x 100;* and (3) have an undergraduate major in history or its equivalent as determined by the departmental graduate committee.

**Degree Programs**

Students pursuing the master's degree in history may choose one of three degree programs, depending on their personal and professional goals. PLAN A (thesis with language) is strongly recommended for all students who plan study in history beyond the master's level. PLAN B (thesis without language), and PLAN C (substitution of 9 hours of graduate history courses for the thesis, without language) are considered terminal degrees and are intended primarily for those who do not intend further graduate work in history. Upon admission to the graduate program, each student will sign a Master's Declaration of Study indicating which plan he or she intends to follow.

Under PLAN A, students are required to demonstrate reading proficiency in French, German, Latin, Russian, or Spanish. This should be done early in the program of study. The language requirement may be satisfied by completion of 4 semesters of study in the language, with an overall GPA of 3.0, or by demonstrating reading proficiency, which will be determined by the department in cooperation with the Department of Languages and Literatures. Students may also make arrangements through the departmental chair to take a standardized (ETS) foreign language test administered at UAH.

**Degree Requirements**

In addition to the Graduate School requirements, the History Department requirements for the Master of Arts degree are as follows:

**PLAN A**

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;
5. Reading proficiency in French, German, Latin, Russian, or Spanish;
6. Oral comprehensive examination covering courses and thesis. Students must demonstrate competency in at least two fields of history.
PLAN B
Same as above, excluding language requirement.

PLAN C
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 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;
4. Nine hours of graduate history courses in lieu of a thesis;
5. Oral and written comprehensive examination covering coursework. Students must demonstrate competency in at least two fields of history.

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

Non-Traditional Fifth-Year Program
Those who have a B.A. or B.S. degree with a major or its equivalent in history as determined by the Department of History, who 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. Graduates of this program earn both an M.A. in history and Class A certification. Students in the Fifth-Year Program follow the same admission requirements and degree requirements for the M.A. as other graduate students, but can use two of their education courses to meet Requirement #2 under Plans A, B, or C (six additional hours of elective graduate courses in history or a related subject). 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 provisional 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 3 hrs.
Southern society, economics, politics and culture concentrating on the nineteenth century South through Reconstruction.
514 The New South 3 hrs.
The post-Reconstruction South emphasizing the economic, social, and political readjustments made during the twentieth century.

524 The Atlantic World 3 hrs.
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.

527 The Age of the American Revolution 3 hrs.
Politics, society, economy, culture and international conflicts from 1754 through the Revolutionary War to 1815.

528 The Republic in Crisis 3 hrs.
Political, social, and economic changes in the United States and its sections from 1815 through the Civil War and Reconstruction.

537 The Rise of Modern America 3 hrs.
Economic and social changes, imperialism, and the growth of government in the United States from 1877 to the 1920s.

538 Modern America 3 hrs.
American society, politics, economics, and foreign affairs from the end of World War I to the origins of the Cold War.

539 Recent America 3 hrs.
Contemporary America from the 1950s to the present analyzing both domestic and foreign affairs.

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

574 The Renaissance and Reformation 3 hrs.
Selected topics in the Italian Renaissance and European Reformation.

575 Crisis in Europe, 1560-1660 3 hrs.
Europe in an age of anxiety, religious wars, political upheaval, witch hunts, and the early scientific revolution.

576 Absolutism and Enlightenment, 1660-1763 3 hrs.
Europe from Louis XIV to the Peace of Paris, an age of political stability and intellectual innovation.

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

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

579 Europe in the Twentieth Century 3 hrs.
Major developments in Europe from 1914 to the present, including the two World Wars and post-war reconstruction.

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

598 Readings in History 1-3 hrs.
In exceptional circumstances, a student may ask a professor to provide a reading course on a subject of the professor's choosing.
Courses at the 600-level are open to graduate students or to senior history majors in accordance with specific Graduate School requirements.

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

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

**618 Studies in Early American History** 3 hrs.
Research, writing, and critical examination of selected topics in early American history from 1607 to 1800.

**619 Studies in Nineteenth-Century American History** 3 hrs.
Research, writing, and critical examination of selected topics in nineteenth-century American history.

**620 Studies in Twentieth-Century American History** 3 hrs.
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, 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.
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.

 Cliente  
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 on any particular subject matter expertise. However, each student will be expected to complete SOC 333 or PY 300 or 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. A minimum of 18 hours at the 600-level.
3. 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 Professions
   - PSC 635 Methodological Issues and Public Policy
   *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.
4. 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
5. 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 co-coordinator.
6. 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 co-coordinator.

7. Courses in other disciplines. Student should consult with department co-coordinator to determine appropriate coursework from other disciplines.

8. Other Options - 6 hours. One of the following options:
   PSC 695 Internship in Government (3 hrs. + one elective)
   PSC 699 Master’s Thesis (6 hours)
   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.
Provides an analytical framework for critical thinking about public policy processes in American governments. Examines policymaking processes. Discusses political, economic, social and institutional factors that influence policymaking processes and the impacts of policy decisions by national, state, and local levels of governments.

**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.

**611 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.
Designed to provide students the tools needed to become knowledgeable, informed users and consumers of social science research. The course surveys major issues relevant to the application of quantitative data to problems of public policy and administration. Issues include research design, measurement and operationalization, sampling, data collection, data analysis and interpretation, and evaluation. Prerequisites: SOC 333 or PY 300 or permission of chair.

637 Development of Management and Policy 3 hrs.
The evolution of modern American business management and government policy. (Same as HY 637.)

639 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.

651 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.

665 American Foreign Policy 3 hrs.
Analysis of major theories explaining foreign policy and various controversies surrounding policy processes and issues.

668 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; and the problems associated with disarmament and arms control. Prerequisite: Undergraduate course in international relations recommended.

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

699 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

335 Morton Hall
Telephone: (256) 824-6191
Email: psychol.grad@uah.edu

Degree: Master of Arts (Experimental Psychology)

Chair: Sandra L. Carpenter, Professor

Professors:
  Carpenter, S. L.; personality and social cognition: the self, groups and teams
  Kirkpatrick, S.W.; learning disabilities, facial interpretation, moral orientation

Assistant Professors:
  Neuschatz, J.; false memories and memory illusions
  Torres, A.; biological psychology, hormones and behavior, psychophysiology, stress, health psychology
  Young, K.R.; perception and human factors

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 applied experimental, biological, cognitive, developmental and social psychology. This program is directed primarily 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 therapeutic 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 coursework, and three strong positive recommendations. A minimum of 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, a clearly developed statement of intent for graduate study and at least one (preferably two) papers in the area of experimental psychology written by the applicant. Recommendations, the statement of intent, and the experimental paper(s) should be sent to: The Graduate Committee, Department of Psychology, 335 Morton Hall, The University of Alabama in Huntsville, Huntsville AL 35899. Applications are not reviewed until all materials including GRE scores are received. The deadline for applications is June 1.

Degree Requirements

1. The thesis student must complete at least 30 hours of graduate work, including a minimum of 6 hours of thesis. Only 6 hours may be transfer courses that are approved by the graduate committee of the department.
2. The non-thesis student must complete at least 33 hours of graduate work, including a minimum of 6 hours of supervised research.
3. The student’s Program of Study must include PY 607, 608, 610, 611, 641, and 6 hours of either PY 650 or 699.
4. 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.

5. The thesis student must pass an oral comprehensive examination which covers both coursework and thesis research.

6. The non-thesis student must pass both written and oral comprehensive examinations that cover coursework in PY 610, 611, and two content areas of the student’s choice.

7. 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.

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. (Same as ISE 502.)

503 Human Factors Psychology 3 hrs.
Study of human performance in human-technology-environment systems. Consideration of human capabilities and limitations as related to controls and displays, and the role of human cognition in decision-making and training effectiveness. Prerequisite: Senior/graduate standing. (Same as ISE 503.)

505 Psychopharmacoology 3 hrs.
Introduction to drug classification and action with emphasis on physiological and psychological interactions. Prerequisite: Senior/graduate standing.

506 Psychology of Women 3 hrs.
Examines theory and research in the psychological functioning of women, both in the United States and other nations. Topics include achievement and education, mental and physical health issues, biological influences on women’s behavior, women and work, and victimization of women. Prerequisite: Senior/graduate standing.

507 Cross-cultural Psychology 3 hrs.
Examines psychological similarities and differences between members of industrialized and non-industrialized cultures. Comparisons will include development, social interaction, personality, cognition, and perception, as well as psychological health and treatment, work, and acculturation. 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: 15 hours PY or graduate standing and permission of instructor.

535 Theories of Abnormal Psychology 3 hrs.
Selected disorders such as depression, anxiety disorders, and personality disorders from different theoretical orientations with emphasis on cognitive behavioral theory. Prerequisites: PY 433 or approval of instructor, and senior/graduate standing.

College of Liberal Arts 194
536 Psychobiology of Stress and Illness  
Overview of physiological stress responses and their influence on health behavior and illness. Prerequisite: Senior/graduate standing. (Same as BYS 536.)

540 Animal Behavior  
Examines the experimental and theoretical foundations of the study of animal behavior. Animal behavior will be discussed in terms of immediate mechanisms, development, survival value, and evolution. Some emphasis will be placed on the relevance of animal behavior to human behavior and on the importance of understanding behavior in context. Prerequisites: PY 101, 102, & 302 or BYS 119, 120, & 4 additional hours in BYS. (Same as BYS 540.)

601 Advanced Developmental Psychology  
Overview of major models of developmental theory and of theorists representing these models. Examination of issues, problems and research relevant to these theories. Prerequisite: Graduate standing in psychology.

602 Proseminar: Cognitive  
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.

606 Language Development  
Stages and processes of the development of language and communication skills. Prerequisite: Graduate standing in psychology.

607 Faculty Research Seminar  
Presentation of faculty research to familiarize students with the fields of psychology represented among the faculty. Required each fall semester.

608 Graduate Research Seminar  
Presentation of graduate student research. Required each spring semester.

610 Experimental Design  
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.

611 Statistics for Experimental Methods  
Statistical techniques for analysis of data generated by experimental designs. Lab Fee: $60. Prerequisites: PY 610 or permission of the instructor and graduate standing in psychology.

613 Non-experimental Designs  
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.

615 Graduate Seminar  
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.

628 Human Learning Theory  
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.
629 Behavior Modification 3 hrs.
Psychological principles concerning control of human behavior and current theoretical and experimental research in behavior modification. Prerequisite: Graduate standing in psychology.

641 Concentrated Readings/Research in Specialization Area 3 hrs.
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 advisor. May be taken more than once for credit. Prerequisite: Permission of instructor.

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.

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 of thesis credit will apply to the degree. Credit awarded upon successful completion of the thesis. Prerequisites: PY 641 and graduate standing in psychology.
The College of Nursing offers the Bachelor of Science in Nursing, the Master of Science in Nursing, a Post-Master's Family Nurse Practitioner Certificate, and a Graduate Certificate in Nursing Education. The faculty of the College of Nursing believe that nursing is a caring profession that is based on a unique body of knowledge which is derived from the arts, humanities, physical, biological, social, behavioral and health sciences, as well as from clinical practice.

The College of Nursing is dedicated to excellence in teaching, practice, scholarship, and service. Faculty have the responsibility to educate students of nursing as well as to provide continuing education, to engage in scholarly activities that will develop and extend the discipline of nursing, and to provide service to the nursing profession, the community, and the academic environment in which nursing study resides.
Accreditation
The Master of Science in Nursing (M.S.N.) programs offered by the College of Nursing are accredited by the Commission on Collegiate Nursing Education (CCNE). The undergraduate program is also approved by the Alabama Board of Nursing.

Mission
The fundamental purpose of the College of Nursing is to prepare nurses at the baccalaureate and master’s level who are critical thinkers, life-long learners, and are able to practice as caring professionals in a variety of health care delivery systems. As the only institution offering both undergraduate and graduate nursing programs in north Alabama, the college is also a regional center for research activities in nursing. In addition, the college is committed to providing educational services for and in collaboration with agencies for professional nursing development. Educational offerings and faculty practice are both services to community clients and means of improving health care and delivery systems. In order to meet its obligations in teaching, research, scholarly activities, practice and service, the college maintains high quality faculty who are excellent teachers and expert practitioners who add to the body of nursing knowledge.

Degrees and Certificates Offered
The College of Nursing offers master’s degree programs as well as a post-master’s family nurse practitioner certificate program and a graduate certificate in nursing education.

Master’s Degree
Graduate tracks offered through the College are focused on preparing advanced practice nurses in direct care provider roles as a family nurse practitioner, acute care nurse practitioner, adult clinical nurse specialist, or in an indirect care provider role as a nurse administrator. The Master of Science degree is awarded upon successful completion of one of the four tracks.

Advanced practice nursing is distinguished by autonomy of practice and characterized by both increased complexity in clinical decision making and skills in managing organizations and health care environments.

Comprehensive health assessment skills provide a foundation for the critical thinking used in diagnostic decision making and treatments of complex human responses of diverse individuals, families and communities to health problems. Advanced practice nursing students are guided in classroom and clinical experiences to formulate clinical decisions to manage common health problems, acute and chronic illnesses and promotion of wellness.

Theory and research form a central core of knowledge for all tracks in the master’s program. Building on content in these areas, all students integrate education, management, leadership, and consultation into their clinical experiences as they practice in a variety of settings. Practice sites for clinical courses are individually arranged with the student. Classes are usually offered one day per week and may be offered on campus, at off campus sites or through web-based courses.

Students who successfully complete their program of study are eligible to sit for the national certification examination in their area of expertise.

Adult Clinical Nurse Specialist
This advanced practice nurse is an expert clinician and client advocate in a nursing practice specialty with adults. They provide direct client care including assessing, diagnosing, planning and prescribing pharmacologic and non-pharmacologic interventions for health problems, health promotion and preventive care. The adult clinical nurse specialist is also involved in indirect practice activities with the goal of improving outcomes of care. Practice settings include hospitals, clinics and community health agencies.
Nurse Practitioner

The nurse practitioner is a skilled health care provider who uses expert clinical judgment and decision making in the performance of comprehensive health assessments, differential diagnoses and prescribing of pharmacologic and non-pharmacologic interventions in the direct treatment of health problems. Nurse practitioners function as care providers, case managers, researchers, consultants, and educators. Two nurse practitioner tracks are offered at the college: family nurse practitioner and acute care nurse practitioner. Although both are advanced practice nurses, family nurse practitioners function as primary care providers focusing on common health care problems. Family nurse practitioners establish collaborative practices with primary care physicians to deliver culturally sensitive care to clients. Acute care nurse practitioners focus on the care of adults with acute illnesses and may practice in the hospital, home, or clinic setting. Acute care nurse practitioners provide expert interventions focused on health promotion, illness prevention, and health care management.

Nurse Administrator

Health care organizations are becoming increasingly complex businesses. Nurse administrators are emerging as executive leaders able to direct people and organizations in the creation of more humanistic but fiscally sound health care systems.

The faculty prepare nurses to design and implement strategic plans and manage departments and organizations. Students are prepared to assume leadership roles in hospital and community settings and serve as case managers. Human resource and fiscal management theories are merged with organizational theory as the student engages in classroom and clinical experiences to implement strategies that enhance health care for individuals, families, and communities.

Post-Master’s Certificate

Students already possessing a master’s degree in nursing have the opportunity to pursue a family nurse practitioner certificate. Students are admitted to the family nurse practitioner certificate program on a full-time basis to complete the requirements in one year.

Graduate Certificate Program in Nursing Education

Students who are currently enrolled in graduate education or those possessing a master’s degree have the opportunity to continue their education and obtain a certificate in nursing education. Classes for this program are arranged in a manner to allow for full time employment or continued study in the master’s program. The program is composed of five courses and requirements for the certificate program may be completed in one calendar year.

More detailed information about opportunities for students seeking graduate degrees and certification may be obtained from the College of Nursing Office of Student Affairs (256) 824-6742.

Distance Learning

The mission of the College is to provide excellence in teaching, research, and service while providing unique opportunities and creative flexible programs for students, faculty, and the community. Distance learning and the use of other new educational technologies are part of the future for the continuing mission.

The College of Nursing offers select graduate courses via interactive television (IITS) to sites in north Alabama. These offerings allow students at distant geographical sites to actively participate in class and clinical learning activities.

The faculty are expanding these opportunities for the IITS and using the Internet and Web-based courses to enhance educational opportunities. For further information and class offerings, contact the College of Nursing Office of Student Affairs (256) 824-6742.
Computer Literacy

The College of Nursing acknowledges that health care systems are evolving at an accelerated rate and becoming increasingly reliant on computer technology. Computer literacy is rapidly becoming a basic communication skill. Prior to enrolling in nursing courses, it is suggested that students familiarize themselves with basic computer skills. Students should be able to use a computer to log on to their email account to communicate with other students and faculty. They should be able to log on to the Internet to access class content. Ability to use a word processing program and perform Internet searches for health care related materials are also suggested skills.

Clinical Facilities

The College of Nursing offers a wide diversity of clinical sites for student experiences. The college has contracts with over 600 health related agencies in Alabama and surrounding states.

Madison County has two general hospitals with a licensed capacity of 1,013 beds, a county health department, and numerous skilled nursing homes and home health care agencies. The University of Alabama at Birmingham Medical Clinics-Huntsville Program also serve as clinical sites for students in the College of Nursing.

Huntsville Hospital System, the largest general hospital in the northern part of Alabama, is the regional medical 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. Crestwood Medical Center is a private general hospital fully equipped to handle most diagnostic and surgical procedures. Rural health clinics across Alabama are also used for student experiences. Other hospitals, clinics, and physicians’ offices are used on a selective basis.

Service and Scholarship

In addition to its teaching mission of providing quality education for students, the College of Nursing provides continuing education for nurses. Educational programs may be offered at the College of Nursing or at individual health care agencies. The faculty and students of the college are committed to the provision of services for the people of Huntsville and surrounding communities. These activities are focused on the improvement of health and healthy behaviors and include such activities as health fairs and screenings.

Faculty and students also conduct and disseminate research to address issues in health care from health policy initiatives and the delivery of services to specific clinical problems. Faculty are also active in the provision of consultative services to a variety of health care agencies and educational institutions.

Advising and Assistance

The focus of advising in the College of Nursing is to assist students to successfully progress toward their educational objectives. Advising is designed to provide assistance where desired and appropriate. All pre-admission graduate students are advised in the College of Nursing Office of Student Affairs located on the second floor of the Nursing Building.

Students admitted to the graduate program are assigned a faculty advisor who assists them throughout the remainder of the academic program. Faculty advisors assist students in completing a program of study as well as providing guidance for future employment or educational endeavors.

Admission Requirements

Admission into the graduate program is competitive and is based on the strength of the applicants' records. Students applying for fall admission must submit their application package by stated deadlines.

Each student must apply to the School of Graduate Studies as well as apply to the College of Nursing. Please note that admission to the School of Graduate Studies does not imply admission to
the College of Nursing. All students must meet the requirements for admission into the School of Graduate Studies. In addition to those requirements, the requirements for admission into the College of Nursing are:

1. Graduation from a National League for Nursing Accrediting Commission or Commission for Collegiate Nursing Education accredited baccalaureate program with a major in nursing;
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 baccalaureate coursework completed;
3. Acceptable score on either the Graduate Record Examination (GRE) or the Miller Analogies Test (MAT) taken within the last five years. Desired scores are 1500 on the GRE or 50 on the MAT. For tests taken after October 1, 2002, the analytic score is computed by taking the (raw score plus 2) x 100;
4. Three letters of recommendation 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 license as a registered nurse in the State of Alabama or eligibility for an Alabama license. An Alabama license must be obtained prior to enrolling in graduate courses.

Applicants who meet or exceed both the GPA requirement and the GRE or MAT test score are eligible for unconditional admission to the graduate program. Students who meet only one of these criteria are eligible for conditional admission on a space available basis.

Requirements for Enrollment for Admitted Students

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 cardiopulmonary resuscitation (CPR) training must be provided to the College of Nursing Office of Student Affairs prior to enrolling in a nursing class. CPR certification must be maintained throughout the program. In addition, all students entering advanced practice tracks must obtain and maintain advanced cardiac life support certification (ACLS) prior to enrolling in a nursing class.
3. Students may be required to undergo drug testing prior to enrollment in nursing courses and for cause at other points. Information on testing requirements and procedures is provided upon admission and prior to each academic year.
4. Documentation of current license 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 must maintain an active and unencumbered Alabama license throughout the program. Students will not be allowed to continue in the program if any nursing license is placed on probation, suspended, or revoked. Clinical experiences in states other than Alabama require an active license in that state as well as in Alabama. Students must notify the College of Nursing if there is any change in license status.

