2005

2005-2007 Graduate Catalog

University of Alabama in Huntsville

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UAH
The University of Alabama in Huntsville

Graduate Catalog 2005 - 2007
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Contents

Campus Map ................................................................. 2
Calendar ................................................................. 4, 5
General Information ...................................................... 7
Student Information ..................................................... 11
Financial Information ................................................... 22
Academic Information .................................................. 27
School of Graduate Studies ........................................... 35
  Graduate Programs .................................................. 35
  Graduate Admissions ............................................... 43
  Graduate Assistantships ........................................... 47
  Graduate Degree Requirements ................................... 48
Interdisciplinary Programs ........................................... 55
College of Administrative Science ................................... 73
College of Engineering ............................................... 97
College of Liberal Arts ............................................... 144
College of Nursing ................................................... 181
College of Science .................................................... 194
Division of Continuing Education ................................. 243
Board of Trustees ..................................................... 247
Administration ......................................................... 248
Graduate Faculty ....................................................... 249
Index ........................................................................ 268
### Fall Semester 2005
- **August 17**: Late Registration
- **August 19**: Faculty Convocation/New Faculty Orientation
- **August 24**: Classes Begin
- **August 27**: First Saturday class
- **September 5**: Labor Day Holiday
- **October 6 - 8**: Fall Break
- **November 23**: No Classes
- **November 24 - 26**: Thanksgiving holidays - No classes
- **December 5**: Last MW class
- **December 6**: Last MW class
- **December 7**: Last TR class
- **December 12**: Last Tuesday only class/final exam
- **December 17**: Last Wednesday only class/final exam
- **December 23 - 31**: Study Day/Weather Day

### Spring Semester 2006
- **January 1**: New Year’s Holidays
- **January 5**: Late Registration
- **January 8**: Classes Begin
- **January 13**: First Saturday class
- **January 15**: Martin Luther King Jr. Holiday
- **March 20 - 25**: Spring Break
- **April 11**: Honors Day - No Classes
- **April 21**: Last MWF class
- **April 24**: Last MW class
- **April 25**: Last TR class
- **April 26**: Last Wednesday only class/final exam
- **April 27**: Study Day/Weather Day
- **April 27 - May 3**: Last Thursday only class/final exam
- **April 29**: Final Examinations
- **May 1**: Last Saturday only class/final exam
- **May 2**: Last Monday only class/final exam
- **May 14**: Last Tuesday only class/final exam

### Summer 2006
- **May 26**: Registration
- **May 29**: Memorial Day Holiday
- **May 30**: Classes Begin – 10 week
- **May 30**: Classes Begin – 1st 5 week
- **June 27**: Last class - 1st 5 week
- **June 28**: Study Day – 1st 5 week
- **June 29 - 30**: Final Examinations - 1st 5 week
- **July 3-4**: Independence Day Holidays
- **July 5**: Classes begin - 2nd 5 week
- **July 31**: Last MWF class – 10 week
- **July 31**: Last MW class - 10 week
- **August 1**: Last TR class - 10 week
- **August 2**: Last class - 2nd 5 week
- **August 2 – 4**: Final Examinations - 10 week
- **August 3 – 4**: Final Examinations - 2nd 5 week

*Ten Week MW classes short one class
**No Study Day
# Proposed Academic Calendar 2006-2007

(Prepared February 2005 - All dates tentative and subject to change without prior notice.)

## Fall Semester 2006

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>August 18</td>
<td>Late Registration</td>
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<tr>
<td>August 18</td>
<td>Faculty Convocation/New Faculty Orientation</td>
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<tr>
<td>August 19</td>
<td>First Saturday class</td>
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<tr>
<td>August 23</td>
<td>Classes Begin (Wednesday)</td>
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<tr>
<td>September 4</td>
<td>Labor Day Holiday</td>
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<tr>
<td>October 5 – 7</td>
<td>Fall Break</td>
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<tr>
<td>November 22</td>
<td>No Classes</td>
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<tr>
<td>November 23 – 25</td>
<td>Thanksgiving Holidays - No Classes</td>
</tr>
<tr>
<td>December 4</td>
<td>Last MWF class</td>
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<tr>
<td>December 4</td>
<td>Last MW class</td>
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<tr>
<td>December 5</td>
<td>Last TR class</td>
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<tr>
<td>December 5</td>
<td>Last Tuesday only class/final exam</td>
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<tr>
<td>December 6</td>
<td>Last Wednesday only class/final exam</td>
</tr>
<tr>
<td>December 6</td>
<td>Study Day/Weather Day</td>
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<tr>
<td>December 7</td>
<td>Last Thursday only class/final exam*</td>
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<tr>
<td>December 7 – 13</td>
<td>Final Examinations</td>
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<tr>
<td>December 9</td>
<td>Last Saturday only class/final exam</td>
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<tr>
<td>December 11</td>
<td>Last Monday only class/final exam</td>
</tr>
<tr>
<td>December 17</td>
<td>Fall Commencement</td>
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<tr>
<td>December 22 – 31</td>
<td>Winter break - No Classes</td>
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</table>