Progression Requirements

1. Any student who receives a “C” in the following clinical nursing courses in the graduate program in the UAH College of Nursing will be reviewed for progression by the Graduate Curriculum Subcommittee. This committee will recommend either continuation in the program, a repeat of the course, or dismissal from the nursing program. Written input from appropriate faculty will be obtained. The Graduate Curriculum Subcommittee will make recommendations to the Associate Dean.

Courses:
- ACNP I, II, III, IV
- Nursing Administration I, II
- Advanced Health Assessment
- FNP I, II, III, IV
- ACNS I, II, III, IV

201 College of Nursing
2. If the recommendation is for the student to repeat the course, he/she may retake the course at the next time the course is offered.

3. If the student obtains a “C” in a nursing course and is allowed to continue, makes a “C” in a second clinical nursing course, or if the student receives a “C” in the retake of the original course, this student may not be allowed to progress independent of GPA, and will be dismissed from the College of Nursing. The student may petition for readmission to the Director of Nursing Student Affairs.

4. If the student makes a “C” in any graduate course and the student’s GPA falls below a 3.0, the student will be placed on academic probation by the University. The student has an additional twelve semester hours to bring the GPA up to 3.0 in accordance with the UAH School of Graduate Studies policy.

5. No student will be able to record a grade less than a “C” on their program of study for the graduate program.

Health Requirements

The clinical experiences of nursing students require a health screening program. The following steps are required as part of admission to and enrollment in the graduate program:

1. Each student is required to have a health examination by a 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. Each student must be immunized 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. Each student is required to be immunized against 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 the published deadlines. Immunizations and titers are at the expense of the student;

4. Each student is required to be annually tested for tuberculosis. Evidence of the annual testing or results of a recent chest x-ray are required. Testing expenses are the responsibility of the student. Documentation of the test results must be received by the College of Nursing Office of Student Affairs by published deadlines;

5. 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 will be at the expense of the student. Students are required to maintain health insurance throughout the program.

Student Financial Services

Student Financial Services, located in the University Center, provides financial aid information and assists students in meeting individual needs.

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 the Alabama Board of Nursing for further information.
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 and admitted students enrolled for part-time study who will graduate within 12 months. Application forms may be obtained through the College of Nursing Office of Student Affairs.

3. Elizabeth M. Fisher Memorial Scholarship.
4. Graduate Teaching Assistantships.
5. Graduate Research Assistantships.
6. Graduate Tuition Scholarships.

Course Load
The usual course load for a full-time graduate student in nursing is from 9 to 12 hours. Students may choose to complete a degree in full-time or part-time study with the exception of the post-master's students. Students admitted to the post-master's program are required to complete the program in full-time study.

Degree Requirements
In addition to the graduate degree requirements of the School of Graduate Studies, a student is required to complete a minimum of 39-42 semester hours of graduate coursework in the Adult Clinical Nurse Specialist Track, the Acute Care Nurse Practitioner Track, the Family Nurse Practitioner Track, or the Nursing Administration Track. Please note that curricular changes may be made in the coming year. Please contact the College of Nursing Office of Student Affairs for the most current information.

Students may follow one of two research options for their program of study:

Thesis Option
1. Completion of all required core and clinical or administration track courses
2. Completion of 6 hours of thesis
3. A minimum of "B" average for all degree credit coursework
4. Submission of an acceptable thesis describing research
5. Successful completion of the final comprehensive examination of coursework and thesis.

Non-thesis Option
1. Completion of all required core and clinical or administration track courses
2. Completion of 6 hours of graduate electives or completion of a research project
3. A minimum of "B" average for all degree credit coursework
4. Successful completion of the final comprehensive examination on coursework.

Final Comprehensive Examination
A final comprehensive examination is required of all nursing student degree candidates. The examination is conducted by a committee of at least three members appointed by the Associate Dean of the College of Nursing. The examining committee is composed of faculty members whose areas of expertise cover the areas listed on the student's Program of Study. The examination is given at least six weeks prior to graduation.

Nursing Tracks
Core Requirements: (9) semester hours
Scholarly Inquiry for Advanced Nursing Practice (NUR 602) 3 hrs.
Thesis/Other research activities (NUR 698, 699, graduate courses) 6 hrs.
Acute Care Nurse Practitioner Track
In addition to the above 9 semester hours of required core courses, the student must complete the following required courses (33 semester hours):
- Advanced Health Assessment (NUR 605) 3 hrs.
- Pathophysiology (NUR 606) 3 hrs.
- Pharmacology in Advanced Practice (NUR 607) 3 hrs.
- Acute Care Nurse Practitioner I (NUR 620) 6 hrs.
- Acute Care Nurse Practitioner II (NUR 621) 6 hrs.
- Acute Care Nurse Practitioner III (NUR 622) 6 hrs.
- Acute Care Nurse Practitioner IV (NUR 623) 6 hrs.
A minimum of 42 semester hours is required for the Acute Care Nurse Practitioner Track.

Adult Clinical Nurse Specialist Track
In addition to the above 9 semester hours of required core courses, the student must complete the following required courses (33 semester hours):
- Advanced Health Assessment (NUR 605) 3 hrs.
- Pathophysiology (NUR 606) 3 hrs.
- Pharmacology in Advanced Practice (NUR 607) 3 hrs.
- Adult Clinical Nurse Specialist I (NUR 660) 6 hrs.
- Adult Clinical Nurse Specialist II (NUR 661) 6 hrs.
- Adult Clinical Nurse Specialist III (NUR 662) 6 hrs.
- Adult Clinical Nurse Specialist IV (NUR 663) 6 hrs.
A minimum of 42 semester hours is required for the Adult Clinical Nurse Specialist Track.

Family Nurse Practitioner Track
In addition to the 9 semester hours of required core courses, the student must complete the following required courses (33 semester hours):
- Advanced Health Assessment (NUR 605) 3 hrs.
- Pathophysiology (NUR 606) 3 hrs.
- Pharmacology in Advanced Practice (NUR 607) 3 hrs.
- Family Nurse Practitioner I (NUR 610) 6 hrs.
- Family Nurse Practitioner II (NUR 611) 6 hrs.
- Family Nurse Practitioner III (NUR 612) 6 hrs.
- Family Nurse Practitioner IV (NUR 613) 6 hrs.
A minimum of 42 semester hours is required for the Family Nurse Practitioner Track.

Nursing Administration Track
In addition to the 9 semester hours of required core courses, the student must complete the following required courses (30 semester hours):
- Nursing Administration in Health Care Systems (NUR 630) 3 hrs.
- Resource Management (NUR 631) 3 hrs.
- Fiscal Management (NUR 632) 3 hrs.
- Nursing Administration I (NUR 633) 6 hrs.
- Nursing Administration II (NUR 634) 6 hrs.
- Basic Budgeting in Health Systems (NUR 636) 3 hrs.
- Case Management (NUR 637) 3 hrs.
- Healthcare Informatics (NUR 638) 3 hrs.
A minimum of 39 semester hours is required for the Nursing Administration Track.

Post-Master’s Family Nurse Practitioner Program
The Post-Master’s Family Nurse Practitioner Program is designed for individuals who have already earned a master’s degree in nursing but who desire additional preparation for family nurse practitioner certification. Students must be formally admitted to the program to enroll and must meet identical academic standards as students enrolled in the master’s program. Students admitted to this program must attend full-time. In order to facilitate this study, this certificate program may
be offered on Saturdays on the UAH campus, and may be offered off campus. Graduates from this program are eligible to sit for the national certification examination for family nurse practitioners.

There are two required prerequisite courses for the Post-Master’s Family Nurse Practitioner Program. Students must have completed advanced health assessment and pathophysiology at UAH or another institution prior to enrolling in any course. Students enrolling in this program will complete the requirements for the FNP in three semesters of study.

The program of study is as follows:

- NUR 607 Pharmacology in Advanced Practice 3 hrs.
- NUR 610 Family Nurse Practitioner I 6 hrs.
- NUR 611 Family Nurse Practitioner II 6 hrs.
- NUR 612 Family Nurse Practitioner III 6 hrs.
- NUR 614 Family Nurse Practitioner V 3 hrs.
- NUR 615 Family Nurse Practitioner VI 3 hrs.

**Graduate Certificate In Nursing Education Program**

The College supports the belief that a master’s degree is a minimum requirement for teaching in a nursing education setting. Courses are open to current graduate students enrolled in any of the master’s tracks offered by the College of Nursing as well as to nurses already holding a master’s degree in nursing. Students not already enrolled in the master’s program must be formally admitted to the program and meet the same admission standards as other graduate students.

The purpose of the 15 clinical hour program is to:

- Prepare nurses with a master’s degree to teach in a variety of settings, i.e., associate degree-nursing programs, clinical faculty in baccalaureate programs and health care agency educational programs
- Prepare nurses with the theory and practice experiences to develop and implement educational offerings in a variety of settings for diverse populations
- Prepare nurses with a variety of teaching strategies and delivery systems for today’s new learning environment
- Prepare nurses with the necessary tools and strategies to effectively evaluate nursing performance in both clinical and classroom settings
- Prepare nurses with the skills necessary for role development as a faculty member.

The program of study is as follows:

- NUR 640 Curriculum Development in Nursing 3 hrs.
- NUR 641 Teaching/Learning in Nursing 3 hrs.
- NUR 642 Testing and Evaluation in Nursing Education 3 hrs.
- NUR 643 Faculty Role Development 3 hrs.
- NUR 644 Practicum in Teaching Nursing 3 hrs.

**Graduate Courses in Nursing (NUR)**

**500 Special Topics**

Advanced study of selected area of interest in nursing. Elective. Prerequisite: Approval of instructor. Lab Fee: $30. Fall, Spring, Summer.

**525 Human Sexuality**

Theory and issues related to human sexuality in health and illness. Emphasis on theory and values, clarification of human sexuality needs. Lab Fee: $30. Elective, open to all university students. Fall, Summer.
534 Death and Dying 3 hrs.
A consideration of death and dying in the present time. Influences upon current attitudes and thinking gleaned from historical, cultural, philosophical, and scientific perspectives. Focus will be placed on helping the individual student recognize intimate reactions and beliefs concerning death and identifying coping resources. Elective, open to all university students. Lab Fee: $30. Summer.

537 Nursing as a Political Force 3 hrs.
The course explores the historical, current, and future impact of nursing on the political process. Local, state, national, and international aspects of nursing as a political force are analyzed. Emphasis is on political systems, regulatory processes, and organizational issues influencing health care delivery. Elective, open to all university students. Lab Fee: $30. Fall, Summer.

540 Oncology Nursing 3 hrs.
This course provides a holistic approach to the nursing care of people with cancer. The nursing process is used as the basis for promoting health and facilitating adaptation in the person with cancer. The course includes clinical experiences in selected agencies. Prerequisite: Admission to the College of Nursing. Lab Fee: $30. Summer.

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 are included. Lab Fee: $30. Spring.

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. Elective; open to university students. 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. Fall.

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. Spring.

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. Prerequisites: NUR 605, 606. 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. Spring.

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. Prerequisite: NUR 606 or 607. Lab Fee: $180. Summer.
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.

614 Family Nurse Practitioner V 3 hrs.
First of two culminating courses/seminar/clinical practicum in the family nurse practitioner certificate program. The clinical practicum will be completed in a primary care setting. Classroom seminar focuses on the role, trends, and health policy issues facing the family nurse practitioner. Prerequisites: NUR 610. Lab Fee: $90. Summer.

615 Family Nurse Practitioner VI 3 hrs.
The culminating course/seminar/clinical practicum in the family nurse practitioner certificate program. The clinical practicum will be completed in a primary care setting. Classroom seminar focuses on the role, trends, and issues facing the family nurse practitioner. Prerequisites: NUR 610, 612, 614. Lab Fee: $90. Fall.

620 Acute Care 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.

621 Acute Care Nurse Practitioner II 6 hrs.
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 6 hrs.
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 6 hrs.
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. Lab Fee: $180. Fall.

630 Nursing Administration in Health Care Systems 3 hrs.
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 3 hrs.
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 3 hrs.
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. Prerequisite: NUR 636. 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. 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. Lab Fee: $30. Fall.

637 Case Management
Introduction to health care delivery through the case management model. Basic foundation information targeting the professional nurse's role in case management. Types of case management are discussed and analyzed. Impact of managed care to case management and other care delivery methods is explored for a changing health care delivery system. Fiscal implications of case management are considered. Lab Fee: $30. Fall.

638 Healthcare Informatics
This course focuses on information system concepts and technologies used in the structuring and processing of nursing information to arrive at clinical decision-making for healthcare. Analysis of information systems in clinical management, administration, education, and research will be completed. Students will explore capabilities, benefits, barriers, and related information and technologies comprising current state of informatics design and use in health and nursing related systems. Emphasis is placed on strategies, issues and technologies of information collection, analysis and communication. Prerequisite: NUR 339. Lab Fee: $30. Summer.

640 Curriculum Development in Nursing
Principles and concepts of curriculum development are examined with respect to their application to development of both the theoretical and clinical components of nursing programs. Includes principle regarding theories of learning, the changing nature of knowledge and societal needs as basic considerations directing curricular planning and revision. Lab fee: $30. Spring.

641 Teaching/Learning in Nursing
Emphasis is on the development of classroom and clinical laboratory teaching skills and includes a critical appraisal of specific teaching strategies. The student is provided the opportunity to acquire knowledge in the use and design of common and innovative teaching methods including web-based and interactive delivery systems. Lab fee: $30. Fall.

642 Testing and Evaluation in Nursing
Major emphasis on the development of classroom and clinical skills in appraisal and evaluation methods of student performance. The student is provided with the opportunity to acquire skills in constructing various types of testing and evaluation (formative and summative) procedures as they relate to nursing education. Lab fee: $30. Fall.

643 Faculty Role Development in Teaching
Role theory serves as the basis for the discussion and practice in developing teaching, service and research role of a faculty member in a nursing program. Discussion on legislative and professional agencies issues and policies impinging on the teaching role. Lab fee: $30. Summer.
644 Practicum in Teaching 3 hrs
Opportunities to do practice teaching with nursing students in various phases of their basic educational programs. Learning activities will be planned on an individual basis and based on the specific teaching responsibilities of their primary course assignment. Selected baccalaureate degree and/or associate degree programs will be used as practice sites. Lab fee: $90. Spring.

650 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.

660 Adult Clinical Nurse Specialist I 6 hrs.
Primary focus is on nursing care of adults and families with long-term alterations in health. Sub-roles of the advanced practice nurse are introduced and reinforced. Theory concerning adult development, health promotion, and disease prevention practices, identifying populations at risk, cultural and environmental diversity issues, provides the background knowledge used by the student in giving care to patients/families in a variety of settings. Patient and caregiver needs and care interventions are central as the student practices the role of clinician caring for adults with chronic problems. Prerequisites: NUR 605; 606. Lab Fee: $180. Fall.

661 Adult Clinical Nurse Specialist II 6 hrs.
Care management of the adult patient in the hospital or community setting. Rural and other vulnerable populations are of major concern. Health policy, fiscal regulations, and differing health delivery systems serve as points of discussion. Clinical experiences with vulnerable and underserved populations primarily in rural settings. Prerequisites: NUR 660; 606 or 607. Lab Fee: $180. Spring.

662 Adult Clinical Nurse Specialist III 6 hrs.
Advanced nursing care of adults of diverse populations in secondary or tertiary settings. Emphasis on special needs and advanced nursing care of adults with acute health alterations. Student clinical experiences are therapeutic nursing interventions with acutely ill patients with complex health problems. Prerequisites: NUR 660, 661. Lab Fee: $180. Summer.

663 Adult Clinical Nurse Specialist IV 6 hrs.
Culminating residency course where the student uses the sub-roles of the advanced practice nurse—clinician, teacher, manager, researcher, consultant, in providing direct and indirect care to the adult patient. Legal, ethical, and licensing issues affecting the role of the advanced practice nurse are points of classroom discussion, along with current issues and trends. Theories concerning ethical decision making, consultation, leadership, and methods of research utilization enhance the student's practice. The clinical placement should strengthen the student's area of concentration developed with the faculty advisor. Prerequisites: NUR 660, 661, 662. Lab Fee: $180. Fall.

698 Other Activities 1-6 hrs.
Application of activities appropriate to student program of study. Intended to expand student knowledge and enhance track specific content. Prerequisite: Advisor approval. Lab Fee: $20. Fall, Spring, Summer.

699 Thesis 1-6 hrs.
Independent research investigation related to practice of nursing under faculty guidance. Minimum of six hours required. Prerequisites: NUR 602. Lab Fee: $20. Fall, Spring, Summer.
COLLEGE OF SCIENCE

C207 Materials Science Building
Telephone: (256) 824-6605
Email: scigrad@uah.edu
Web Site: http://www.uah.edu/HTML/Academics/Science

Degrees:
- Master of Arts
- Master of Science
- Master of Science in Software Engineering
- Doctor of Philosophy

Dean: John D. Fix, B.S., M.A., Ph.D., Professor of Physics
Associate Dean: Debra M. Moriarity, B.S., Ph.D., Professor of Biological Sciences

Mission
The College of Science at UAH is dedicated to providing high-quality undergraduate and graduate education in science and mathematics, maintaining an environment that promotes internationally recognized faculty research programs, and providing service to the university, state, and regional communities as a source of scientific and mathematical expertise.

Facilities/Services
The College of Science includes the Departments of Atmospheric Science, Biological Sciences, Chemistry, Computer Science, Mathematical Sciences, and Physics. In addition, faculty in the College are associated with numerous UAH research centers including the Center for Applied Optics, Center for Automation and Robotics, Earth System Science Center, Global Hydrology and Climate Center, Information Technology and Systems Center, Center for Microgravity and Materials Research, Center for Space Plasma and Aeronomic Research, Laboratory for Materials and Surface Science, Laboratory for Structural Biology, Consortium for Materials Development in Space and the National Space Science and Technology Center. The College takes advantage of its strategic location in the midst of the heavy concentration of high technology-oriented companies and agencies of North Alabama. Because of this, unique opportunities are offered for original research at the forefront of science and technology, including problems that 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.

Degrees and Programs
The College of Science offers the following graduate degree programs:

- Applied Mathematics: Ph.D.
- Atmospheric Science: M.S., Ph.D.
- Biological Sciences: M.S.
- Chemistry: M.S.
- Computer Science: M.S., M.S.S.E., Ph.D.
- Mathematics: M.A., M.S.
- Physics: M.S., Ph.D.
Interdisciplinary programs offered in cooperation with the College of Engineering include:

- Biotechnology Science and Engineering Ph.D.
- Materials Science M.S., Ph.D.
- Optical Science and Engineering Ph.D.

These programs are described in the “Interdisciplinary Programs” section of the catalog.

In addition, certificate programs are available in Environmental Science, Software Engineering and Information Assurance.

The College of Science also offers courses 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.

**ATMOSPHERIC SCIENCE**

National Space Science and Technology Center
Room 4080
Telephone: (256) 961-7877
Email: atmos@uah.edu
Web Site: http://www.atmos.uah.edu

**Degrees:**
- Master of Science
- Doctor of Philosophy

**Chair:** Ronald M. Welch, Professor

**Professors:**
- Christy, J.R.; climate dynamics, global change
- Essenwanger, O.M. (Research); statistical climatology
- Perkey, D.J.; global change, mesoscale modeling
- Vaughan, W.W. (Research); satellite meteorology, reference atmospheres
- Welch, R.M.; remote sensing, radiative transfer, disease and climate

**Associate Professors:**
- Christopher, S.A.; satellite remote sensing
- Han, Q.; satellite cloud climatology, remote sensing, radiative transfer
- Knupp, K.R.; severe storms, radar meteorology
- Newchurch, M.J.; atmospheric chemistry and air pollution

Atmospheric science is 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 Army Research Office, the Environmental Protection Agency, and the Tennessee Valley Authority all fund atmospheric science research at UAH. The Department is housed in the National Space Science and Technology Center (NSSTC) a unique
institute in which scientists from the NASA Marshall Space Flight Center, the National Weather Service, the Space Science and Technology Alliance, other government agencies and industry all work together on research programs of national 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 on undergraduate and graduate credit;

b) a combined score of at least 1550 on the verbal, quantitative, and analytical sections of the Graduate Record Examination (GRE) (for GRE tests taken after Oct. 1, 2002 the score on the analytical portion is obtained by multiplying the (raw score plus 2) by 100);

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 (213 computer-based test).

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) (for GRE tests taken after Oct. 1, 2002 the score on the analytical portion is obtained by multiplying the (raw score plus 2) by 100);

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 (213 computer-based test).

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 courses in ordinary and partial 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 three core courses:

- ATS 541 Atmospheric Thermodynamics and Cloud Physics
- ATS 551 Atmospheric Fluid Dynamics I
- ATS 561 Atmospheric Radiation I
The student must also earn at least two semester hours of credit in ATS 780 and 781 (Seminar series), one semester hour credit in ATS 502 (Computational Tools), 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 three core courses (above), at least two semester hours of credit in ATS 780 and 781 (Seminar series), ATS 502 (Computational Tools), and the passing of a written or oral 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 may be written or oral, or both. 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 majority of the committee must be full-time UAH faculty members who have Full Membership in the graduate faculty and in the major department. For thesis students a written notice of the time and place of examination is sent to the Graduate Dean. 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 three common core courses (ATS 541, 551 and 561) and ATS 651 (Atmospheric Fluid Dynamics II). 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 covering material in the three core courses plus three other ATS courses chosen from the catalog with numbers of 520 or higher, excluding ATS 761 and 770. 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, (three of the committee members must be full-time ATS faculty who are Full Members of the UAH graduate faculty) 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**

   According to graduate school policy, residence may be established through either (i) being enrolled as a full-time student (at least 9 graduate semester hours) either for one continuous academic year,
or for Spring and Fall semesters in the same calendar year, or (ii) being enrolled in at least 6 hours of graduate course work in at least three of four consecutive semesters.

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 dissertation registration is required. Students must also register for a total of at least three hours of ATS 780, 781, 782 (Seminar series) plus ATS 502 (Computational Tools). These four semester hours may not be used to meet minimum degree requirements.

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, the chair of the atmospheric science department, the dean of the College of Science, and 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 program 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)

501 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. (Same as ATS 401, ES 401, ES 501.)

502 Computational Tools for Atmospheric and Environmental Scientists 1 hr.
Designed for incoming graduate students. Fundamentals of computation using IDL or other suitable programming language, focusing on basic skills, interpretations, creating plots, and displaying data. Prerequisite: Consent of instructor. This course may not be used to meet minimum degree requirements. Fall. (Same as ES 502.)

509 Applications of Computers in Meteorology 3 hrs.
Survey of data types and languages commonly used in the meteorological community along with practical application to meteorology. Course is designed to prepare students for graduate work and research in atmospheric science. Lab fee $40. Prerequisite: Consent of instructor. Summer, alternate years. This course may not be used to meet minimum degree requirements.
511 Introduction to Geographical Information Systems 3 hrs.
Introduces vector, raster and tabular concepts, emphasizing the vector approach. Topics include: spatial relationships, map features, attributes, relational database, layers of data, data ingesting, digitizing from maps, projections, output, applications and availability of public data sets. (Same as CE 411, CE 511, ES 411, ES 511, ATS 411.) Fall.

513 Geographical Information Systems and Remote Sensing 3 hrs.
Hands-on approach to GIS and satellite remote sensing. Popular satellite data sets such as LANDSAT and AVHRR are coupled with GIS data sets to increase understanding of the earth system. Topics include satellite sensors, basic radiative transfer, orbits, raster formats, atmospheric correction, distortion, image corrections, rotations and mapping, spatial resolution, image interpretation, radiometric and geometric enhancement, multispectral transformations, and classifications. (Same as ATS 413, ES 413, ES 513.) Spring.

514 Scale and Landscape in GIS 3 hrs.
Relationship of scale processes in the interpretation of remote sensing and GIS applications. Topics include those associated with multiple representations of remote sensing data, analysis techniques for integrating multiple sets of remote sensing and auxiliary data at different scales, and geostatistics. Prerequisite: ATS 513. (Same as ATS 414, ES 414, ES 514.) Fall.

515 Advanced Topics in GIS 3 hrs.
Advanced special topics: visualization of GIS and remote sensing data, landscape characterization (pattern vs. process), multitemporal analysis, aggregation of data types, developing an integrated GIS environment for performing complex space-time modeling analyses, and land-atmosphere interactions. Prerequisite: ATS 513. (Same as ATS 415, ES 415, ES 515.) Spring.

520 Introduction to Atmospheric Chemistry and Air Pollution 3 hrs.
This self-contained introductory course in atmospheric chemistry and air pollution is designed to provide seniors and graduate students the basics of atmospheric chemistry and air pollution concepts. Topics include air pollutants, air-pollution meteorology, atmospheric gases and aerosols, and atmospheric processes. This course will also develop the necessary fundamentals for those wishing to take the advanced (600 level) courses in the atmospheric chemistry/air pollution study area. ES 520 and ATS 520 require a research project; ES/ATS 420 do not. Prerequisites: PH 112 and CH 121 or consent of instructor. (Same as ATS 420, ES 420, ES 520.)

541 Atmospheric Thermodynamics and Cloud Physics 3 hrs.
General aspects of thermodynamic and cloud physical processes occurring within the atmosphere; atmospheric statics and stability, saturation point analysis, aerosols, nucleation, and the behavior/growth of cloud particles and hydrometers. Prerequisites: MA 324, PH 112. (Same as ATS 441, ES 441, ES 541.) Fall.

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. (Same as ATS 451, ES 451, ES 551.) Fall.

552 Synoptic Meteorology 3 hrs.
Analysis, interpretation and forecasting synoptic-scale and mesoscale phenomena, including air masses, frontal systems, cyclones, anti-cyclones, tropical cyclones and associated mesoscale phenomena. Emphasis on the use of remotely-sensed data from satellites, radars and profilers using state-of-the-art workstations. Prerequisites: ATS 541, 551. (Same as ATS 452, ES 452, ES 552.) Spring, even years.
554 Forecasting Mesoscale Processes 3 hrs.
Detection and forecasting of atmospheric mesoscale phenomena, including the structure and evolution of clouds, precipitation (including floods), thunderstorms and severe weather. Includes basics on instruments used to detect mesoscale phenomena, most notably satellite and radar. Based mainly on computerized modules and related exercises. Prerequisite: ATS 551. (Same as ATS 454, ES 454, ES 554.)

561 Atmospheric Radiation I 3 hrs.
Fundamentals of terrestrial atmospheric radiation. Topics include: solar radiation at the top of the atmosphere, radiative transfer equation, gaseous absorption, scattering by molecules and particles, band models, transmittance along an inhomogeneous path, and microwave radiative transfer. Prerequisites: MA 324, PH 112. (Same as ATS 461, ES 461, ES 561.) Spring.

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 climactic signals in the data. Determination of global-scale forcing mechanisms which impact climate. Prerequisites: ATS 541, 551. Fall, odd years.

620 Atmospheric Chemistry and Aerosols 3 hrs.
Atmospheric chemistry and aerosols; primary processes, thermodynamics, photochemistry, kinetics, models, and measurements applied to the troposphere and stratosphere; natural and anthropogenic processes affecting the chemistry of Earth’s troposphere and stratosphere; effects of chlorine, nitrogen, hydrogen, and oxygen catalytic cycles. Ground-based and satellite-borne observations of traces species are described. Requires an understanding of atmospheric structure and elementary atmospheric chemistry. Prerequisite: ATS 520 or consent of instructor. (Same as ES 620.)

622 Air Pollution Modeling 3 hrs.
Advanced air pollution modeling, covers in considerable depth air pollution modeling concepts and methods. Lagrangian and Eulerian modeling approaches ranging from microscale (PBL) to synoptic (regional) scale. Lagrangian modeling will be focused on detailed modeling of large point- and areas-source plumes; Eulerian modeling will range from Large Eddy Simulations (LES) to regional-scale modeling with nested domains and plume-in-grid treatments; covers atmospheric transport/dispersion/chemistry, cloud and aerosol processes, and wet and dry deposition processes; students get experience in implementing specific plume, LES, and urban-regional modeling codes used in research and regulatory applications. Prerequisites: ATS 520, 551 or consent of instructor. (Same as ES 622.)

630 Physical Climatology 3 hrs.
This course is designed to provide a hands-on perspective to the study of the climate system using satellite data sets. The emphasis will be on understanding the physical aspects of the global climate system. Topics include global energy balance, energy balance of the surface, hydrologic cycle, climate classification, ocean circulation, natural and anthropogenic climate change and other selected topics such as urban climate and mountain weather and climate. Prerequisite: ATS 501 or consent of instructor. (Same as ES 630.) Fall, even years.

635 General Circulation 3 hrs.
Detailed examination of the observed dynamic, thermodynamic and chemical structure of the atmosphere, including mid-latitude baroclinic systems, tropical systems, global-scale energy, mass and momentum budgets and the fundamental climatology of the atmosphere. Prerequisites: MA 324, ATS 541, 551. Spring, odd years.

651 Atmospheric Fluid Dynamics II 3 hrs.
Wave motions in the atmosphere with emphasis on Rossby, Kelvin and gravity waves. Systematic scaling of primitive equations to develop quasi-geostrophic and Ekman-layer theory. Shallow water theory, stratified flows, and barotropic and baroclinic instability. Prerequisite: ATS 551. Spring.
655 Mesoscale and Microscale Atmospheric Processes 3 hrs.
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. Prerequisites: ATS 541, 551. Spring, odd years.

Covers a broad range of topics concerning digital image processing applied to the remote sensing of atmospheric, cloud and surface properties. Topics include image interpretation, radiometric and geometric enhancement of satellite imagery, supervised and unsupervised classification techniques, image transformations, textures, atmospheric correction, calibration and navigation of satellite imagery. Prerequisites: MA 324, PH 112. Fall, odd years.

671 Radar Meteorology 3 hrs.
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. Prerequisite: ATS 541. Spring, even years.

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, thermodynamics, turbulent parameterization, initialization and coordinate transformation. Prerequisites: MA 415, ES/ATS 551. (Same as ES 68.1)

690 Selected Topics in Atmospheric Science 1-3 hrs.
Selected topics of interest not included under other courses. Prerequisite: Approval of instructor. All semesters.

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

740 Cloud Processes 3 hrs.
Theory and observation of the bulk microphysical composition and kinematic structure of various cloud types, including fog. Topics include: precipitation formation processes in warm and cold clouds, interactions among dynamical, microphysical and radiative processes within cloud systems, the dynamics of thunderstorm systems and hurricanes, and remote sensing applications of clouds and precipitation. Prerequisites: ATS 541, 551. Spring, even years.

761 Atmospheric Radiation II 3 hrs.
Advanced topics in atmospheric radiative transfer. Specific topics include Maxwell equations, Mie theory, polarization and radiative transfer in a scattering atmosphere. Prerequisite: ATS 561. Spring, even years.

770 Satellite Remote Sensing II 3 hrs.
Analysis and interpretation of satellite data: AVHRR, GOES, SSM/I, ERBE and LANDSAT. Topics include retrieval and analysis of earth radiation budget, cloud liquid water, land and ocean temperatures, vegetation characteristics, cloud optical properties, biomass burning fire patterns, smoke and dust aerosols, and advanced cloud classification techniques and applications to NASA's Mission to Planet Earth. Prerequisite: ATS 570. Spring, even years.
780 Seminar 1 hr.
Speakers are invited to report on research relevant to the field of atmospheric science. Students are expected to attend at least twelve seminars and to write short descriptions of the presentations. Fall. *This course may not be used to meet minimum degree requirements.*

781 Student Seminar 1 hr.
Speakers are invited to report on research relevant to the field of atmospheric science. Students are expected to attend at least six seminars and to make a 15-minute conference-type presentation on a research topic in atmospheric science selected in agreement with their advisor and write a short description of the presentation. Spring. *This course may not be used to meet minimum degree requirements.*

782 Professional Development 1 hr.
Special topics concerning professional ethics, writing scientific journal articles, proposals and resumes, preparing budgets, publish or perish quality vs. quantity, personal relationships in the workplace, research administration, funding agencies, stress and burnout. *This course may not be used to meet minimum degree requirements.*

790 Selected Topics in Atmospheric Science 1-3 hrs.
Selected topics of interest not included under other courses. Prerequisite: Approval of instructor. All semesters.

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

**BIOLOGICAL SCIENCES**

142 Wilson Hall
Telephone: (256) 824-6260
Email: biology.grad@uah.edu

Degree: Master of Science

Chair: Gopi K. Podila, Professor

Professors:
- Campbell, P.S. (Emeritus); reproductive physiology, sex steroid hormone action, endocrine disrupters
- Eley, M.H.; chemical and biological conversions of biomass
- Garstka, W.R.; reproduction and chemical communication in vertebrates, paleontology
- Lawton, R.O.; structure and composition of forest communities, natural products biology
- Modlin, R.F. (Emeritus); biology of crustacea, ecology of marine and freshwater ecosystems
- Moriarity, D.M.; regulation of eucaryotic gene expression, natural products biology
- Podila, G.K.; fungal genomics, plant molecular biology and biotechnology
- Shriver, J.S.; NMR spectroscopy, structural biology

Associate Professors:
- Johnson, A.D.; nutritional physiology
- Leahy, J.G.; environmental microbiology, molecular physiology, evolution of biodegradative microorganisms
Assistant Professors:
- Bishop, A.; neurobiology, Alzheimer's disease
- Boyd, D.L.; developmental biology, genetics
- Davis, M.R.; plant molecular biology, genomics and biotechnology
- Magnuson, R.D.; signaling and regulation of bacterial gene expression
- Ng, J.; structural biology, biochemical evolution of RNA, microgravity protein crystallization

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 department provides an atmosphere and research facilities that are especially suitable for students pursuing an M.S. degree or the new interdisciplinary Ph.D. program in Biotechnology Science and Engineering. Our faculty members have national and international recognition and a strong commitment to research. Our faculty members understand and work with graduate students in designing their research projects and course work for M.S. or the Ph.D. degrees. Students in the program study under the guidance of a faculty advisor and an advisory committee. The department emphasizes research and course work in the following areas: cell biology, environmental biology, genetics and molecular biology, microbiology and physiology. More detailed information can be found in individual faculty web pages. Qualified graduate students may apply for teaching assistantships that provide a stipend and tuition. Individual faculty also have research projects that fund graduate research assistantships. Students applying to our M.S. or the Biotechnology Science & Engineering Ph.D. programs are encouraged to contact individual faculty for availability of research assistantships.

For additional information on the Biotechnology Science and Engineering Ph.D. program, see the Interdisciplinary Programs section of this graduate catalog.

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 M.S. graduate program is a cooperative venture with Alabama A&M University, with a combined faculty at both UAH and A&M of approximately 25. 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 each 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.
Masters of Science Degree Requirements

The graduate faculty, in cooperation with the biology graduate faculty of Alabama A&M University, offers an M.S. in biological sciences with emphasis in cell biology, environmental biology, genetics and molecular biology, microbiology, or 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. The graduate program of study cannot include more than 4 credit hours each of BYS 691 or BYS 692. Three credit hours of graduate seminar can be counted toward fulfillment of the graduate program. Titled BYS 691 courses offered on an ad hoc basis and instructed as part of the didactic curriculum are exempt from the 4 credit hour maximum.

Students may elect one of the following three plans for the Masters degree:

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;
   d. Oral presentation of Master’s report before supervisory committee.

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;
   d. Oral presentation of Master’s report before supervisory committee.

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 120, 214 or 321, 301 or 361, and 340 or 543 recommended, or permission of instructor.

505 Psychopharmacology 3 hrs.
Introduction to drug classification and action with emphasis on physiological and psychological interactions. Prerequisite: 9 hrs. BYS or PY.
519 Gene Structure and Function  
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  
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: $40. 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: $30. Prerequisite: BYS 321.

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: $50. 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 biochemical 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.

535 Advanced Microbiology  
Aspects of microbial behavior, development, morphogenesis or physiology. Prerequisites: BYS 321 and BYS/CH 361.

536 Psychobiology of Stress and Illness  
Overview of physiological stress responses and their influence on health, behavior, and illness. Prerequisite: 9 hrs. BYS or PY. (Same as PY 536.)

540 Animal Behavior  
Examines the experimental and theoretical foundations of the study of animal behavior. Animal behavior will be discussed in terms of immediate mechanisms, development, survival value, and evolution. Some emphasis will be placed on the relevance of animal behavior to human behavior and on the importance of understanding behavior in context. Prerequisites: PY 101, 102 and 302 or BYS 119, 120 and 4 upper level hours in BYS. (Same as PY 540.)

543 Molecular Biology of the Cell  
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 340; BYS/CH 361 recommended.

544 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 340 or 543.
545 Cellular and Developmental Biology Laboratory 2 hrs.

547 Biochemistry I 3 hrs.
Structural chemistry and function of biomolecules, mechanisms of biochemical reactions, enzyme kinetics, and energy transfer. Prerequisite: CH 332 or BYS/CH 361. (Same as CH 561.)

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

556 Advanced Molecular Techniques 3 hrs.
Laboratory techniques in molecular biology, including methods of recombinant DNA technology for identification, cloning, and characterization of genes. Prerequisites: BYS 219, 340, and 519 (may be taken concurrently) or approval of instructor. One 2-hour and one 5-hour lab per week. Lab Fee: $250.

561 Physiological Ecology 4 hrs.
Physiological and behavioral responses of organisms to natural changes in their chemical and physical environment. Prerequisite: BYS 312 or approval of instructor. BYS 361 or 532 recommended. Lab Fee: $30.

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. Field trips required. Prerequisites: BYS 312. Lab Fee: $30

563 Population Ecology 4 hrs.
Distribution, population dynamics and behavior of animal populations in relation to environmental factors. One 4-hour lab per week. Field trips required. Prerequisites: BYS 312. Lab Fee: $30.

564 Limnology 3 hrs.
Fresh-water environments and organisms exemplified by lakes, ponds, and streams in North Alabama.

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. Prerequisite: BYS 378. Lab Fee: $40.

621 Pathogenic Bacteriology 4 hrs.
Survey of bacterial diseases in humans. Mechanisms of pathogenicity and host-parasite interactions. Includes laboratory. Prerequisites: BYS 361, 421, 430, or approval of instructor. Lab Fee: $50.

641 Advanced Cell Biology (also at AAMU) 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. Prerequisite: BYS 543 or approval of instructor. Lab Fee: $50.

644 Topics in Cell and Developmental Biology and Biological Fine Structure 2 hrs.
Discussion of current topics in cell biology with emphasis on student participation. Both plant and animal cells will be emphasized. Depending on the number of students, some terms may be devoted to short research problems. Prerequisite: BYS 543 or 641 or approval of instructor.
646 Molecular Genetics (also at AAMU) 3 hrs.
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.

647 Enzymology 3 hrs.
Detailed study of enzymes including protein synthesis; primary, secondary, tertiary and quaternary structure; nomenclature, physiological and catalytic function; enzyme kinetics, and metabolic regulations of enzyme activity. Prerequisite: BYS 547 or CH 561 or approval of instructor.

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

Interaction of population structure, genetic properties, and ecology factors in controlling dynamics and evolutionary character of natural population. One 4-hour lab per week. Prerequisites: BYS 312, BYS 564, or approval of instructor. Lab Fee: $40.

690 Seminar (also at AAMU) 1 hr.
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.

691 Special Topics (also at AAMU) 1-4 hrs.
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.

692 Research (also at AAMU) 2-4 hrs.
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: $30 for 2 hours; $40 for 3 hours; $50 for 4 hours.

699 Master's Thesis (also at AAMU) 1-6 hrs.
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.

Graduate Courses Offered at Alabama A&M University (AAMU)
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.

510 Radiation Biology 4 hrs.
Characteristics of radioisotopes, detection and counting techniques and instrumentation, tracer techniques, health and safety system. Prerequisite: Consultation with instructor.

511 Biological Control 4 hrs.
Components of resistance, use of parasites, predators and microorganisms, foreign exploration, shipment, release and establishment of imported parasites and predators.

512 Histotechnology 3 hrs.
Microscopic study of the various tissues and organs of the animal systems.

223 College of Science
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>522</td>
<td>Microbial Physiology</td>
<td>3 hrs.</td>
<td>Relationship between structure and biochemical functions in microorganisms. Lab Fee: $40.00. Prerequisite: Microbiology, organic chemistry, and biochemistry.</td>
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<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>
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<tr>
<td>524</td>
<td>Mycology</td>
<td>4 hrs.</td>
<td>Lines of phycymycetes using representative species; various series of actinomycetes; representative pathogenic (crop and vegetative pathogens) and nonpathogenic heterobasidiomycetidae organisms; order and families of homobasidiomycetidae. Ontogenetics, cellular, and structural study applied to all divisions, classes, series, orders and families. Lab Fee: $40.</td>
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<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 321.</td>
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<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>
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<tr>
<td>534</td>
<td>Medical Physiology II</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>
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<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. Lab fee $50. Prerequisite: ZOO 409.</td>
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<tr>
<td>541</td>
<td>Cell Physiology</td>
<td>4 hrs.</td>
<td>Interconversions and functions of biomolecules in cells, including the major metabolic pathways, bioenergetics, interrelations of various pathways, and various mechanisms of metabolic regulation. One 3-hour lab per week. Prerequisites: BIO/CHE 361 and 362 or consent of instructor.</td>
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<tr>
<td>542</td>
<td>Analytical Biochemistry Laboratory</td>
<td>2 hrs.</td>
<td>Advanced laboratory dealing with modern techniques of molecular biology and biochemistry. Prerequisite: Organic Chemistry.</td>
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<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>
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<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>
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</tbody>
</table>
552 Insect-Pest Management 4 hrs.
Insect surveys, ecological basis for control, plant and animal resistance to insects, control by parasites, predators, microorganisms, management by genetics principles, chemical attractants, chemical repellents, sterilization, insecticides, and integrated systems of pest management. Prerequisite: general entomology or advanced applied entomology.