*Thursday Only Class short one session

## Spring Semester 2007

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<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>January 1</td>
<td>New Year's Holiday</td>
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<tr>
<td>January 5</td>
<td>Late Registration</td>
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<tr>
<td>January 8</td>
<td>Classes Begin</td>
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<tr>
<td>January 15</td>
<td>First Saturday class</td>
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<tr>
<td>January 17</td>
<td>Martin Luther King Jr. Holiday</td>
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<tr>
<td>March (To Be Arranged)</td>
<td>Spring Break</td>
</tr>
<tr>
<td>March (F/Wk of Spring Break)</td>
<td>Staff Spring Break Holiday</td>
</tr>
<tr>
<td>April 10</td>
<td>Honors Day - No Classes</td>
</tr>
<tr>
<td>April 20</td>
<td>Last MWF class</td>
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<tr>
<td>April 23</td>
<td>Last MW class</td>
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<tr>
<td>April 24</td>
<td>Last TR class</td>
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<tr>
<td>April 25</td>
<td>Last Wednesday only class/final exam</td>
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<tr>
<td>April 25</td>
<td>Study Day/Weather Day</td>
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<tr>
<td>April 26</td>
<td>Last Thursday only class/final exam</td>
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<tr>
<td>April 26 – May 2</td>
<td>Final Examinations</td>
</tr>
<tr>
<td>April 28</td>
<td>Last Saturday only class/final exam</td>
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<tr>
<td>April 30</td>
<td>Last Monday only class/final exam</td>
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<tr>
<td>May 1</td>
<td>Last Tuesday only class/final exam</td>
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<tr>
<td>May 13</td>
<td>Commencement</td>
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## Summer 2007

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<tbody>
<tr>
<td>May 25</td>
<td>Registration</td>
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<tr>
<td>May 28</td>
<td>Memorial Day Holiday</td>
</tr>
<tr>
<td>May 29</td>
<td>Classes Begin - 10 week</td>
</tr>
<tr>
<td>May 29</td>
<td>Classes begin - 1st 5 week</td>
</tr>
<tr>
<td>June 26</td>
<td>Last class - 1st 5 week</td>
</tr>
<tr>
<td>June 27</td>
<td>Study day - 1st 5 week</td>
</tr>
<tr>
<td>June 28 – 29</td>
<td>Final examinations - 1st 5 week</td>
</tr>
<tr>
<td>July 2</td>
<td>Classes begin - 2nd 5 week</td>
</tr>
<tr>
<td>July 4</td>
<td>Independence Day Holiday</td>
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<tr>
<td>July 26</td>
<td>Last TR class - 10 week</td>
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<tr>
<td>July 30</td>
<td>Last MWF class - 10 week</td>
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<td>July 30</td>
<td>Last MW class - 10 week</td>
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<tr>
<td>July 31</td>
<td>Study Day - 10 week</td>
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<tr>
<td>July 31</td>
<td>Last class - 2nd 5 week</td>
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<tr>
<td>August 1</td>
<td>Final Examinations - 10 week</td>
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<tr>
<td>August 1 – 3</td>
<td>Final Examinations - 2nd 5 week</td>
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<td>August 2 – 3</td>
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General Information

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 (SACS) to award bachelor's, master's, and doctoral degrees. SACS (1866 Southern Lane, Decatur, GA. 30033-4097; telephone: 404-679-4501) should be contacted only for information about UAH accreditation. Several UAH programs are accredited by their respective accrediting agencies. Academic programs in chemistry are accredited by the American Chemical Society. Eight undergraduate engineering programs (aerospace engineering option in mechanical, chemical, civil, computer, electrical, industrial and systems, optical, and mechanical) are accredited by the ABET, Inc. Both undergraduate and graduate programs in nursing are accredited by the National League of Nursing. Computer Science holds accreditation from the Computing Accreditation Commission of ABET, Inc. Programs in music and music education are accredited by the National Association of Schools of Music. All programs, both undergraduate and graduate, in the College of Administrative Science are accredited by the American Assembly of Collegiate Schools of Business-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 30 major buildings, all of which have been constructed since 1960. The buildings contain modern equipment and exemplify modern functional design.