553 Insect Taxonomy and Morphology 4 hrs.
Classification of insects, external and internal anatomy of insects, with emphasis on the comparative and functional aspects. Prerequisite: BIO 455.

560 Environmental Biology 3 hrs.
Principles of interaction between living systems and their resources. Current problems in management of natural resources including new approaches in management of pest populations.

565/565L Phycology - Morphology of Classes; Growth Requirements 4 hrs.

570 Plant Pathology 4 hrs.
History, nonparasitic, and parasitic diseases incited by bacteria, fungi, plasmodiophorales, nematodes, and viruses. Disease control through exclusion, eradication, protection, and post resistance. Prerequisite: BIO 344.

571 Plant Anatomy 4 hrs.
Ontogeny, differentiation, and maturation of tissues and organs of angiosperms. Problems in growth and development of an angiosperm, using histological techniques. Two 3-hour labs per week. Lab Fee: $40. Prerequisite: BYS 372 or approval of instructor.

572 Plant Taxonomy 4 hrs.
Principles of classifying, naming, and identifying vascular plants with emphasis on flowering plants. Ecologic factors influencing vegetational distribution.

590 Problems in Biological Sciences 4 hrs.
(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 climactic and soil factors that influence their distribution and adaptations. Provision for individual investigation in biological science.

622 Applied and Industrial Microbiology 4 hrs.
Examine by microbiological assay sewage disposal and waste water treatment plants. Microorganisms of industrial importance in biological production of antibiotics, vitamins, organic acids, and alcohols. Prerequisite: Microbiology.

623 Advanced Virology 4 hrs.
Outline of field of virology stressing molecular biology of virus replication. Immunology, genetics, and epidemiology. Bacterial and vertebrate viruses although some discussion of plant and insect viruses. Prerequisites: Microbiology, Principles of Virology.

631 Medical Pharmacology 5 hrs.
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.
632 Cardiovascular Physiology
Mechanisms of cardiac muscle excitation and interaction. Analysis of peripheral circulation. Neural regulation of circulation. Angiograph, electrocardiography, and vectorcardiography as diagnostic tools. Prerequisites: Medical Physiology I and II.

642 Advanced Cell Physiology
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.

645 Human Cytogenetics and Its Clinical Application
Review of normal human chromosome structure and normal chromosome segregation and morphology with clinical consideration.

652 Advanced Applied Entomology
Economic thresholds, economic injury levels, population dynamics, residues in food crops, chemical control, insect transmission of plant disease, and livestock. Prerequisite: General entomology.

653 Taxonomy of the Immature Insect
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.

CHEMISTRY
C203 Materials Science Building
Telephone: (256) 824-6153
Email: apply@matsci.uah.edu
Web Site: http://www.chemistry.uah.edu

Degree: Master of Science

Chair: James K. Baird, Professor

Professors:
Baird, J.K.; theoretical radiation chemistry, crystal growth and critical phenomena in solution
Gregory, J.C.; cosmic ray astronomy, interaction of fast atoms with surfaces
Meehan, E.J., Jr.; x-ray crystallography of proteins
Radonovich, L.J.; x-ray crystallography, organometallic chemistry
Riley, C. (Emeritus); electrodeposited materials, biocompatible surfaces
Setzer, W.; biomedical aspects of biologically active phytochemicals
Shriver, J.S.; NMR spectroscopy

Associate Professors:
Edmondson, S. (Research); NMR spectroscopy
Kaukler, W. (Research); x-ray microscopy, materials processing
Weimer, J.; surface kinetics and surface bonding studies
Assistant Professors:

Chen, L. (Research); x-ray diffraction of large molecules
DiGiammarino, E. (Research); protein biochemistry and structural biology
Gebauer, A; macrocyclic compounds
George, M. A.; sensors, thin film coatings
Scholz, C.; biosurfaces, biomaterials and polymers
Vogler, B.; biological macromolecules

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. 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.

Equipment

Major equipment in the Chemistry Department includes: Varian 800 and 500 MHz nuclear magnetic resonance spectrometers equipped for both liquid and solid phase studies, Auger electron spectrometer, GC/MS, fluorescence spectrometer, x-ray photoelectron spectrometer, plasma chemistry apparatus, Jarrell-Ash 2 meter spectrometer, Varian Dris-90 ultraviolet-visible spectrometer, Beckman DB-G visible-ultraviolet spectrometers, single crystal and surface x-ray diffractometers, atomic absorption spectrometers, SEM, EDS, scanning tunneling and atomic force microscopes, surface x-ray diffractometer, FTIR with small angle and microscope attachments, molecular modeling system, Waters binary gradient liquid chromatography system, Perkin-Elmer high pressure liquid chromatograph, gas chromatographs and various CWand pulsed lasers. The University has a DEC AXP7000 computer and has access to a Cray-XMP supercomputer at the Alabama Supercomputer Center located in Huntsville. The Chemistry Department has numerous IBM compatible, 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.

Plan I (thesis option)

Graduate students selecting Plan I will be asked to take placement exams in biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. In the event that a student fails one
of the placement exams, the student must make up this deficiency by passing a graduate course in the appropriate field selected from Group I, below

## Group I Major Field Courses

<table>
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<tr>
<th>Field</th>
<th>Courses</th>
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<tr>
<td>5. Polymer Chemistry:</td>
<td>CH 540 Polymer Synthesis and Characterization, and CH 645 Polymer Physical Chemistry.</td>
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</tbody>
</table>

After having passed the placement exams and/or making up any deficiencies identified by these exams, the student must take enough courses to have at least two courses from one of the five major fields listed under Group I, for example, two courses in biochemistry or two courses in inorganic chemistry, etc. A total of at least 24 semester hours of graduate course credit is required under Plan I. The hours remaining to make up the 24 should be selected from Group II below:

## Group II Special Topics and Electives

A maximum of six courses can be chosen from: CH 521, 531, 540, 549, 553, 554, 560, 561, 562, 565, 600, 601, 602, 603, 621, 631, 632, 640, 641, 642, 643, 644, 645, 646, 647, 648, 650, 661, 700, 705, 721, 735, 745, 746, 765; MTS 501, 502, 660, 661, 701; BYS 519, 543; CHE 560, 561; and BSE 601.

In satisfying the Group II requirements, however, a maximum of three courses can be chosen from the special topics selections: CH 700, 705, 721, 735, 745, 746, 765; BSE 601.

Course selection from Group II is ordinarily done with the help of the student’s advisor. The student must register for CH 780 during each semester of residence, and must register for a minimum of two semesters of CH 699. The student should select a thesis advisor from among the eligible faculty, complete a thesis, and successfully defend it before his supervisory committee.

## Plan II (non-thesis option)

Graduate students entering Plan II must qualify by meeting one of the following preliminary examination requirements:

a) Passing placement exams in biochemistry, inorganic chemistry, organic chemistry and physical chemistry.

b) Having previously passed at least two sections of the Materials Science Program Exam I.

c) Having previously passed the Biotechnology Science and Engineering Preliminary Exam.

Students selecting option (a) and failing to pass one or more of the subject placement exams, must make up the deficiency by passing two courses in the appropriate field selected from Group I above.

Course requirements under Plan II include 6 semester hours chosen from one of the five fields listed under Group I above plus 27 hours of graduate coursework in chemistry or related fields. Of the total of 33 hours of course work required under Plan II, at least 18 hours must be in chemistry. Plan II requires a program of study drawn up by the student and the Chemistry M.S. degree program advisor.

Students must also register for CH 780 Chemistry Seminar during at least four semesters. 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. Prerequisite: CH 346. Lab Fee: $60.

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. Prerequisites: CH 332, and 342 or 348 or approval of instructor. Lab Fee: $50.

540 Polymer Synthesis and Characterization 3 hrs.
Synthesis of commercially relevant and novel polymers. Polymer characterization and discussion of the structural dependence of polymer properties. Prerequisites: CH 331. Students who have successfully completed CH 540 cannot also receive credit for CH 440 or MTS 649.

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.
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, CH 343 or PH 351, MA 244, 324. (Same as PH 451, PH 551, OSE 555, MTS 651.) Fall.

554 Introductory Quantum Mechanics II 3 hrs.
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: CH 553 or PH 551. (Same as PH 452, PH 552, MTS 652.) Spring.
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. Prerequisites: Senior standing in chemistry or physics and approval of the instructor. Lab Fee: $60.

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 or BYS 547. (Same as BYS 548.)

565 Molecular Biochemistry Laboratory 2 hrs.
Practical experience in isolation and characterization of biomolecules. Prerequisite: CH 562. Lab Fee: $60.

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 332, 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. Prerequisite: CH 341 or CH 347 or approval of instructor.

641 Statistical Thermodynamics 3 hrs.
Principles leading to the development of Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics. Thermodynamic properties calculated from partition functions. Prerequisite: CH 343.

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

643 Quantum Chemistry 3 hrs.
Application of quantum theory to the chemical bond. Prerequisite: CH 343.
644 Chemical Electrodynamics 3 hrs.
Electrodynamics problems encountered in chemistry. Maxwell’s equations, electrostatics. Onsager and Debye theory of dielectrics, molecular dipole moments, Beer’s law, Landolt’s rule, light scattering from macromolecules, quantum theory of radiation, magnetic susceptibility, introduction to NMR and ESR. Prerequisites: CH 342, MA 324.

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

646 Thermodynamics of Materials 3 hrs.
Fundamental thermodynamic review, phase equilibrium, chemical reaction equilibrium, free energy, binary and ternary phase transformations, solution models and selected topics. Prerequisite: CH 341 or equivalent. (Same as CHE 646 and MTS 646.)

647 Advanced Biophysical Chemistry I 3 hrs.
Advanced biophysical chemistry, including the first, second, and third laws of thermodynamics and their practical applications. Solution thermodynamics and acid-base equilibria. Prerequisites: CH 342 or 348, MA 324, or approval of instructor. Students who have completed CH 347 cannot earn credit for CH 647.

648 Advanced Biophysical Chemistry II 3 hrs.
Advanced biophysical chemistry, including intermolecular, and intramolecular forces; binding; electrolyte solutions; water and macromolecules. Prerequisite: CH 647. Students who have completed CH 348 cannot earn credit for CH 648.

650 Principles of Liquid & 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 MTS 650 and CHE 650.)

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

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

700 Current Topics in Chemistry 3 hrs
Advanced laboratory research in one of the departmental research groups. The student works on an independent or group research project. Completion of the course requires a written and an oral report. Prerequisite: approval of the instructor.

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

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

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

745 Selected Topics in Physical Chemistry 3 hrs.
Prerequisite: CH 643 and approval of instructor.

231 College of Science
746 Solid State Chemistry 3 hrs.
Chemical properties of solids. Includes phase equilibria, chemical bonding in ionic and covalent crystals, thermodynamics of atomic defects, ionic conductivity in solids, corrosion, and introduction to surfaces and adsorption. Prerequisites: CH 342, MA 324.

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

780 Chemistry Seminar 1 hr.
Required during each semester of residence.

COMPUTER SCIENCE

300 Technology Hall
Telephone: (256) 824-6088
Email: info.grad@cs.uah.edu
Web Site: http://www.cs.uah.edu

Degrees:
Master of Science
Master of Science in Software Engineering
Doctor of Philosophy

Certificates:
Software Engineering
Information Assurance

Chair: Heggere S. Ranganath, Professor

Professors:
Amin, A.T.; algorithms, graphs and networks, software testing
Davis, C.G. (Emeritus); software engineering, software requirements definition techniques
Graves, S.J.; distributed computing, data and information systems, software engineering
Johannes, J.D (Emeritus); artificial intelligence, distributed operating systems, software engineering
Ranganath, H.S.; image processing, pattern recognition, neural networks, data mining
Richards, P.G.; numerical analysis, modeling of ionosphere and plasmasphere
Shiva, S.G. (Emeritus); artificial intelligence, software engineering, parallel and distributed processing, VLSI design methodologies
Slater, P.J.; graph theory, combinatorics

Associate Professors:
Delugach, H.S.; software requirements development, knowledge based systems
Li, W.; object oriented software design, real time software engineering
Newman, T.S.; visualization, graphics, and computer vision
Rochowiak, D.M.; cognitive science, artificial intelligence, computer ethics

College of Science 232
Assistant Professors:

Cox, G.; computer architecture, networks, distributed systems
Etzkorn, L.H.; software re-use, object oriented software development
Hart, D.R.; distributed computing, visualization, software engineering
Weisskopf, M.E.; modern operating systems, distributed processing
Aygun, R.; Multimedia, video and image processing, data mining, bioinformatics

The Computer Science Department offers the M.S. and Ph.D. degrees with a major in computer science, and the M.S.S.E. degree in software engineering. In addition, the department offers certificate programs in software engineering and in information assurance. Certificates can be earned in conjunction with the M.S. degree, or independently of any degree program.

The UAH campus is fully networked with a fiber optics backbone and is a member of the NSF's VBNS2 network, giving high-speed connectivity to the Internet. The department has modern networked computing facilities, containing PC's and SUN work stations, and provides excellent computing support for instruction and research.

Additional information can be obtained from the Computer Science homepage at http://www.cs.uah.edu. Requests for admissions information can be sent by email to: admissions@cs.uah.edu.

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 are required for admission to the program. Transcripts will be reviewed and deficiencies in computer science background may result in the need to take one or more broadening courses. 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 I, CS II, CS III An Introductory sequence covering Object-Oriented Programming and Data Structures in C/C++/Java
- CS 214 Introduction to Discrete Structures
- CS 317 Introduction to Design and Analysis of Algorithms
- CS 490 Introduction to Operating Systems
- 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.

**The Program of Study**

A program of study should be completed as soon as the course content of the program has been selected. The plan must be made in consultation with an advisor from the computer science faculty. The student's faculty advisor, department chair, and the Dean of the School of Graduate Studies approve the program of study. After approval, student requested changes must be agreed to by the student's advisor and submitted for approval.

**Teaching Areas**

The Computer Science Department offers an exceptionally broad spectrum of courses. For convenience, they are listed below by category. The teaching areas include software engineering, computer graphics and image processing, data and information technology, computer architecture and networking, artificial intelligence, languages and systems, and theoretical computer science. There is no requirement to stay within a particular area, and students may freely select from any of the areas when preparing the program of study with an advisor.

**Software Engineering**

Software engineering is a study of the process of large-scale software development. It includes a study of the phases of software development with emphasis on tools and practices for good software development. A student who completes the M.S. program, which includes CS 650 and 15 semester hours selected from the following: CS 550, 551, 552, 553, 555, 651, 652, 654, 656, 658, 666, 668, 750, and 695 or 696, will receive the software engineering certificate as well as the M.S. degree.

The courses in this area include:

- **CS 550** ADA Program Support Environments
- **CS 551** Object Oriented Software Modeling
- **CS 552** Advanced Object Oriented Design
- **CS 553** Client Server Computing
- **CS 555** Formal Program Development
- **CS 650** The Software Engineering Process
- **CS 666** Software Studio I
- **CS 651** Advanced Object-Oriented Development using UML
- **CS 652** System and Software Requirements Methods
- **CS 654** Software and Design Techniques and Tools
- **CS 656** Software Testing and Reliability
- **CS 658** Software Project Management and Quality Assurance
- **CS 750** Advanced Software Engineering Topics
- **CS 668** Software Studio 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 548** Human-Computer Interaction
- **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
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 585 Introduction to Computer Security
- CS 660 Large Scale Scientific Computing
- CS 685 Computer Security
- CS 687 Database Systems
- CS 787 Advanced Database Systems

Computer Architecture and Networking
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 570 Introduction to Computer Networks
- CS 586 Microprocessor Architecture
- CS 613 Computer Architecture
- 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

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 Introduction to Neural Networks
- CS 567 Artificial Intelligence I
- CS 660 Large Scale Scientific Computing
- CS 685 Computer Security
- CS 690 Advanced Operating Systems
- CS 703 Theory of Programming Languages
- CS 717 Advanced Algorithm Design and Analysis
- CS 730 Artificial Intelligence II
- CS 780 Fault Tolerant Computing

Languages and Systems
The languages and systems area includes instruction in programming languages, systems programming, operating systems, and their use in problem solutions.

- CS 524 Programming Languages
- CS 526 Program Translation and Compiler Construction
- CS 590 Programming Environments with UNIX
- CS 690 Advanced Operating Systems
- CS 790 Operating Systems Seminar

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.

- CS 603 Formal Languages and Automata Theory
- CS 617 Design and Analysis of Algorithms
- CS 703 Theory of Programming Languages
- CS 717 Advanced Algorithm Design and Analysis
Graduate Certificate Programs

Software Engineering Certificate

The Software Engineering Program is designed for those students who want to broaden their knowledge in this area, but do not necessarily desire to pursue a graduate degree in computer science. The certificate requires 18 graduate semester hours of coursework in software engineering, which must include CS 650 and five courses selected from the following courses: CS 550, 551, 552, 553, 555, 652, 654, 656, 658, 750, or 695. Students desiring to complete the certificate program should have either industrial experience in software development or have undergraduate courses in software development. Students may not work toward a Software Engineering Certificate concurrently with or after receiving the M.S.S.E.

Information Assurance Certificate

The Department of Computer Science collaborates with the Department of Electrical and Computer Engineering and the College of Administrative Science to offer an interdisciplinary graduate certificate program in Information Assurance. Contact the Department for further details.

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.

Plan I.

A minimum of 24 semester hours of coursework and the writing of an acceptable thesis is required. At least six hours of thesis credit (CS 699) must be earned. A student must present his/her thesis and pass an oral examination based on the thesis and related coursework. Plan I students must register for CS 699 each term they receive supervision from their advisor.

Plan II.

A minimum of 33 semester hours of coursework is required. A student must pass a written comprehensive examination over the four core courses given below. Plan II students must complete at least 18 hours of coursework before taking the written comprehensive examination. The examination may only be taken twice.

The following requirements and restrictions apply to a student in either plan.

Course Requirements

All students must take the following four courses:

- CS 613 Computer Architecture
- CS 617 Design and Analysis of Algorithms
- CS 650 The Software Engineering Process
- CS 690 Advanced Operating Systems

If a student has not had an undergraduate course in programming languages, CS 524 must be included in the program of study. No more than 50% of the hours in the program of study may be 500-level courses. No more than three hours of selected topics or independent study courses may be included in a program of study. Exceptions must be recommended by the student's advisor and approved by the department chair.
Grade Requirements
A grade of B or better must be earned in each of the core courses. A grade of B or better must be earned in each of the 500-level courses which is counted toward the degree. No grade lower than C can be counted toward a graduate degree. A 3.0 average must be maintained in all graduate work at UAH and in all work to be counted toward the degree.

Time Limit
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.

Transfer Credit
Graduate work may be transferred from another institution according to Graduate School policy.

Master of Science in Software Engineering
Students applying for the master’s program are expected to have an undergraduate background in computer science. Those students who do not have such a background must satisfy the breadth requirements described above. In particular, students who have not had an undergraduate course in programming languages must take CS 524. Plan II students can count CS 524 as their additional graduate course.

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 in Software Engineering is conferred under Plan I or Plan II

Plan I. (thesis) A minimum of 24 semester hours of coursework and the writing of an acceptable thesis is required. At least six hours of thesis credit (CS 699) must be earned. A student must present his/her thesis and pass an oral examination based on the thesis and related coursework. Plan I students must register for CS 699 each term they receive supervision from their advisor.

Plan II. (non-thesis) A minimum of 33 semester hours of coursework is required. Plan II students must complete CS 666 and 668. A Plan II student must pass a written comprehensive examination over the four core courses given below. Plan II students must complete at least 18 hours of coursework before taking the written comprehensive examination. The examination may only be taken twice.

The following requirements and restrictions apply to a student in either plan.

Course Requirements
All students completing the M.S.S.E. must take the following four courses:
(12 semester hours)
- CS 613 Computer Architecture
- CS 650 The Software Engineering Process
- CS 617 Design and Analysis of Algorithms
- CS 690 Advanced Operating Systems

Plan II students must take CS 666 and CS 668 (Software Studio I and II).
Students completing the M.S.S.E. under Plan II (non-thesis) must take 15 semester hours from the Software Engineering Courses listed above (not counting CS 650) or twelve hours from the list (not counting CS 650) and an approved additional three semester hour graduate course in computer science.