Student housing consists of North Campus Residence Hall, Central Campus Residence Hall, and the nine-building Southeast Campus Housing Complex. Phase I of North Campus Residence Hall opened in fall 2002, and Phase II, a near replication of the existing residence hall, is expected to open in fall 2005.

Morton Hall, 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 accommodates the offices of Multicultural Affairs, the Honors Program, the Writing Center, and International Education.

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

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

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

The Offices of Human Resources, Accounting and Finance, Accounts Payable, Alumni Relations, University Advancement, University Development, and University Relations are located in Shelbie King Hall along with the Institute for Science Education.

Von Braun Research Hall contains the Office of Sponsored Programs, 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 Department of Computer & Network Services.

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 Offices of Career Services and Cooperative Education.

The Materials Science Building contains offices for Chemistry, Materials Science, Biotechnology Science and Engineering, the Laboratory for Structural Biology, classrooms, and state of the art research laboratories for programs in chemistry, biotechnology, nuclear-magnetic resonance spectrometry, and materials science. The Materials Science Building also houses the 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, studios, 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.

Marion Beirne Spragins Hall has classrooms and offices for Health and Physical Education and Athletics, a gymnasium with a seating capacity of 2,800, racquetball courts, and other physical education, recreational, and athletic training facilities.

The Central Receiving 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 Department of Facilities and Operations, which include administrative offices, custodial services, public safety, facilities maintenance, grounds management services, stockroom, and fleet services.

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 Department of Business Services including Purchasing Services, Telecommunications, and the Copy Center.

Olin B. King Technology Hall is located on the west side of 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 in Computer Science. It also houses the Center for Space Plasma and Aeronomic Research (CSPAR), the Propulsion Research Center, and the Information Technology & Systems Center.

The Robert "Bud" Cramer Research Hall which houses the National Space Science & Technology Center or NSSTC is also located on the west side of 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 organizations 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.
Two new buildings will be under construction between 2005 and 2007. The Applied Sciences Building will provide state-of-the-art lab facilities as well as teaching and resource facilities for chemistry, physics, biology, and mathematical sciences. It will serve to make the campus more modern in facilities and design by helping to create a technology quadrangle that will consolidate engineering, math, and science. Also, scheduled for construction is a multi-level intermodal parking facility that will provide an additional 1,200 parking spaces in a centralized location adjacent to the technology quadrangle.

M. Louis Salmon Library

The M. Louis Salmon Library is housed in a 105,000 square feet facility which includes a state-of-the-art high-tech wing with an Information Arcade, five computer labs, including a math tutorial lab, a liberal arts lab, a nursing lab, and a Library/distance learning lab. Over 250 workstations are supported in the facility. A Media/Distance Learning support center is also housed in the Library.

The Library supports the academic and research programs of the University. It has a collection of over 325,000 print volumes, a selective collection of over 500,000 United States government publications, and over 600,000 materials in microform, and manuscript collections. In addition to books and microform materials, the Library offers a broad selection of books, journals, newspapers and other serials in electronic form. Approximately 15,000 electronic periodicals, over 40,000 electronic books and over 250 databases can be accessed both on and off campus via the Library website at http://www.uah.edu/library. In addition, the University Archives/Special Collections offer a number of unique collections, including the papers of former Congressman Robert Jones, the personal Library of Willy Ley, the architectural research collection of Harvie P. Jones, and several space related collections involving such projects as the Saturn V rocket, Skylab and Apollo-Soyuz.

For students in science, engineering and technology, research at UAH is supported by the Redstone Scientific Information Center (RSIC), located five miles from campus. RSIC 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. UAH subscribes to numerous full-text and bibliographical data bases each of which supports specific colleges, including Liberal Arts, Nursing, Administrative Science, Engineering, and Science.

The Library is privileged to provide access to many major online resources including the entire Elsevier online collection of over 1845 journal titles through Science Direct as well as the IEEE collection. Many materials from the Library are available without charge to UAH faculty members and graduate students by request through the Salmon Library. Reciprocal borrowing agreements are also in force with over 100 academic libraries and particularly with the Network of Alabama Academic Libraries (NAAL). Also, the Library has a contract with the University of Illinois and its 10 million books and 100,000 serial titles. 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 the Online Computer Library Center (OCLC) and the Network of Alabama Academic Libraries (NAAL) facilitates rapid document delivery/interlibrary loan service to faculty and students without charge.