Students completing the M.S.S.E. under Plan I (thesis) must take twelve hours from the Software Engineering Courses listed above (not counting 650).

If a student has not had an undergraduate course in programming languages, CS 524 must be included in the program of study. No more than 50% of the hours in the program of study may be 500-level courses. No more than three hours of selected topics or independent study courses may be included in a program of study. Exceptions must be recommended by the student’s advisor and approved by the department chair.

Grade Requirements
A grade of B or better must be earned in each of the core courses. A grade of B or better must be earned in each of the 500-level courses which is counted toward the degree. No grade lower than C can be counted toward a graduate degree. A 3.0 average must be maintained in all graduate work at UAH and in all work to be counted toward the degree.

Time Limit
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.

Transfer Credit
Graduate work may be transferred from another institution according to Graduate School Rules.

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 by a departmental admissions committee. 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 54 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 will be approved by the student’s Supervisory Committee. 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 524, CS 603, CS 613, CS 617, 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 in the program.

Preliminary Examination
Ph.D. students will be required to take a preliminary examination, consisting of (1) a written test covering CS 613, CS 617, CS 650, and CS 690, and (2) an evaluation by the graduate faculty of the student’s overall academic potential. The examination must be taken within a year after admission to the Ph.D. program, or 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. As part of the Qualifying Examination, each student will present a research proposal to the Supervisory Committee.

Residency Requirements
According to graduate school policy, residence may be established through either (i) being enrolled as a full-time student (at least 9 graduate semester hours) either for one continuous academic year, or for Spring and Fall semesters in the same calendar year, or (ii) being enrolled in at least 6 hours of graduate course work in at least three of four consecutive semesters.

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. For additional requirements, consult the Academic Information Section of this Graduate Catalog.

Dissertation
The research described in the dissertation must be submitted for publication in an approved journal prior to defense of the dissertation. A public defense of the dissertation is required.

SPECIAL COMPUTER SCIENCE COURSES (CS)
The following courses serve as broadening courses for students entering the computer science graduate program. They are not open to computer science undergraduates and cannot be taken for credit by computer science undergraduate 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: $50.
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. Prerequisite: CS 221. Lab Fee: $40.

Graduate Courses in Computer Science (CS)
Courses numbered at the 500-level 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. Consult "Seniors Taking Graduate Courses" in the Graduate Admissions section of this catalog for specific policies and approval procedures.

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. (Same as ED 520.) Lab Fee: $40. May not be applied to CS major or minor.

524 Programming Languages 3 hrs.
Principles of modern programming language features and design. Imperative vs. declarative language styles. General purpose language features, e.g., operators, expressions, recursion, object-orientation. Special purpose language features, e.g., support for graphical interfaces, concurrency, non-determinism. Relationship of language design and implementation. Formal grammars, BNF notation. Brief history of programming languages. Taught as CS 424/524. Course completion and/or grade requirements for graduate credit will differ from those for undergraduate credit. Students may not receive credit for both CS 424 and CS 524. Prerequisites: CS 317 and proficiency in a modern programming language. Lab Fee: $40.

526 Program Translation and Compiler Construction 3 hrs.
Language representation; grammar classification; lexical analysis technique and tools; parsing technique and tools; compile-time and run-time symbol table design; code generation and optimization; error diagnostics. Compiler writing tools. Prerequisites: CS 317, CS 424/524 and CS 403 recommended. Lab Fee: $50.

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. Prerequisites: CS 317 and CS 524. Lab Fee: $40.

537 Introduction to Neural Networks 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. Prerequisite: CS 317. Lab Fee: $40.

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. Prerequisites: CS 221 (or proficiency with the C programming language), and MA 244. Lab Fee: $40.
548 Human-Computer Interaction 3 hrs.
Introduction to human-computer interaction and principles of graphical user interface design. Includes examination of interactive environments including windowing systems development tools, multimedia, and visual programming interfaces. Prerequisite: CS 545.

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. Prerequisite: CS 350 or equivalent introductory course in Ada. Lab Fee: $40.

551 Object Oriented Software Modeling 3 hrs.
Object oriented methods and design concepts, the Unified Modeling Language (UML), tools for object oriented development, multiple-viewed modeling techniques, forward and reverse engineering using software modeling. Prerequisite: CS 207 or 304 or 321. Lab Fee: $40.

552 Advanced Object Oriented Design 3 hrs.
Advanced C++ programming and techniques, concepts, and styles to realize and make object-oriented designs more reusable, extendable, and simple. Emphasis on quantification of what makes a "good" design. Introduces "design patterns" as elements of reusable object-oriented software development. Prerequisite: CS 304 or 307 or 321. Lab Fee: $40.

553 Client/Server Computing 3 hrs.
Conceptual and practical aspects of client/server computing, a software development paradigm that requires an understanding of object-oriented software technologies, World Wide Web technologies, networking, and standardized middleware such as CORBA. Fundamental concepts of distributed object computing, multithreading, and CORBA architectures. Students will apply the concepts in the development of practical distributed programs. Techniques for developing Web-enabled software applications. Prerequisite: CS 306 or CS 321. Lab Fee: $40.

555 Formal Program Development 3 hrs.
Propositional and predicate calculi, reasoning about programs, weakest precondition, program development, developing invariants, efficiency consideration, and program documentation. Prerequisites: CS 317 and CS 424 or 524. Lab Fee: $40.

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. Prerequisite: ED/CS 520. (Same as ED 560.) Lab Fee: $40. May not be applied to CS major or minor.

570 Introduction to Computer Networks 3 hrs.
Organization and operation of computer networks. Physical, Data Link, Network, Transport, and Application-layer protocols and algorithms; LAN and WAN systems; TCP/IP; Wired and wireless organizations; security approaches. Prerequisite: CS 413 or CS 513. Lab fee: $40. Taught as CS 470/570; course completion and/or grade requirements for graduate credit will differ from those for undergraduate credit. May not be taken by students who have taken CS 470.

585 Introduction to Computer Security 3 hrs.
This course examines the issues related to security policies, models and mechanisms applicable to providing security for computer-based systems including operating systems, database management systems, and networks.

586 Microprocessor Architecture 3 hrs.
590 Programming Environments with UNIX
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. Prerequisite: CS 390 or two years experience in UNIX. Lab Fee: $40.

595 Independent Study
Individual directed study under the supervision of an instructor. Prerequisite: approval of instructor

596 - 598 Selected Topics in Computer Science
Course offered by an instructor in a specialized area of computer science. Prerequisite: Approval of instructor. Lab Fee: $40.

603 Formal Languages and Automata Theory
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. Prerequisites: CS 317, CS 424 or 524; CS 403 recommended. Lab Fee: $40.

613 Computer Architectures
Organization, operation, and analysis of advanced computer architectures. Topics include advanced pipelining approaches, multi-processor architectures, instruction set architectures, memory hierarchy design, hardware and software-based performance optimization, and system performance measurement. Prerequisite: CS 413 or CS 513. Lab Fee: $40.

617 Design and Analysis of Algorithms
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. Prerequisite: CS 317 or CS 517. Lab Fee: $40.

620 Curriculum Integration Technology
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 skill techniques. Implementing instructional events using long-distance technologies. Prerequisites: ED/CS 520, and CS 560. (Same as ED 620.) May not be applied to CS major or minor. Lab Fee: $40.

630 Artificial Intelligence I
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. Prerequisites: CS 317, CS 424 or 524. Lab Fee: $40.

635 Computational Models of Cognition
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. Prerequisite: CS 630. Lab Fee: $40.

637 Neural Networks II
640 Automatic Pattern Recognition 3 hrs.
Discriminant analysis, maximum likelihood decisions, deterministic and nondeterministic approaches for trainable classifiers, preprocessing and feature extraction, clustering, syntactic pattern recognition. Pattern recognition in image analysis. Prerequisites: MA 244, MA 385 and CS 317. Lab Fee: $40.

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. Prerequisites: MA 244, MA 385 and CS 317. Lab Fee: $40.

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. Emphasis is on 3-D techniques and algorithms. A significant number of programming projects are involved. Prerequisite: CS 545. Lab Fee: $40.

646 Computer Geometry Modeling 3 hrs.
Numerical and computer representation of curves and surfaces, solid geometry modeling and management aspects of geometric data. Computer procedures associated with coordinate transformation, curve and surface design, orientation, cubic-tension-B-splines, Bezier curves/surfaces, and interpolation methods. Discuss graph-based and Boolean models and concepts of constructive application to robotics, animation, image processing and computer graphics, CAD/CAM/CAE. Prerequisite: CS 545. Lab Fee: $40.

650 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. Covers issues associated with professionalism and the ethical use of computers in the information age, including software piracy and copyrighting software. Prerequisites: CS 317, CS 490 and CS 424 or 524, or approval of instructor based upon applicable industrial software development experience. Lab Fee: $40.

651 Advanced Object Oriented Development Using UML 3 hrs.
Fundamental software engineering concepts illustrated through the unified modeling language (UML). Introduces “use cases”. System architecture as developed through an incremental iterative process. Core workflows including requirements, analysis, design, implementation and test. Includes a team project. Prerequisites: CS 551 and CS 650. Lab Fee: $40.

652 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. Prerequisite: CS 650 or approval of instructor based upon applicable industrial software development experience. Lab Fee: $40.

654 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. Prerequisite: CS 650 or approval of instructor based upon applicable industrial software development experience. Lab Fee: $40.
656 Software Testing and Reliability  
3 hrs.
Test data adequacy, test data selection, and output oracle; functional, structural, and fault-based testing methods; integration testing and system testing; system reliability models and application; test tool; test planning and management. Prerequisite: CS 650. Lab Fee: $50.

658 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. Prerequisite: CS 650 or approval of instructor based upon applicable industrial software development experience. Lab Fee: $50.

660 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. Prerequisite: MA 515. Lab Fee: $40.

666 Software Studio I  
3 hrs.
This is the first course in a two-course sequence where students work in teams on medium-sized software projects. Activities include analyzing and documenting software system requirements, producing a project plan, designing and building a prototype, and orally presenting the project for evaluation. The practice of software design and evaluation is conducted in an iterative cycle so that the design-evaluation phases are repeated twice to generate a more mature design. Prerequisites: CS 650, a designated 600-level software engineering elective, and a designated 500 or 600-level software engineering elective. Lab Fee: $50.

668 Software Studio II  
3 hrs.
This is the second course in a two-course sequence where students work in teams to continue the software engineering cycle with emphasis on software management, evolution, maintenance, quality analysis, testing, integration, validation, and security auditing. Prerequisites: CS 666. Lab Fee: $50.

670 Computer Networks  
3 hrs.
Detailed analysis of the organization and operation of computer networks, focusing on algorithms and organizations for the Network Layer and Data Link Layer protocols of Wired and Wireless systems. Prerequisite: CS 470 or CS 570. Lab fee: $40.

685 Computer Security  
3 hrs.
Advanced topics in security policies, models, and mechanisms applicable to providing security for computer based systems, including operating systems, database management systems, and networks. Prerequisite: CS 585. Lab Fee: $40.

687 Database Systems  
3 hrs.
Basic concepts of database 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. Prerequisite: CS 490. Lab Fee: $40.

690 Advanced Operating Systems  
3 hrs.
Review of multiprogramming operating systems including process management and virtual memory. Operating systems for shared and distributed memory multiprocessors and distributed systems. Topics include distributed file systems, concurrency and distributed process coordination. Introduction to network communication issues and special purpose systems such as real time systems, transaction processing systems, and client-server technology. Prerequisites: CS 490 or equivalent, CS 413, or CS 513. Lab Fee: $40.
695 Independent Study  
3 hrs.
Individual directed study under the supervision of an instructor. Prerequisite: Approval of instructor.

696-698 Selected Topics in Computer Science  
3 hrs.
Course offered by an instructor in a specialized area of computer science. Lab Fee: $40.

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. Prerequisite: CS 603. Lab Fee: $40.

713 Distributed Processing Systems  
3 hrs.
Computer network configurations, communication protocols, and architectural tradeoffs; distributed databases; operating systems and software issues. Reconfiguration, recovery, and reliability, specification and design of distributed systems: case studies. Prerequisites: CS 670, and CS 690. Lab Fee: $40.

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. Prerequisites: CS 613 and CS 690. Lab Fee: $40.

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. Prerequisites: CS 613, CS 524, and CS 690. Lab Fee: $40.

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. Prerequisite: CS 617. Lab Fee: $40.

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 meta-level architectures. Prerequisite: CS 630. Lab Fee: $40.

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. Prerequisites: CS 613 and CS 642. Lab Fee: $50.

750 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. Prerequisite: CS 650 or approval of instructor based upon applicable industrial software development experience. Lab Fee: $40.
780 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. Prerequisites: CS 613 and CS 617. Lab Fee: $40.

787 Advanced Database Systems 3 hrs.
Advanced topics in databases. Introduction to distributed databases and current research in coupling artificial intelligence techniques to databases. Query optimization, concurrency control, security and recovery issues in both centralized and distributed databases. Prerequisite: CS 687. Lab Fee: $40.

790 Operating Systems Seminar 3 hrs.
Advanced research topics in operating system theory and practice. Students will read and discuss classic and current papers in the literature. Each student will present reports in class and prepare a substantial research paper. Prerequisite: CS 690. Lab Fee: $40.

795 Independent Study 3 hrs.
Individual directed study under the supervision of an instructor. Prerequisite: Approval of instructor.

796-798 Advanced Selected Topics in Computer Science 3 hrs.
Course offered by an instructor in a specialized area of computer science. Prerequisite: Approval of instructor. Lab fee $40.

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

ENVIRONMENTAL SCIENCE PROGRAM

142 Wilson Hall
Telephone: (256) 824-6388
Email: lawtonr@uah.edu

Coordinator: Robert 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)

501 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. (Same as ES 401 and ATS 401/501.)

502 Computational Tools for Atmospheric and Environmental Scientists 1 hr.
Designed for incoming graduate students. Fundamentals of computation using IDL or other suitable programming language, focusing on basic skills, interpretations, creating plots, and displaying data. Prerequisite: Consent of instructor. (Same as ATS 502.) Fall. This course may not be used to meet minimum degree requirements.

511 Introduction to Geographical Information Systems 3 hrs.
Introduces vector, raster and tabular concepts, emphasizing the vector approach. Topics include: spatial relationships, map features, attributes, relational database, layers of data, data ingesting, digitizing from maps, projections, output, applications and availability of public data sets. (Same as CE 411/511, ES 411 and ATS 411/511.) Fall.

513 Geographical Information Systems and Remote Sensing 3 hrs.
Hands-on approach to GIS and satellite remote sensing. Popular satellite data sets such as LANDSAT and AVHRR are coupled with GIS data sets to increase understanding of the earth system. Topics include satellite sensors, basic radiative transfer, orbits, raster formats, atmospheric correction, distortion, image corrections, rotations and mapping, spatial resolution, image interpretation, radiometric and geometric enhancement, multispectral transformations, and classifications. (Same as ATS 413, ATS 513, ES 413.) Spring.

514 Scale and Landscape in GIS 3 hrs.
Relationship of scale processes in the interpretation of remote sensing and GIS applications. Topics include those associated with multiple representations of remote sensing data, analysis techniques for integrating multiple sets of remote sensing and auxiliary data at different scales, and geostatistics. Prerequisite: ES 513. (Same as ATS 414, ATS 514, ES 414.) Fall.

515 Advanced Topics in GIS 3 hrs.
Advanced special topics: visualization of GIS and remote sensing data, landscape characterization (pattern vs. process), multitemporal analysis, aggregation of data types, developing an integrated GIS environment for performing complex space-time modeling analyses, and land-atmosphere interactions. Prerequisite: ES 513. (Same as ATS 415, ATS 515, ES 415.) Spring.

520 Introduction to Atmospheric Chemistry and Air Pollution 3 hrs.
This self-contained introductory course in atmospheric chemistry and air pollution is designed to provide seniors and graduate students the basics of atmospheric chemistry and air pollution concepts. Topics include air pollutants, air-pollution meteorology, atmospheric gases and aerosols, and atmospheric processes. This course will also develop the necessary fundamentals for those wishing to take the advanced (600 level) courses in the atmospheric chemistry/air pollution study area. ES 520 and ATS 520 require a research project; ES/ATS 420 do not. Prerequisites: PH 112 and CH 121 or consent of instructor. (Same as ATS 420, ATS 520, ES 420.)
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 Educators: Huntsville 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. (Same as ED 532.) Lab Fee: $20. This course may not be used to meet degree requirements for UAH graduate programs.

533 Space Orientation for Educators: Washington 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 or ED 532. (Same as ED 533.) This course may not be used to meet degree requirements for UAH graduate programs.

534 Space Orientation for Educators: Russia 3 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 534.) This course may not be used to meet degree requirements for UAH graduate programs.

541 Atmospheric Thermodynamics and Cloud Physics 3 hrs.
General aspects of thermodynamic and cloud physical processes occurring within the atmosphere; atmospheric statics and stability, saturation point analysis, aerosols, nucleation, and the behavior/growth of cloud particles and hydrometers. Prerequisites: MA 324, PH 112. (Same as ATS 441/541 and ES 441.) Fall.

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. (Same as ATS 451, ATS 551, ES 451.)

552 Synoptic Meteorology 3 hrs.
Analysis, interpretation and forecasting synoptic-scale and mesoscale phenomena, including air masses, frontal systems, cyclones, anti-cyclones, tropical cyclones and associated mesoscale phenomena. Emphasis on the use of remotely-sensed data from satellites, radars and profilers using state-of-the-art workstations. Prerequisites: ATS 541, 551. (Same as ATS 452, ATS 552, ES 452.) Spring, even years.
554 Forecasting Mesoscale Processes
Detection and forecasting of atmospheric mesoscale phenomena, including the structure and evolution of clouds, precipitation (including floods), thunderstorms and severe weather. Includes basics on instruments used to detect mesoscale phenomena, most notably satellite and radar. Based mainly on computerized modules and related exercises. Prerequisite: ATS 551. (Same as ATS 454, ATS 554, ES 454.)

561 Atmospheric Radiation I
Fundamentals of terrestrial atmospheric radiation. Topics include: solar radiation at the top of the atmosphere, radiative transfer equation, gaseous absorption, scattering by molecules and particles, band models, transmittance along an inhomogeneous path, and microwave radiative transfer. Prerequisites: MA 324, PH 112. (Same as ATS 461, ATS 561, ES 461.) Spring.

593 Directed Studies in Atmospheric and Environmental Science
Supervised compilation, summarization, and discussions of special topics in environmental science.

620 Atmospheric Chemistry and Aerosols
Atmospheric chemistry and aerosols; primary processes, thermodynamics, photochemistry, kinetics, models, and measurements applied to the troposphere and stratosphere; natural and anthropogenic processes affecting the chemistry of Earth’s troposphere and stratosphere; effects of chlorine, nitrogen, hydrogen, and oxygen catalytic cycles. Ground-based and satellite-borne observations of traces species are described. Requires an understanding of atmospheric structure and elementary atmospheric chemistry. Prerequisite: ES 520 or consent of instructor. (Same as ATS 620.)

622 Air Pollution Modeling
Advanced air pollution modeling, covers in considerable depth air pollution modeling concepts and methods. Lagrangian and Eulerian modeling approaches ranging from microscale (PBL) to synoptic (regional) scale. Lagrangian modeling will be focused on detailed modeling of large point- and areas-source plumes; Eulerian modeling will range from Large Eddy Simulations (LES) to regional-scale modeling with nested domains and plume-in-grid treatments; covers atmospheric transport/dispersion/chemistry, cloud and aerosol processes, and wet and dry deposition processes; students get experience in implementing specific plume, LES, and urban-regional modeling codes used in research and regulatory applications. Prerequisites: ES 520, 551 or consent of instructor. (Same as ATS 622.)

630 Physical Climatology
This course is designed to provide a hands-on perspective to the study of the climate system using satellite data sets. The emphasis will be on understanding the physical aspects of the global climate system. Topic include global energy balance, energy balance of the surface, hydrologic cycle, climate classification, ocean circulation, natural and anthropogenic climate change and other selected topics such as urban climate and mountain weather and climate. Prerequisite: ES 501 or consent of instructor. (Same as ATS 630.) Fall, even years.

652 Space Science
Provides teachers in-depth experience with the science associated with the space program. Topics include: astrophysics, materials processing, plasma physics, life sciences, orbital mechanics, propulsion, weather, and remote sensing. Prerequisite: ES 532. Lab Fee: $20.

681 Numerical Atmospheric Modeling
Introduction to numerical methods applied to simulation of the atmosphere. Basic numerical solution techniques, along with filtering, radiative parameterizations, thermodynamics, turbulent parameterization, initialization and coordinate transformation. Prerequisites: MA 415, ES 551. (Same as ATS 681.)
MATHEMATICAL SCIENCES

205 Madison Hall
Telephone: (256) 824-6470
Email: math.grad@uah.edu
Web Site: http://www.math.uah.edu

Degrees:
- Master of Arts
- Master of Science
- Doctor of Philosophy

Chair: Kyle T. Siegrist, Professor

Professors:
- Ames, K.A.; partial differential equations, singular perturbation theory
- Friedman, M.J.; numerical analysis, differential equations
- Gibson, P.M.; linear algebra, combinatorics
- Li, J.; differential equations, mathematical modeling in epidemiology
- Morales, C.H.; functional analysis, operator theory
- Siegrist, K.T.; probability, stochastic processes, reliability theory
- Slater, P.J.; graph theory, combinatorics

Associate Professors:
- Howell, K.B.; elasticity theory, partial differential equations
- Huang, W.; differential equations, dynamical systems
- Kunin, B.I.; fracture mechanics, differential geometry
- Zhang, G.H.; graph theory, combinatorics

Assistant Professors:
- Ai, S.; differential equations, dynamical systems
- Ravindran, S.S.; computational fluid dynamics

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 (thesis) or Plan II (non-thesis). 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 18 hours of graduate coursework in mathematics and at least 24 hours of total graduate coursework, and programs without a thesis (Plan II) require at least 33 hours of graduate coursework and at least 24 hours of these should be in mathematics. At least 50 percent of the coursework hours must be completed in courses numbered 609 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, MA 544, MA 585, MA 653, MA 656, MA 685, ST 687, MA 686 or ST 787, and three approved graduate courses, including at least one numbered 609 or above; and the coursework for a non-thesis program of study concentrating in numerical analysis might be MA 515, MA 526, MA 538, MA 544, MA 614, MA 615, MA 626, MA 715, and three approved graduate courses, including at least two courses numbered 609 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, MA 542, MA 544, MA 585, MA 614, MA 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, MA 654) and linear and numerical linear algebra (MA 544, MA 614). The joint program examination can not be taken more than twice.

The comprehensive qualifying examination covers the entire Program of Study and the student's proposal for a dissertation topic, and is administered by the student's graduate study supervisory committee on behalf of the School of Graduate Studies. 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 dissertation proposal, 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.

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. Prerequisite: MA 330 and MA 442, or approval of instructor. This course is taught as MA 452/502. Course completion and/or grade requirements for the MA 502 course will differ from those for the MA 452 course.
503 Introduction to Complex Analysis
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. Prerequisites: MA 201 and one MA course at the 300 level or above, or approval of instructor.

504 Intermediate Differential Equations
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-Bendixson theorem and strange attractors, power series solutions, Frobenius series solutions. Prerequisites: MA 244, MA 324.

506 Methods of Partial Differential Equations
Survey of theory and methods for solving elementary partial differential equations. 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 and MA 244. No credit given to students who have successfully completed MA 526.

508 Applied Linear Algebra
Fundamental concepts of linear algebra are developed with emphasis on real and complex vector spaces, linear transformations and matrices. 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. Prerequisites: MA 244, MA 324. No credit given to students who have successfully completed MA 544.

Graduate Courses in Mathematics (MA)

515 Introduction to Numerical Analysis
Analysis and derivation of numerical methods for: the approximate solution of nonlinear equations; interpolation and integration of functions; approximating solutions of ordinary differential equations. Prerequisites: MA 244, 324, CS 121 or equivalent, plus one 500-level (or higher) MA course, or graduate standing in the Department of Mathematical Sciences. Lab Fee: $40.

524 Dynamical Systems I
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, MA 324, and MA 452.

526 Partial Differential Equations I
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
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

Counting, pigeonhole principle, permutations and combinations, generating functions, recurrence relations, principle of inclusion and exclusion, Polya's theory of counting. Prerequisite: MA 442 or approval of instructor.

542 Algebra

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

Vector spaces over a field, bases, linear transformations, matrices, determinants, eigenvalues, similarity, Jordan canonical forms, dual spaces, orthogonal and unitary transformations. Prerequisites: MA 244 and MA 442.

561 Introduction to Fourier Analysis

Brief development of trigonometric and exponential Fourier series, derivation of the classical Fourier transform from Fourier series, classical properties of Fourier transforms, transforms of functions, convolution, elementary development of the delta function, transforms of periodic functions, use of transforms to solve systems, introduction to the discrete transform and/or multidimensional transforms, as time permits. Prerequisites: MA 244, and MA 324. This course is taught as MA 460/561. Course completion and/or grade requirements for the MA 561 course will differ from those for the MA 460 course.

562 Intermediate Fourier Analysis

(Formerly MA 560). 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, MA 324, acquaintance with classical Fourier analysis (such as covered in MA 460).

565 Intermediate Mathematical Modeling

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, MA 324, MA 385, one MA course at 400-level or above, and CS 121 or equivalent.

585 Probability

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

Requested selected topics.

607 Mathematical Methods I

Review of 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 transform and equations. Prerequisite: MA 324. (Same as PH 607.)

609 Mathematical Methods II

Continuation of MA 607. Prerequisite: MA 607. (Same as PH 609.)

College of Science 254
614 Numerical Methods for Linear Algebra
Norms and vector spaces, matrix factorizations and direct solution methods, stability and conditioning, iterative methods for large linear systems, the algebraic eigenvalue problem. Prerequisites: MA 415 or 515, MA 508 or MA 544, CS 121 or equivalent. Lab Fee: $50.

615 Numerical Methods for Partial Differential Equations
Finite difference methods for parabolic, elliptic, and hyperbolic partial differential equations, error analysis, stability, and convergence of finite difference methods. Prerequisites: MA 415 or MA 515, MA 506 or MA 526, MA 508 or MA 544 or MA 614, CS 121 or equivalent. Lab Fee: $50.

624 Dynamical Systems II
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, MA 538, MA 508 or MA 544.

626 Partial Differential Equations II
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.

633 Geometry
Axioms of incidence and order, affine and metric properties, isometries, similarities, transformation groups, projective planes. Prerequisites: MA 442, MA 544 or approval of instructor.

638 General Topology
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.

640 Graph Theory
Graphs, subgraphs, trees, connectivity, Euler tours, Hamilton cycles, matchings, edge colorings, independent sets, vertex colorings, planar graphs, Kuratowski’s theorem, four color theorem, directed graphs, networks, cycle and bond spaces. Prerequisite: MA 540 or MA 542.

643 Group Theory
Isomorphism theorems, permutation groups, basis theorem and fundamental theorem for finite abelian groups, the Remak-Krull-Schmidt theorem, Sylow theorems, normal series, solvable groups, extensions, and selected topics in representation theory. Prerequisite: MA 542.

644 Matrix Theory
Functions of matrices, invariant polynomials, elementary divisors, similarity of matrices, normal forms of a matrix, matrix equations, generalized inverses, non-negative matrices, localization of eigenvalues. Prerequisite: MA 544. MA 503 or MA 656 recommended.

645 Combinatorial Design
Systems of distinct representatives, difference sets, coding theory, block designs, finite geometries, orthogonal Latin squares, and Hadamard matrices. Prerequisites: MA 540, MA 544.

653 Real Analysis I
Countable sets, characterization of open and closed sets, Heine-Borel theorem, Riemann integral, Lebesgue measure and outer measure, measurable functions, Lebesgue integral, Fatou’s lemma, and Lebesgue-dominated convergence theorem. Prerequisites: MA 538 and one MA course at the 540 level or above.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>654</td>
<td>Real Analysis II</td>
<td>3</td>
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<tr>
<td></td>
<td>Differentiability of monotone functions, functions of bounded variation, absolute continuity, convex functions, Minkowski and Holder inequalities, $L^p$ spaces, Riesz-Fischer representation theorem, Fubini's theorem and selected topics. Prerequisite: MA 653.</td>
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<tr>
<td>656</td>
<td>Complex Analysis I</td>
<td>3</td>
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<tr>
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<td>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.</td>
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<tr>
<td>658</td>
<td>Introduction to Functional Analysis</td>
<td>3</td>
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<td>Normed and inner product spaces, finite dimensional spaces, product and quotient spaces, equivalent norms, Hahn-Banach theorem, principle of uniform boundedness, openmapping theorem, Riesz representation theorem, complete orthonormal sets, Bessel's inequality, Parseval's identity, and conjugate spaces. Prerequisite: MA 538.</td>
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<tr>
<td>661</td>
<td>Special Functions</td>
<td>3</td>
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<td>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 MA 656.</td>
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<tr>
<td>662</td>
<td>Asymptotics and Perturbation Methods</td>
<td>3</td>
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<td></td>
<td>Asymptotic series, regular and singular perturbation theory, asymptotic matching, Laplace's method, stationary phase, steepest descents, WKB theory. Prerequisites: MA 502, MA 504 or MA 624, MA 503 or MA 656 recommended.</td>
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<tr>
<td>667</td>
<td>The Calculus of Variations and Optimal Control</td>
<td>3</td>
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<td>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, MA 502.</td>
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<tr>
<td>685</td>
<td>Stochastic Processes with Applications I</td>
<td>3</td>
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<tr>
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<td>Discrete and continuous Markov chains, Poisson processes, counting and renewal processes, and applications. Prerequisites: MA 585, MA 244 or approval of instructor.</td>
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<tr>
<td>686</td>
<td>Stochastic Processes with Applications II</td>
<td>3</td>
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<td>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.</td>
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<tr>
<td>690</td>
<td>Special Topics in Mathematics</td>
<td>3</td>
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<td>Offered upon demand. Advanced selected topics of interest in areas such as discrete mathematics, numerical analysis, differential equations, and stochastic processes.</td>
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<tr>
<td>695</td>
<td>Graduate Seminar</td>
<td>1</td>
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<td>Selected topics in advanced mathematics, conducted as a research seminar.</td>
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<tr>
<td>699</td>
<td>Master's Thesis</td>
<td>3</td>
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<td>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.</td>
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<tr>
<td>715</td>
<td>Numerical Methods for Partial Differential Equations II</td>
<td>3</td>
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<td>Finite element methods for parabolic, elliptic, and hyperbolic partial differential equations; error analysis, stability, and convergence. Prerequisites: MA 538, MA 615. Lab Fee: $50.</td>
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</tbody>
</table>

College of Science 256
726 Theory of Partial Differential Equations 3 hrs.
Hilbert space theory of existence, uniqueness, and regularity for partial differential equations. Prerequisites: MA 526, MA 538.

740 Combinatorial Algorithms 3 hrs.
Linear, polynomial and exponential graph theoretic algorithms, generating combinatorial objects, and NP-completeness. Prerequisite: MA 640.

756 Complex Analysis II 3 hrs.
Applications of residue theory, harmonic functions and their applications, Mittag-Leffler theorem, infinite products, Weierstrass product theorem, conformal mapping and Riemann mapping theorem, univalent functions, analytic continuation and Riemann surfaces, Picard’s theorems, and selected topics. Prerequisite: MA 656 or approval of instructor.

785 Advanced Probability Theory 3 hrs.
Measure and integration, probability spaces, convergence concepts, law of large numbers, random series, characteristic functions, central limit theorem, random walks, conditioning, Markov properties, conditional expectations, and elements of martingale theory. Prerequisites: MA 585, MA 653.

790 Special Topics in Advanced Mathematics 3 hrs.
Offered upon demand. Advanced selected topics of interest in areas such as discrete mathematics, numerical analysis, differential equations, and stochastic processes.

795 Graduate Seminar 1 hr.
Selected topics in advanced mathematics, conducted as a research seminar.

799 Doctoral Dissertation 3, 6, or 9 hrs.
Required each semester a student is receiving direction on a Ph.D. dissertation.

Graduate Courses in Statistics (ST)

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

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

787 Theory of Statistics II 3 hrs.
Continuation of hypothesis testing, likelihood ratio and unbiased tests, uniformly most powerful tests, power function, nonparametric tests, statistical decision theory, distribution and linear models. Prerequisite: ST 687.
PHYSICS

201-B Optics Building
Telephone: (256) 824-2483
Email: physics.grad@uah.edu
Web Site: http://www.uah.edu/physics

Degrees:
   Master of Science
   Doctor of Philosophy

Chair: Lloyd W. Hillman, Professor

Professors:

Axford, I. (Chan Professor of Physics); solar-terrestrial relations, plasma fluid dynamics, astrophysics
Barr, T. (Emeritus); optics
Comfort, R.H.; atmospheric and magnetospheric physics
Dimmock, J.O.; optics, solid-state physics
Duthie, J.G.M. (Emeritus); nonlinear optics, optical processing
Emslie, A.G.; astrophysics, solar physics
Fix, J.D.; astrophysics, cool stars
Franz, F.; atomic physics
Franz, J.R.; solid state physics, electronic properties of disordered materials
Gregory, D.A.; optical processing
Hillman, L.W.; optics, biomedical optics, illumination, laser dynamics
Horwitz, J.L.; ionospheric and magnetospheric physics
Miller, J.A.; solar physics, plasma physics
Paciesas, W.S. (Research); x-ray and gamma-ray astronomy
Smalley, L.L. (Emeritus); theoretical physics, general relativity
Takahashi, Y.; astrophysics, cosmic rays, particle physics

Associate Professors:

Lieu, R.; EUV astrophysics, radiation processes
Pakhomov, A.V.; optics, materials
Zhang, S.N. (Research); high-energy astrophysics

Assistant Professors:

Bonamente, M. (Research); high-energy astrophysics
Lompado, A. (Research); optics, scattering, bio-optics
Miller, R. S.; astrophysics, detector development
Oluseyi, H.; astrophysics, astrophysical instrumentation
Preece, R. (Research); gamma-ray astronomy
Sanghadasa, M.F. (Research); optics

The physics graduate program provides a smooth transition to a more comprehensive and rigorous treatment of the 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, high-energy astrophysics, relativity, and plasma physics.
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 electromagnetic properties of matter, thermal and mechanical properties of materials, and solid state physics.

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. One is for an M.S. degree with a thesis. The other 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 writing a thesis do not need to take the comprehensive examination. Students with a Graduate Research Assistantship may be required to file a Program of Study reflecting the thesis option. A thesis is also 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. Thesis students and students in the Optical Science and Engineering Ph.D. program (that desire a non-thesis MS in physics) are required to take PH 551,552,601, 621, and 631.

Students pursuing a degree through the Optics and Photonics Technology Curriculum 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) or 33 credit hours (no thesis) is required to graduate. 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 for First 1.5 Years Leading to Comprehensive Exam

<table>
<thead>
<tr>
<th>First Year</th>
<th>Second Year</th>
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<tbody>
<tr>
<td><strong>Fall</strong></td>
<td><strong>Spring</strong></td>
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<tr>
<td>PH 607</td>
<td>PH 609</td>
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<tr>
<td>PH 551</td>
<td>PH 552</td>
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<tr>
<td>Special Topic*</td>
<td>Special Topic*</td>
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<tr>
<td><strong>Second Year</strong></td>
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<tr>
<td>PH 601</td>
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<tr>
<td>PH 631</td>
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<tr>
<td>PH 711</td>
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</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 Department of 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. Detailed information on many pertinent matters can be found in a publication available in the department office.

Admission to the Ph.D. program in physics is dependent upon 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. Students are permitted two attempts to pass the Comprehensive Examination. A student who fails on the first attempt must retake the examination the following year.

Once the comprehensive examination is passed, a student should proceed to form supervisory committee and prepare a Program of Study. A minimum of 48 hours of graduate course credit is required for the Ph.D. in physics. A maximum of 9 semester hours credit in thesis/research work from the master’s degree may be allowed to count toward the 48 hour requirement. PH 601, 621, 622, 631, 732, 751, and a minimum of 12 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 program of study, students must then pass the Ph.D. qualifying examination. This examination is conducted under the auspices of the School of Graduate Studies. It tests students’ general fitness for pursuing a research project in their chosen area and their general knowledge of physics and may be taken no more than twice.

Finally, a significant portion of the dissertation must be submitted for publication in an approved journal with international circulation.

Graduate Courses in Physics (PH)

531 Introduction to Plasma Dynamics
3 hrs.
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. (Same as MAE 531.) Fall.

541 Geometrical Optics
3 hrs.
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-ybar 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 3 hrs.
Scalar and electromagnetic waves, polarization, coherence, reflection and refraction; two beam and multiple beam interference, interferometers, Fabry-Perots, thin films, diffraction, and absorption and dispersion. (Same as OSE 542 and EE 542.) Fall, Spring.

544 Optoelectronics 3 hrs.
Review of polarized light, the Jones and Mueller calculi. Propagation of light in birefringent material. Modulation of light using electro-optic effect, Kerr effect, acousto-optic 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.

546 Radiometry, Detectors, and Sources 3 hrs.
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. Power spectral density, properties of sources, photon noise. Prerequisite: PH 342. (Same as OPT 446, OSE 546.) Spring.

551 Introductory Quantum Mechanics I 3 hrs.
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, PH 351 or CH 343, MA 244, 324. (Same as PH 451, CH 553, OSE 555, MTS 651.) Fall.

552 Introductory Quantum Mechanics II 3 hrs.
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 or CH 553. (Same as PH 452, CH 554, MTS 652.) Spring.

560 Introduction to Solid State Physics I 3 hrs.
Crystal binding and crystal structure. Crystal structure determination. Phonons and lattice vibrations. Free electron gas. Electronic energy band theory. Prerequisite or parallel: PH 651. (Same as MTS 660.) Fall.

561 Introduction to Solid State Physics II 3 hrs.
Thermal properties of solids. Electronic properties, optical properties, electronic properties in a magnetic field, semiconductor devices, magnetism, superconductivity, defects and alloys, dislocations and crystal growth, non-crystalline solids, surfaces and interfaces. Prerequisite: PH 560. (Same as MTS 661.) Spring.

570 Optical and Photonic Systems Design 3 hrs.
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.

571 Astrophysics 3 hrs.
572 Advanced Astrophysics & Cosmology 3 hrs.

573 High Energy Astrophysics 3 hrs.

601 Classical Dynamics 3 hrs.
Variational principles and Lagrangian mechanics, rigid body motion, Hamilton’s equations, and theory of small oscillations. Aspects related to modern physics. Prerequisite: PH 301. Fall.

607 Mathematical Methods I 3 hrs.
Review of 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, even years.

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

632 Fourier Optics 3 hrs.
Introducing the optical system as an invariant linear system, convolution, Sommerfield’s diffraction integral, Fourier Transform, angular spectrum, coherent and incoherent imaging, optical transfer function. (Same as OSE 632 and EE 632.)

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. Prerequisite: 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 line width; Q-switching and mode locking; photon statistics and noise; physical origins of noise; light modulation and detection. Prerequisite: PH 432. (This course may be substituted for OSE 645.) Summer.

651 Computational Quantum Mechanics 3 hrs.

652 Applied Quantum Mechanics 3 hrs.
Application of quantum mechanics in solid state, electronics, materials science, and optics. Topics to include: Hydrogen atom and molecule, excitons, phonons, Bloch’s theorem, periodic boundary conditions, electrons and holes, band structure of simple semiconductors, dipole transitions, optical constants, absorption and emission processes. Introduction to device physics. Prerequisite: PH 551 or OSE 555. (Same as OSE 655.) Spring, odd years.

654 Optical Testing 3 hrs.
Spherometry; refractive index measurements; optical bench measurements of imaging systems via T-bar nodal slide (effective focal length, f-number, axial color, field curvature and distortion, transverse ray aberrations); illumination falloff; image resolution tests (finite object); modulation transfer function; star image testing; knife edge tests; Hartmann tests; Fizeau interferometer and testing configurations; null lens testing of aspheres; wavefront measurements (point diffraction interferometer, radial shear interferometer); Prerequisites: OSE 541, 542. (Same as OSE 654.) Spring.

661 Astrophysical Instrumentation and Data Analysis 3 hrs.

670 Optomechanical Design and Manufacturing 3 hrs.
Practical aspects of optomechanical design, material selection, fabrication and integration of precision optical components and systems for commercial, space, and military applications. Topics include: fixture design, tolerance analysis, machining methods, thermal stabilization, integrated computer-aided design and analysis, diamond machining, finishing and plating techniques. Prerequisite: OSE 541. (Same as OSE 670.) 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.

263 College of Science
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 transformation, Hamilton-Jacobi theory, Lagrangian field theory, selected topics. Prerequisite: PH 601. Offered upon demand.

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 Quantum Devices 3 hrs.
Quantum aspects of optical, electronic, and semiconductor devices approached from a phenomenological/physical point of view. Topics will include: Quantum well devices, optical modulators, optical detectors, quantum Stark effects, electrooptic devices, high speed optical devices, frequency chirping in high speed devices and system applications. Prerequisites: PH 652 or OSE 655. (Same as OSE 755.) Fall, odd years.