Reference services are provided both through electronic reference and onsite supported by subject specialist librarians, who are available to assist students in finding information in person, by e-mail, phone or through the Library’s virtual reference service. Group Library instruction sessions are provided to teach students how to locate, manage, and evaluate the information they need for class projects and papers. Other Library services include group study rooms, computers for writing papers, a scanner workstation, a digital audio/video room, and support for distance education and special computer accommodations for users with disabilities. A new and user-friendly printing system is also available in the Library InfoArcade and labs.

For additional information, inquire at the Circulation Desk, (256)824-6530, the Reference Desk, (256)824-6529 or Interlibrary Loan, (256)824-6124. Library home page: http://www.uah.edu/library
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, Math lab, 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
The Counseling Center at UAH provides specialized professional services designed to assist students in their academic, personal, and social development. Many students encounter personal difficulties that affect the course of their collegiate experience. The Counseling Center provides short-term therapy to help students cope with stress and/or learn new skills.

Counseling services are free of charge to all currently enrolled UAH students. Our staff has a commitment to meeting the needs of individuals from diverse backgrounds. Services are confidential and in accordance with the ethical guidelines of the American Psychological Association. Information about counseling sessions does not go on a student's academic record and is not released to any other individuals (on campus or off) without the student's written permission—except in rare situations as mandated by law.

Students come in for a variety of concerns such as relationships, self-esteem, time management, test anxiety, family concerns, depression, sleeping problems and stress management. See our webpage at www.uah.edu/counseling/ for more information.

To schedule an appointment, contact the Counseling Center at 824-6203 or come by Room 113 in the University Center.
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 (OMA), 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 oma@.uah.edu.

Wellness Center (Student Health Services)
Currently enrolled UAH students with valid ID's may be seen for many of their health care needs by appointment at the Wellness Center located in the University Center, Room 203. Office visits are charged a base fee, currently $5.00. However, other services will be billed to the student at a modest charge. The Wellness Center is open Monday through Friday 8:15 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 and knowledge 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 Student Information
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 wishes job search assistance may register with the office by submitting a copy of their resume and filling out a 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/Job Fairs, 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 students who apply for University housing are assigned to the Central Campus Residence Hall (CCRH) which opened in the fall of 1991. Second-year residents may apply to our newest residence halls, North Campus Residence Halls Phase I and Phase II (NCRH Ph. I & Ph. II). Residents who are of at least junior status or 21 years of age may apply to Southeast Campus Housing (SECH).

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 Ph. I & Ph. II 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. NCRH Ph. II also contains 33 studio (one-bedroom) apartments. Access to the buildings is by electronic card access. Laundry facilities, a recreation room, a student room and mail service are available. NCRH Ph. I and CCRH also contain 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 mailbox, 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 Ph. I & Ph. II has a full time, live-in 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 RA's. RA's 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 housing lease (either academic year August-May or 12 month depending on location); 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 \textit{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.

\textbf{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.

\textbf{Lounges}

A well lit, spacious lounge, designed as a place to relax and meet friends, is equipped with comfortable furniture.

\textbf{Game Room}

Located in the lower level of the Center, the game room has pool tables and ping-pong tables. Two TV lounges, with cable TV, are located in the game room.

\textbf{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.

\textbf{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.

\textbf{University Food Service}

Through the delivery of an exceptional food program, the UAH community is provided with options, quality, and convenience.

The Charger Café is an “All You Can Eat” dining area. The menu program is known as Ultimate Dining and features rotating formats of food presentation: Classics, Pizzarette, The Grille, Performance Station, Soup ‘n Salad, Sub ‘n Sandwich, Vegetarian Selections, Desserts and Beverages. A spacious dining room with an adjacent patio is available for all guests.

Mom’s features two popular dining concepts - Freshens and Jazzman’s Café. Freshens is the largest custom-blended smoothie retailer in the country and one of the most popular smoothie and frozen yogurt and treats concepts in the United States. A perfect location for a healthy snack or meal. Jazzman’s Café provides a coffee shop menu and atmosphere; great for early morning meetings, quick lunches, or afternoon coffee breaks. Freshly brewed gourmet coffees, teas, fresh-baked gourmet muffins and cookies, salads and sandwiches provide a variety of choices for all to enjoy.

Catering is also offered in the University Center as well as other areas of campus. The hours of operation are posted near the entrance of each dining area.
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 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 “Singled 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 maintains 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.