745 Quantum Electronics 3 hrs.
The propagation of optical beams in homogeneous and lens-like 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. Offered upon demand.

751 Quantum Field Theory 3 hrs.
Formalism of quantum field theory, construction and evaluation of Feynman diagrams for quantum electrodynamics and the weak interaction, first-order processes, renormalization, particle scattering and decay, nucleon structure, introduction to quantum chromodynamics, accelerator experiments, and astrophysical applications. Prerequisites: PH 552, 609. Fall, odd years.

College of Science 264
760 Quantum Theory of Solids 3 hrs.
Semiclassical introduction, second quantization and the electron gas, boson systems, one-electron theory and metals, electron-phonon interactions, superconductivity, dynamic electrons in a magnetic field, semiconductor crystals, energy bands, impurity states, semiconductor crystals, optical absorption and excitations. Prerequisites: PH 552, 561, 631. Offered on demand.

780-789 Selected Topics 3 hrs.
Topics include superconductivity, advanced plasma theory, properties of solids, laser propagation, collision theory, quantum electronics, gravitational theories. Fall, Spring, Summer.

792 Physics Seminar 1 hr.
Students attend seminars by invited speakers. Two semesters are required for all M.S. students and three semesters for Ph.D. students. Does not count toward minimum degree requirements. Fall, Spring.

795 Advanced Physics Project Laboratory 3 or 6 hrs.
Advanced laboratory research in one of the departmental research groups. Student works on an independent or group project. 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.

799 Doctoral Dissertation 3, 6, 9 hrs.
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.
DIVISION OF CONTINUING EDUCATION

110 Wilson Hall
Telephone: (256) 824-6013
Email: clantonk@cepo.conted.uah.edu

Interim Director: Karen Mack Clanton, B.A., M.S.M.

Mission

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 Professional Development; Health and Physical Education; Space Orientation for Professional Educators, and the Academy for Lifetime Learning. The Division of Continuing Education’s offices are located in Wilson Hall.

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. Health and physical education activities are located in the University Fitness Center, an on-campus facility that contains an indoor pool, gymnasium, weight room, indoor track and aerobic area. Courses are also held in Spragins Hall, which maintains racquetball and tennis courts. Other continuing education activities are held at various locations throughout the community.

Professional Development

Public and Customized Training

The Department of Professional Development develops and presents professional training and educational activities in the areas of business and management, engineering technology, computer technology, foreign languages, and interior design. Programs are designed to allow an individual the choice of attending individual course or courses of interest, or to complete a more structured certificate program leading to a Certificate of Professional Achievement. Courses are offered day and evening, to help accommodate the busiest of schedules. Students are offered a conducive atmosphere for meeting their professional training needs, with state-of-the-art computer labs and classrooms, and instructors who are known and respected industry practitioners and researchers in their respective fields.

Customized contract training is provided for organizational clients in business, industry, and government. New programs can be developed, or existing programs tailored, to meet specific needs and offered at the client’s site or at the Professional Development Department facilities on the UAH campus. Customized programs provide a cost-effective and convenient method of employee training, structured in a format that creates a team environment, and assists in implementation of learning in the workplace.
Certificate programs and professional review series include:

- Advanced Contract Management
- Aerospace Propulsion Systems
- C Programming
- Contract Management
- Interior Design
- ISO9000-2000
- Java Developer
- Linux
- Network Management
- Oracle Database
- Oracle Developer
- Procurement Management
- Project Management
- Radar Systems Design And Analysis
- Supervisory Development
- Systems Engineering
- Test And Evaluation Engineering
- Visual Basic
- Web Graphics
- Web Publisher

A wide variety of single short courses on current topics of interest in business, computer technology, and engineering technology are offered each term.

**Listener’s License**

Professional Development coordinates the Listener’s License program, which allows participants to attend regular credit classes, without regard to university admittance status. Listeners are not required to take tests or satisfy attendance requirements, and no academic or CEU credit is awarded. Participants pay an established course fee, any associated laboratory fees, purchase a campus parking decal, and receive library privileges for the term. Only select courses are available through the Listener’s License program, and courses taken through the Listener’s License program may not be petitioned for credit by examination. Students under disciplinary or academic suspension from any college or university are ineligible to register as Listeners. To determine which courses are available for Listener’s License, call the Professional Development Office at 824-6372.

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Health and Physical Education

The department of Health and Physical Education strives to teach individuals to improve their quality of life through educational and fitness activities. Activities focus on incorporating physical fitness as a means of relaxation, reducing the risk of injury and illness, and providing the skills and knowledge necessary to implement a healthy lifestyle.

Adult activities encompass a broad spectrum of recreational, physical, and educational opportunities. Courses include Golf, T'ai Chi, Yoga, Ballroom Dance, Swing Dance, Contemporary Nutrition, Aerobic and Step Aerobics, Weight Training, Body Sculpting, Adult Beginning, Intermediate, and Advanced Swimming, Scuba Diving, Rock Climbing, Repelling, Kayaking and Private Pilot Ground School. The Exercise Physiology option of study available through UAH’s Biology Department, with coursework in the Health and Physical Education Department, can also lead to certification as an athletic trainer.

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Space Orientation Office

The Space Orientation Department 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 Exploring Space: The Classroom Connection (Huntsville); Exploring Space: The Capital Connection (Washington, DC); and Exploring Space: The Russian Connection (former Soviet Union).

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Registration and Course Information

The Division’s Business Office located In Wilson Hall, Room 124, provides registration services for Continuing Education. Call (256) 824-6010 or 1-800-448-4031 for more information and to obtain a current course catalog, or visit our Web site at http://www.coned.uah.edu. There is no application process and enrollments are taken throughout the year.

Non-Credit Courses

UAH awards Continuing Education Units (CEUs) and a certificate will be presented to each person who successfully completes a non-credit course. One CEU is equal to 10 contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction and qualified Instruction. Transcripts are available from the Continuing Education Business Office upon written request for a $4 fee per transcript.

Division of Continuing Education 268
The Academy for Lifetime Learning, Inc.

The Academy for Lifetime Learning, Inc. (The Academy) is a non-profit membership organization with a primary goal of advancing the social, educational, and cultural interests of its members. It is governed by a Board of Directors elected by the membership. The purpose of The Academy is to sponsor non-credit courses, forums, seminars, and other events to promote understanding and appreciation of subjects selected by its members. These activities are designed to satisfy members' interest in a cooperative and socially congenial manner.

The Academy curriculum includes a wide range of courses: Art, Computer, Creative Writing, Economics, Estate Planning, Foreign Languages, Foreign Policies, Government, Great Books, History, Investments, Law, Leisure, Literature, medical Issues, Music, Nature Studies, Poetry, Politics, Psychology, Science, space Exploration, and others! These courses are offered during fall, winter, and spring, and most meet one day a week for eight weeks for approximately 1.5 hours each class. Each course is taught by highly qualified volunteer instructors, and course activities require no tests or grades.

For more information: (256) 824-6959

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270
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271
GRADUATE FACULTY

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272
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275
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276
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278
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280
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281
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REISENWITZ, KIMBERLY V., B.S.N. (Southern New York), M.S.N., C.R.N.P. (University of Alabama in Huntsville). Clinical Assistant Professor, 1999. Research Interests: Asthma, notification of sudden death, and atopic diseases. Email: reisenk@uah.edu

RHOADES, RICHARD G., B.Ch.E. (Rensselaer Polytechnic Institute), M.S. (Massachusetts Institute of Technology), Ph.D. (Rensselaer Polytechnic Institute). Director of Research Institute and professor of Engineering Management, 1997. Research Interests: Organizational design and behavior, management of technical professionals, management of change. Email: rhoadesr@uah.edu

RICHARDS, PHILIP G., Trained Secondary Teachers Certificate (Melbourne Secondary Teachers College), B.S., Ph.D. (La Trobe University). Professor of Computer Science, 1986. Research Interests: Numerical algorithms with applications to space science. Email: richards@cs.uah.edu

RIEDER, ROBERT W., J.D. (Duke University), Assistant Professor of Business Legal Studies, 1989. Email: riederr@uah.edu

ROCHOWIAK, DANIEL M., B.S. (St. Bonaventure University), Ph.D. (University of Notre Dame). Associate Professor of Computer Science, 1990. Research Interests: Cognitive science, artificial intelligence, network communication, professional ethics, philosophy of science, logic. Email: drochowi@cs.uah.edu

ROUNTREE, J. CLARKE III, B.A. (University of Alabama, Huntsville), M.A., Ph.D. (University of Iowa). Chair and Associate Professor of Communication Arts, 1993. Research Interests: Legal argument, especially argument in the U.S. Supreme Court, political rhetoric, the rhetorical work of Kenneth Burke, and rhetorical theory. Email: rountrj@uah.edu

284
SANGHADASA, MOHAN, B.Sc. (University of Colombo, Sri Lanka), M.S. (Bowling Green State University), Ph.D. (University of Alabama, Huntsville). Assistant Research Professor of Physics, 1996. Research Interests: Nonlinear optical materials and biomedical optics. Email: sangham@uah.edu

SCHENKER, DANIEL, B.A. (Brandeis University), M.A., Ph.D. (Johns Hopkins University). Associate Professor of English, 1984. Research Interests: Modern British and American literature. Email: schenkd@uah.edu

SCHNELL, JOHN F., B.S., M.A. (Pennsylvania State University), Ph.D. (University of Illinois). Professor of Economics, 1990. Research Interest: Labor economics. Email: schnellj@uah.edu

SCHOENING, NILES C., B.A. (Columbia University), M.C.P. (Ohio State University), Ph.D. (University of Tennessee). Professor of Economics, 1983. Research Interest: Public planning. Email: schoenn@uah.edu

SCHOLZ, CARMEN, M.S., Ph.D. (University of Technology, Dresden, Germany), Assistant Professor of Chemistry, 1998. Research Interests: Polymers in biomedical applications, biodegradable, biocompatible polymers and environmentally suitable materials, bacterial synthesis. Email: scholzc@uah.edu

SCHROER, BERNARD J., B.S. (Western Michigan University), M.S. (University of Alabama), Ph.D. (Oklahoma State University) P.E., Associate Vice President for Research and Professor of Industrial and Systems Engineering, 1985. Research Interests: Computer integrated manufacturing, operations research, and systems simulation/modeling. Email: schroerb@uah.edu

SCHWARZ, LOIS G., B.S.C.E., M.S.C.E. (University of Wisconsin) , Ph.D. (Northwestern University). Assistant Professor of Civil and Environmental Engineering, 2001. Research Interests: Ground improvement methodologies, engineering property improvement of modified soils, soil-structure interaction, properties and constitutive behavior of unsaturated soils, colloid migration and filtration in porous media, physicochemical characteristics of particulate materials, geoenvironmental containment of contaminants and hazardous wastes, extraterrestrial in-situ resource utilization. Email: lschwarz@cee.uah.edu

SETZER, WILLIAM N., B.S. (Harvey Mudd College), Ph.D. (University of Arizona, Tucson). Professor of Chemistry and Adjunct Associate Professor of Biological Sciences, 1985. Research Interests: Natural products drug discovery, phytochemistry, chemical ecology. Email: setzerw@uah.edu

SEVERN, JOHN K., B.A. (University of Minnesota), M.A., Ph.D. (Florida State University). Associate Professor of History, 1991. Research Interests: French Revolution and Napoleon, 19th century Europe, modern Britain. Email: severnj@uah.edu

SHEN, DASHEN, B.S. (Shanghai University), M.S., Ph.D. (Princeton University). Professor of Electrical and Computer Engineering, 1991. Research Interests: Thin film semiconductors, flat panel displays, rapid prototyping of electronic circuits. Email: shen@ece.uah.edu

SHERMAN, J. DANIEL, B.S. (University of Iowa), M.A. (Yale University), Ph.D. (University of Alabama, Tuscaloosa). Associate Dean and Professor of Management, 1981. Research Interests: Cross functional integration and the management of research and development. Email: sherman@uah.edu

SHRIVER, JOHN W., B.A. (West Virginia University), Ph.D. (Case Western Reserve University). Professor of Biological Sciences and Chemistry, Director of UAH Biomolecular NMR Laboratory, 2001. Research Interests: Protein structure and stability, nuclear magnetic resonance, microcalorimetry, thermophile proteins. Email: shriverj@uah.edu

SHTESSEL, YURI B., M.S.E.E., Ph.D. (Chelyabinsk Polytechnical Institute, Russia). Professor of Electrical and Computer Engineering, 1993. Research Interests: Sliding mode control with application to reusable launch vehicle control and aircraft re-configurable control. Email: shtessel@ece.uah.edu

285
SHUCK, SHERI M. B.A. (Berry College), Ph.D. (Auburn University). Assistant Professor of History, 2000. Research Interests: Native American studies, colonial and revolutionary America, United States in the early republic, women's studies, and southern studies. Email: shucks@uah.edu

SIEGRIST, KYLE T., B.S., M.S., Ph.D. (Georgia Institute of Technology). Chair and Professor of Mathematical Sciences, 1980. Research Interests: Probability, stochastic processes, reliability theory. Email: siegrist@math.uah.edu

SIMPSON, JAMES T., B.S., M.B.A., (University of Southern Mississippi), Ph.D. (University of Alabama, Tuscaloosa). Chair and Professor of Marketing and Management, 1990. Research Interests: Marketing channels and new product development in a high technology environment. Email: simpsonj@uah.edu

SINGH, NAGENDRA, B. Tech (Indian Institute of Technology Kanpur), B.S., M.S., Ph.D. (California Institute of Technology). Professor of Electrical Engineering, 1986. Research Interests: Electromagnetics, microwave engineering, plasma science and engineering, non-linear optics. Email: singh@ece.uah.edu

SITRAMAN, BHAVANI, B.A. (Stella Maris College), M.A. (Ohio University), Ph.D. (University of Massachusetts, Amherst). Chair and Associate Professor of Sociology, 1993. Research Interests: Marriage and family, cross-cultural perspectives on gender, social demography. Email: sitarab@uah.edu

SLATER, PETER J., B.S. (Iona College), M.S., Ph.D. (University of Iowa). Professor of Mathematical Sciences and Computer Science, 1981. Research Interests: Graph theory, combinatorics, domination theory in graphs, facility location in networks, analysis of algorithms. Email: slater@math.uah.edu and pslater@cs.uah.edu

SMITH, JAMES E. JR., B.S.E., Ph.D. (University of South Carolina). Professor of Chemical Engineering, 1982. Research Interests: Microgravity processing of ceramic and metallic composites, direct coal liquefaction, catalysis and reaction engineering, fiber optic chemical sensing, high temperature furnace development and modeling, high speed shear layer mixing. Email: jesmith@che.uah.edu

SOUTH, LISA B. (Mississippi State University), B.S.N. (University of Mississippi), M.S.N., D.S.N. (University of Alabama, Birmingham). Assistant Professor of Nursing, 1996. Research Interests: Nursing care of children, children with cancer, sickle cell disease, hemophilia, home health care of children, self-concept and social support in children with chronic illness, adolescents, neuman systems model, psychosocial issues related to children with cancer. Email: southl@uah.edu


STALLSMITH, BRUCE, W., B.S., M.S., Ph.D. (University of Massachusetts, Boston). Lecturer of Biological Sciences, 1999. Research Interests: Freshwater fishes of North America, especially Fundulus killifish; early life history of fishes; short-term acidification processes in freshwater ponds; saltmarsh ecology. Email: stallsb@uah.edu

STENSBY, JOHN, B.S.E.E. (University of Alabama, Tuscaloosa), M.S.E. (University of Alabama, Huntsville), Ph.D. (Texas A&M University). Professor of Electrical Engineering, 1984. Research Interests: Communication theory and systems. Email: stensby@ece.uah.edu

SWAIN, JAMES J., B.A., B.S., M.S. (University of Notre Dame), Ph.D. (Purdue University). Chair and Professor of Industrial and Systems Engineering, 1992. Research Interests: Applied statistics, computer simulation. Email: jswain@ise.uah.edu

SZILAGYI, STEPHEN J., B.A. (Clark University), M.A., Ph.D. (Lehigh University). Associate Professor of English, 1988. Research Interest: Alexander Pope and his later influence. Email: szilags@uah.edu
Takahashi, Yoshiyuki, B.S. (Saitama University, Japan), M.S. (Kanazawa University, Japan), Ph.D. (Osaka University, Japan). Professor of Physics, 1986. Research Interests: High energy astrophysics, specifically particle and nuclei; laser plasma physics at very high densities; heavy-ion nuclear physics, Quark-gluon plasma. Email: yoshi@cosmic.uah.edu

Tippett, Donald D., B.S. (U.S. Naval Academy), M.E., D. Eng. (Texas A&M University). Associate Professor of Industrial and Systems Engineering, 1992. Research Interests: Project management, teamwork, management of technology, industrial labor relations. Email: tippett@ise.uah.edu

Torres, Aurora, B.S. (University of Oklahoma), M.S., Ph.D. (University of Oklahoma Health Sciences Center). Assistant Professor of Psychology, 1995. Research Interests: Hormones and behavior, stress and cardiovascular responses, health psychology. Email: torresa@uah.edu


Tseng, Fan-T., B.S. (National Chiao Tung University), M.S., Ph.D. (University of Texas, Dallas). Associate Professor of Management Science, 1984. Research Interests: Operations research, scheduling, operations management, and metaheuristics. Email: tsengf@uah.edu

Utley, Dawn R., B.S. (Tennessee Technological University), M.S. (University of Tennessee), Ph.D. (University of Alabama, Huntsville). P.E., Associate Professor of Industrial and Systems Engineering and Engineering Management, 1992. Research Interests: Metrics development and evaluation, teaming progress and evaluation, culture and motivation in knowledge-based organizations. Email: utley@ise.uah.edu

Vaughan, William W., B.S. (University of Florida), Ph.D. (University of Tennessee). Research Professor of Atmospheric Science, 1995. Research Interests: Applied climatology, satellite meteorology, standard and reference atmosphere models. Email: vaughan@nsstc.uah.edu

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. Research Interests: Application of holography to test measurement problems, holographic particle/bubble/aerosol/boundary layer analysis, speckle metrology, laser vibrometry, water and wind tunnel instrumentation. Email: vikramc@uah.edu

Vogler, Bernhard, Diploma, Ph.D. (University of Tuebingen). Assistant Professor of Chemistry, 2001. Research Interests: NMR analysis of biological molecules. Email: vogler@matsci.uah.edu

Wallace, Donald B., B.S., M.S., Ph.D. (University of Wisconsin) P.E. Professor of Mechanical Engineering, 1974. Research Interests: mechanics of materials, machine design, kinematics. Email: wallace@mae.uah.edu

Warboys, Ina, B.S., M.S. (University of St. Francis). Clinical Assistant Professor and Director of Continuing Education of Nursing, 2002. Research Interests: Nursing education and adult education. Email: warboysi@uah.edu


Weatherly, Elizabeth, W., B.S.B.A. (Trinity University), M.B.A., Ph.D. (University of Georgia). Assistant Professor of Management, 1999. Research Interests: Organizational entry: recruitment, job search and choice, socialization, information seeking and other forms of proaction at work, scale development, employment law, and human resource strategy and systems. Email: weathee@uah.edu
WEIMER, JEFFERY J., B.S. (Pennsylvania State University), Ph.D. (Massachusetts Institute of Technology). Associate Professor of Chemistry and Chemical Engineering, 1990. Research Interests: Characterization of chemistry and structure of molecular adsorbates on solid surfaces, determination of kinetics of surface processes using spectroscopic techniques in ultra-high vacuum or at process conditions. Email: jjweimer@matsci.uah.edu

WEISSKOPF, MARY E., B.A. (Vanderbilt University), M.S., Ph.D. (University of Alabama, Huntsville). Assistant Professor of Computer Science, 1983. Email: weisskopf@cs.uah.edu

WELCH, RONALD M., B.S., M.S. (California State University), Ph.D. (University of Utah). Chair and Professor of Atmospheric Science, 1997. Research Interests: Remote sensing, radiative transfer, disease and climate. Email: welch@nssstc.uah.edu

WELLS, B. EARL, B.S.E.E., M.S.E.E., Ph.D. (University of Alabama). Associate Professor of Electrical and Computer Engineering, 1992. Research Interests: Computer architecture, parallel processing, digital design. Email: wells@ece.uah.edu

WESSLING, FRANCIS C., B.S. (Washington University), M.S. (University of New Mexico), Ph.D. (University of Minnesota). Professor of Mechanical Engineering, 1988. Research Interests: Materials processing in space; design of space flight hardware for materials processing; heat transfer. Email: wesslif@uah.edu

WILHITE, ALAN W., B.S., Ph.D. (North Carolina State University), M.S. (George Washington University). Eminent Scholar In Systems Engineering and Simulation, 2001. Research Interests: Life-cycle simulation, aerospace system design and optimization, systems engineering, quality, and risk management. Email: willihtu@ise.uah.edu.


WILLIAMS, LEE E., II, B.A. (Knoxville College), M.A. (East Tennessee State University), Ph.D. (Mississippi State University). Director of Multicultural Affairs and Professor of History, 1972. Research Interests: African-American, southern and modern Alabama history. Email: willial@uah.edu

WILLIAMS, THOMAS J., B.S.Ed., M.Ed., Ph.D. (University of Georgia). Associate Professor of Political Science, 1980. Research Interests: Public Administration, American Government, and Comparative Government. Email: williatj@uah.edu

WILLIAMSON, JOAN, R.N. (Birmingham Baptist Hospital), B.S.N. (University of Alabama, Tuscaloosa), M.S.N., D.S.N. (University of Alabama, Birmingham). Associate Professor of Nursing, 1973. Research Interests: Nurse practitioner, primary care, acute care, sleep, program evaluation. Email: williaj@uah.edu

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. Email: woodwaw@uah.edu

WREN, BRENT M., B.S., M.B.A. (University of Alabama, Birmingham), Ph.D. (University of Memphis). Associate Professor of Marketing, 1994. Research Interests: Marketing channels, marketing strategy, sales management. Email: wrenb@uah.edu

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. Research Interests: Fundamentals of plasmadynamics and magnetohydrodynamics and their application to astrophysical flows; numerical simulation on solar energy thermal storage systems; heat exchange design, solar terrestrial environment, laser gasdynamics, hydrodynamics transient; heat transfer, boundary layer type flows, high speed and missile aerodynamics, numerical methods on engineering and physical systems. Email: wu@cspar.uah.edu
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. Email: wyskidar@uah.edu

YOO, SEONG-MOO, B.A. (Seoul National University, Seoul, Korea), M.S., Ph.D. (University of Texas at Arlington). Associate Professor of Electrical and Computer Engineering, 2001. Research Interests: Computer networks (wireless networks), computer network security, parallel computer architecture. Email: yoos@ece.uah.edu

YOUMANS, MADELEINE N., B.A. (Cornell University), M.A., Ph.D. (University of Southern California). Director, TESOL and ESL and Assistant Professor of English, 1997. Research Interests: TESOL and Sociolinguistics. Email: youmansm@uah.edu

YOUNG, KAREN R., B.A. (Northern Arizona University), M.S., Ph.D. (North Carolina State University). Assistant Professor of Psychology, 2002. Research Interests: Roles of perception, attention, and working memory in visual performance, human factors/ergonomics, and decision making under conditions of uncertainty. Email: youngkr@uah.edu

ZHANG, GUO-HUI, B.S. (Northeast Normal University, P.R. China), M.S., Ph.D. (Southern Illinois University, Carbondale). Associate Professor of Mathematical Sciences, 1993. Research Interests: Graph theory, combinatorics. Email: zhang@math.uah.edu

ZHANG, S.N., B.S. (Tsinghua University, Beijing, China), Ph.D. (University of Southampton, UK). Associate Research Professor of Physics, 1998. Research Interests: Astrophysics, x-ray and gamma ray instrumentation, data analysis and computations. Email: shuang.zhang@msfc.nasa.gov

**EMERITI FACULTY**


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 Emerita of Nursing, 1972.


BIGGS, ALBERT W., B.S. (Southwest Missouri State University), M.S. (Stanford University, Ph.D. (University of Washington), P.E. Professor Emeritus of Electrical and Computer Engineering, 1984.


BRAINERD, JEROME J., B.S., M.S. (University of Notre Dame), Ph.D. (Cornell University), P.E. Associate Professor Emeritus of Mechanical and Aerospace Engineering, 1965.


COOK, F. LEE, B.S., M.S., Ph.D. (Georgia Institute of Technology). Associate Professor Emeritus of Mathematics, 1967.

CORNER, GEORGE W. JR., B.A. (University of Rochester), M.D. (Johns Hopkins University School of Medicine). Professor Emeritus of Medical School, 1978.


ESTES, MARTHA I., B.S.N. (Troy State University, Montgomery), M.S.N. (University of Alabama, Birmingham), Ed.D. (University of Alabama, Tuscaloosa). Assistant Professor Emerita of Nursing, 1984.

FORTE, ALDO, D.Sc. (University of Havana, Cuba). Associate Professor Emeritus of Mathematical Sciences, 1966.


GUINN, GERARD E., B.S. (Auburn University), M.S. (Purdue University), Ph.D. (University of Alabama, Huntsville). Professor Emeritus of Mechanical and Aerospace Engineering, 1990.


HEAMON, 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 Emerita of Nursing, 1975.


JAMES, ROBERT E., B.S. (Carnegie Institute of Technology), M.A. (Hollins College), Ph.D. (University of Tennessee). Associate Professor Emeritus of Psychology and Communication Arts, 1971.


KILGO, REESE D., B.A. (University of Alabama, Tuscaloosa), M.Ed. (University of Florida), Ph.D. (University of Texas). Associate Professor Emerita of Education, 1966.


MACDOUGALL, 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 Emeritus of Political Science, 1975.


MCCALISTER, DONALD V., B.A. (Fresno State College), Ph.D. (University of Tennessee). Professor Emeritus of Medical School, 1972.


MCKNIGHT, WILLIAM B., B.S. (Purdue University), Ph.D. (Oxford University). Research Professor Emeritus of Physics, 1974.


MCNIDER, RICHARD T., B.S. (University of Alabama, Tuscaloosa), M.S. (Florida State University), Ph.D. (University of Virginia). Distinguished Professor Emeritus of Mathematical Sciences, Adjunct Professor of Atmospheric and Environmental Science, 1985.

MEAD, MARGO, B.A. (University of Southern Mississippi), M.L.S. (University of North Texas), M.A. (University of Alabama In Huntsville). Lecturer Emerita In Bibliography, 1990.


PEARSON, BONNIE C., R.N. (St. Joseph's Hospital School of Nursing), B.S., M.Ed. (University of Minnesota). Associate Professor Emerita of Nursing, 1974.

PENOT, DOMINIQUE M., B.A. (University of Aix-France), License (University of Montpellier), Ph.D. (Yale University). Professor Emeritus of Foreign Languages and Literature, 1970.


PORTER, GROVER L., B.S. (University of Tennessee), M.S. (University of North Carolina), Ph.D. (Louisiana State University), C.P.A. Professor Emeritus of Accounting, 1985.


ROGERS, JON G., B.A. (Kansas State Teachers College), M.A. (University of Arkansas), Ph.D. (University of New Mexico). Professor Emeritus of Psychology, 1968.


SHIH, CORNELIUS C., B.S. (National Taiwan University), M.S., Ph.D. (Michigan State University), P.E. Professor Emeritus of Mechanical and Aerospace Engineering, 1965.


SMALLEY, LARRY L., B.S., M.S., Ph.D. (University of Nebraska). Professor Emeritus of Physics, 1967.


STROMECKY, OSTAP, M.A. (Vanderbilt University), Ph.D. (University Libera Ucrainensis, Pragensis). Associate Professor Emeritus of Foreign Languages and Literature, 1967.


SUNG, CHI-CHING, B.A. (National Taiwan University), Ph.D. (University of California, Berkeley). Professor Emeritus of Physics, 1972.
TARTER, DONALD E. B.S. (Middle Tennessee State College), Ph.D. (University of Tennessee). Associate Professor Emeritus of Sociology, 1966.


WALKER, JACK R., B.S. (Mississippi State University), M.S. (Georgia Institute of Technology), Ph.D. (Oklahoma State University), P.E. Associate Professor Emeritus of Industrial and Systems Engineering, 1982.


WHARRY, RHODA E., B.S.E. (University of Arkansas), M.S. (Memphis State University), Ph.D. (Purdue University). Professor Emerita of Education, 1967.


<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board of Trustees</td>
<td>270</td>
</tr>
<tr>
<td>Bookstore</td>
<td>14</td>
</tr>
<tr>
<td>Business Legal Studies (BLS) Graduate Courses</td>
<td>93</td>
</tr>
<tr>
<td>Calendar, Academic</td>
<td>4</td>
</tr>
<tr>
<td>Campus Map</td>
<td>2</td>
</tr>
<tr>
<td>Career Services</td>
<td>11</td>
</tr>
<tr>
<td>Center for Management of Science &amp; Technology (CMOST)</td>
<td>78</td>
</tr>
<tr>
<td>Center for Management &amp; Economic Research (CMER)</td>
<td>78</td>
</tr>
<tr>
<td>Certificate Programs, Graduate</td>
<td>43</td>
</tr>
<tr>
<td>Change of Grade</td>
<td>34</td>
</tr>
<tr>
<td>Chemical &amp; Materials Engineering Department</td>
<td>107</td>
</tr>
<tr>
<td>Chemical Engineering (CHE) Graduate Courses</td>
<td>108</td>
</tr>
<tr>
<td>Chemistry Department</td>
<td>226</td>
</tr>
<tr>
<td>Chemistry, Fifth-Year Program</td>
<td>168, 229</td>
</tr>
<tr>
<td>Chemistry (CH) Graduate Courses</td>
<td>229</td>
</tr>
<tr>
<td>Civil &amp; Environmental Engineering Department</td>
<td>110</td>
</tr>
<tr>
<td>Civil Engineering (CE) Graduate Courses</td>
<td>111</td>
</tr>
<tr>
<td>Class Attendance</td>
<td>32</td>
</tr>
<tr>
<td>Collaborative Programs</td>
<td>44, 106</td>
</tr>
<tr>
<td>College of Administrative Science</td>
<td>76</td>
</tr>
<tr>
<td>College of Engineering</td>
<td>102</td>
</tr>
<tr>
<td>College of Liberal Arts</td>
<td>152</td>
</tr>
<tr>
<td>College of Nursing</td>
<td>197</td>
</tr>
<tr>
<td>College of Science</td>
<td>210</td>
</tr>
<tr>
<td>Communication Arts Department</td>
<td>154</td>
</tr>
<tr>
<td>Communication Arts (CM) Graduate Courses</td>
<td>154</td>
</tr>
<tr>
<td>Computer Engineering (CPE) Graduate Courses</td>
<td>123</td>
</tr>
<tr>
<td>Computer Science Department</td>
<td>232</td>
</tr>
<tr>
<td>Computer Science (CS) Graduate Courses</td>
<td>240</td>
</tr>
<tr>
<td>Conditional Admission</td>
<td>47</td>
</tr>
<tr>
<td>Confidentiality of Records</td>
<td>29</td>
</tr>
<tr>
<td>Continuing Education, Division of</td>
<td>266</td>
</tr>
<tr>
<td>Cooperative Education (Co-op)</td>
<td>44</td>
</tr>
<tr>
<td>Counseling Center</td>
<td>10</td>
</tr>
<tr>
<td>Course Load, Student</td>
<td>31</td>
</tr>
<tr>
<td>Course Numbering System</td>
<td>33</td>
</tr>
<tr>
<td>Course Repeat Policy</td>
<td>35</td>
</tr>
<tr>
<td>Credit to Audit</td>
<td>31</td>
</tr>
<tr>
<td>Dean's List, Graduate</td>
<td>50</td>
</tr>
<tr>
<td>Topic</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Dean's Office, Graduate Studies</td>
<td>36</td>
</tr>
<tr>
<td>Degree Programs, Graduate</td>
<td>37</td>
</tr>
<tr>
<td>Degree Requirements, Graduate</td>
<td>50</td>
</tr>
<tr>
<td>Degree Requirements, Masters Degrees</td>
<td>51</td>
</tr>
<tr>
<td>Degree Requirements, Ph.D. Degrees</td>
<td>53</td>
</tr>
<tr>
<td>Disabled Student Services</td>
<td>10</td>
</tr>
<tr>
<td>Discrimination Policy</td>
<td>28</td>
</tr>
<tr>
<td>Dismissal, Academic</td>
<td>47, 51</td>
</tr>
<tr>
<td>Division of Continuing Education</td>
<td>266</td>
</tr>
<tr>
<td>Doctor of Philosophy Degree</td>
<td>53</td>
</tr>
<tr>
<td>Economics &amp; Finance Department</td>
<td>76</td>
</tr>
<tr>
<td>Economics (ECN) Graduate Courses</td>
<td>94</td>
</tr>
<tr>
<td>Education Department</td>
<td>154</td>
</tr>
<tr>
<td>Education (ED) Graduate Courses</td>
<td>174</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering Department</td>
<td>117</td>
</tr>
<tr>
<td>Electrical Engineering (EE) Graduate Courses</td>
<td>127</td>
</tr>
<tr>
<td>Engineering, College of</td>
<td>102</td>
</tr>
<tr>
<td>Engineering Management (EM) Graduate Courses</td>
<td>141</td>
</tr>
<tr>
<td>English Department</td>
<td>177</td>
</tr>
<tr>
<td>English, Fifth-Year Program</td>
<td>173, 178</td>
</tr>
<tr>
<td>English (EH) Graduate Courses</td>
<td>181</td>
</tr>
<tr>
<td>English Language Arts, Fifth-Year Program</td>
<td>169</td>
</tr>
<tr>
<td>English Language Proficiency Test (ELPT)</td>
<td>47</td>
</tr>
<tr>
<td>English, Linguistics and TESOL (EHL) Graduate Courses</td>
<td>183</td>
</tr>
<tr>
<td>English Proficiency</td>
<td>32</td>
</tr>
<tr>
<td>Environmental Science Program</td>
<td>246</td>
</tr>
<tr>
<td>Environmental Science (ES) Graduate Courses</td>
<td>247</td>
</tr>
<tr>
<td>Environmental Science (ES) Graduate Certificate</td>
<td>43</td>
</tr>
<tr>
<td>Equal Opportunity and Affirmative Action Policy</td>
<td>28</td>
</tr>
<tr>
<td>Examinations</td>
<td>32</td>
</tr>
<tr>
<td>Facilities</td>
<td>7</td>
</tr>
<tr>
<td>Faculty, Graduate</td>
<td>272</td>
</tr>
<tr>
<td>Family Nurse Practitioner, Graduate Certificate</td>
<td>43, 199</td>
</tr>
<tr>
<td>Fellowships</td>
<td>50</td>
</tr>
<tr>
<td>Fifth Year Programs</td>
<td>166</td>
</tr>
<tr>
<td>Final Examination, Masters Programs</td>
<td>52</td>
</tr>
<tr>
<td>Final Examination, Ph.D. Programs</td>
<td>55</td>
</tr>
<tr>
<td>Finance (FIN) Graduate Courses</td>
<td>94</td>
</tr>
<tr>
<td>Financial Aid</td>
<td>25</td>
</tr>
<tr>
<td>Financial Information</td>
<td>22</td>
</tr>
<tr>
<td>Topic</td>
<td>Page</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Liberal Arts, College of</td>
<td>152</td>
</tr>
<tr>
<td>Library</td>
<td>8</td>
</tr>
<tr>
<td>Linguistics and TESOL (EHL) Graduate Courses</td>
<td>183</td>
</tr>
<tr>
<td>Loans</td>
<td>26</td>
</tr>
<tr>
<td>Management &amp; Marketing Department</td>
<td>77</td>
</tr>
<tr>
<td>Management (MGT) Graduate Courses</td>
<td>95</td>
</tr>
<tr>
<td>Management Information Systems (MIS) Graduate Courses</td>
<td>97</td>
</tr>
<tr>
<td>Management of Technology</td>
<td>79</td>
</tr>
<tr>
<td>Management Science (MSC) Graduate Courses</td>
<td>100</td>
</tr>
<tr>
<td>Marketing (MKT) Graduate Courses</td>
<td>100</td>
</tr>
<tr>
<td>Map, Campus</td>
<td>2</td>
</tr>
<tr>
<td>Master's Degree</td>
<td>51</td>
</tr>
<tr>
<td>Materials Science Program</td>
<td>61</td>
</tr>
<tr>
<td>Materials Science (MTS) Graduate Courses</td>
<td>66</td>
</tr>
<tr>
<td>Mathematical Sciences Department</td>
<td>250</td>
</tr>
<tr>
<td>Mathematics, Fifth-Year Program</td>
<td>171, 251</td>
</tr>
<tr>
<td>Mathematics (MA) Graduate Courses</td>
<td>253</td>
</tr>
<tr>
<td>Mathematics Learning Center</td>
<td>10</td>
</tr>
<tr>
<td>MD/MSM</td>
<td>85</td>
</tr>
<tr>
<td>Mechanical &amp; Aerospace Engineering Department</td>
<td>142</td>
</tr>
<tr>
<td>Mechanical Engineering (MAE) Graduate Courses</td>
<td>144</td>
</tr>
<tr>
<td>Miller Analogies Test (MAT)</td>
<td>46</td>
</tr>
<tr>
<td>Mission Statement</td>
<td>6</td>
</tr>
<tr>
<td>Multicultural Affairs</td>
<td>11</td>
</tr>
<tr>
<td>Music Organizations</td>
<td>19</td>
</tr>
<tr>
<td>Non-Degree Admission</td>
<td>48</td>
</tr>
<tr>
<td>Nondiscrimination Policy</td>
<td>28</td>
</tr>
<tr>
<td>Nurse Practitioner</td>
<td>198</td>
</tr>
<tr>
<td>Nursing, College of</td>
<td>197</td>
</tr>
<tr>
<td>Nursing Education, Graduate Certificate</td>
<td>43, 199, 205</td>
</tr>
<tr>
<td>Nursing (NUR) Graduate Courses</td>
<td>205</td>
</tr>
<tr>
<td>Nurse Traineeship Program</td>
<td>27</td>
</tr>
<tr>
<td>Operations Research, Masters of Science in</td>
<td>137</td>
</tr>
<tr>
<td>Optical Science &amp; Engineering Program</td>
<td>69</td>
</tr>
<tr>
<td>Optical Science &amp; Engineering (OSE) Graduate Courses</td>
<td>72</td>
</tr>
<tr>
<td>Payment Methods</td>
<td>24</td>
</tr>
<tr>
<td>Ph.D. Degree</td>
<td>53</td>
</tr>
<tr>
<td>Physics Department</td>
<td>258</td>
</tr>
<tr>
<td>Topic</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Student Activities</td>
<td>14</td>
</tr>
<tr>
<td>Student Government Association (SGA)</td>
<td>15</td>
</tr>
<tr>
<td>Student Organizations</td>
<td>15</td>
</tr>
<tr>
<td>Supervisory Committees, Masters Degrees</td>
<td>51</td>
</tr>
<tr>
<td>Supervisory Committees, Ph.D. Degrees</td>
<td>54</td>
</tr>
<tr>
<td>Teaching Assistantships</td>
<td>49</td>
</tr>
<tr>
<td>Technical Communication, Graduate Certificate</td>
<td>43, 180</td>
</tr>
<tr>
<td>TESOL (EHL) Graduate Courses</td>
<td>183</td>
</tr>
<tr>
<td>TESOL, Graduate Certificate</td>
<td>43, 180</td>
</tr>
<tr>
<td>TESOL Option, MA in English</td>
<td>178</td>
</tr>
<tr>
<td>Test of English as a Foreign Language (TOEFL)</td>
<td>47</td>
</tr>
<tr>
<td>Testing Services</td>
<td>46</td>
</tr>
<tr>
<td>Time Limit, Master's Degrees</td>
<td>52</td>
</tr>
<tr>
<td>Time Limit, Ph.D. Degrees</td>
<td>54</td>
</tr>
<tr>
<td>Transcripts</td>
<td>34</td>
</tr>
<tr>
<td>Transfer Credit, Master's Degree</td>
<td>52</td>
</tr>
<tr>
<td>Transfer Credit, Ph.D. Degree</td>
<td>53</td>
</tr>
<tr>
<td>Tuition, Graduate</td>
<td>23</td>
</tr>
<tr>
<td>Tuition Scholarships</td>
<td>50</td>
</tr>
<tr>
<td>Tutoring Services</td>
<td>10</td>
</tr>
<tr>
<td>Unconditional Admission</td>
<td>46</td>
</tr>
<tr>
<td>University Center</td>
<td>13</td>
</tr>
<tr>
<td>Veterans Affairs</td>
<td>27</td>
</tr>
<tr>
<td>Visiting Student Program</td>
<td>44</td>
</tr>
<tr>
<td>Wellness Center</td>
<td>11</td>
</tr>
<tr>
<td>Withdrawal Policy</td>
<td>34</td>
</tr>
<tr>
<td>Writing Center</td>
<td>10</td>
</tr>
</tbody>
</table>

300
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