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

All students and members of the faculty and staff are eligible to participate in intramural activities. The sports offered include basketball, 3-on-3 basketball, flag football, floor hockey, racquetball, indoor soccer, 6 pack soccer, softball, volleyball, sandpit volleyball, dodgeball, ping pong, badminton, disc golf and 2 man golf tournament.

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.
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 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

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Each additional hour over 12: $212 (resident), $438 (non-resident)

### Undergraduate

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<tr>
<td>20</td>
<td>2829</td>
<td>5998</td>
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</table>

Each additional hour over 20: $97 (resident), $211 (non-resident)

**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 $21 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**

<table>
<thead>
<tr>
<th>Service</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Credit by examination or validation, per semester hour</td>
<td>$10</td>
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<tr>
<td>Replacement of I.D. card</td>
<td>$20</td>
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<tr>
<td>Transcript</td>
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<td>Graduation Application fee (non refundable)</td>
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<td>Duplicate Diploma</td>
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<td>Thesis and Dissertation binding</td>
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<td>Ph.D. dissertation</td>
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<td>UMI Thesis/Dissertation publication fee</td>
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<td>Master’s thesis</td>
<td>$45</td>
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<tr>
<td>Ph.D. dissertation</td>
<td>$55</td>
</tr>
</tbody>
</table>

Financial Information 24
Optional thesis/dissertation copyright fee $45
Vehicle registration (Regulations concerning traffic and parking are available at the Campus Safety Office) $15

Optional Student Health Insurance * - single coverage (family coverage available at additional cost) *mandatory for non-US citizens $275/sem

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.

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. Students who have provisional admission status or are non-degree students are not eligible for federal financial aid.

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.
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, national origin age, disability, citizenship, or veteran status. 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 covered veterans. It is committed to making sustained, diligent efforts to identify and consider such individuals for employment and for opportunities arising during employment.

UAH is also committed to equal educational opportunity for all qualified students and does not discriminate in its educational policies, practices, programs, or activities on the basis of race, color, religion, sex, age, or national origin, 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 ensure 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  
Student Equal Educational Opportunity Officer  
114 University Center  
The University of Alabama in Huntsville  
Huntsville, AL 35899 (256-824-6700)

Dr. Fran Johnson  
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), major field of study, participation in officially recognized activities and sports, dates of attendance, degrees and awards 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 completing a form provided for this purpose in the Office of Student Records.

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, 600 Independence 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 Advanced Degree" or "Application for Graduate Certificate," as appropriate, through Charger Central 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") 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 term in which they receive supervision or during which they are engaged in the formal preparation of the thesis/dissertation. 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, times, procedures and eligibility conditions for registration are published in the Schedule of Classes, which is available in Charger Central, the Academic Advising offices, and on the UAH website. After the published deadline, registration requires approval from the Office of the Provost. A student must submit a written petition with appropriate documentation to substantiate extenuating circumstances to the Office of the Provost. The petition must include signatures from the instructor, the chair of the department that offers the course, the dean of the college in which the student is enrolled, and the Dean of Graduate Studies. All financial obligations to the University must be cleared before a student may register for courses. Students should consult with their academic advisor prior to registration. Non-degree students have a lower registration priority.

Concurrent registration for multiple sections of a course is not allowed.

A student who schedules courses during registration makes a financial commitment to the University. Course adjustments, drops and withdrawals must be officially transacted in writing on a Registration/Schedule Adjustment form and recorded by the Office of Student Records by the published deadlines. Adjustments in fees, if any, will be made by the Office of the Bursar. The University assumes no responsibility for students who attend classes without proper registration.

Schedule Adjustments
Through the fifth day of classes, a student may add a course by registering on the web at www.uah.edu, meeting with their advisor, or submitting a Registration/Schedule Adjustment form to Charger Central. Students should consult with their academic advisor and other university officials as indicated on the Registration Form for advice and approval before making any schedule changes.
To add a class after the published deadline requires a written petition to the Office of the Provost with appropriate documentation to substantiate extenuating circumstances. The petition must include signatures from the instructor, the chair of the department that offers the course, the dean of the college in which the student is enrolled, and the Dean of Graduate Studies. A request to change a section after the deadline must be approved by the instructor of the new section, the chair of the department that offers the course, and the dean of the college in which the student is enrolled.

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.

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

<table>
<thead>
<tr>
<th>Range</th>
<th>Year Student Normally Takes Courses</th>
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</thead>
<tbody>
<tr>
<td>001-099</td>
<td>Refresher (noncredit)</td>
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<tr>
<td>100-199</td>
<td>Freshman</td>
</tr>
<tr>
<td>200-299</td>
<td>Sophomore</td>
</tr>
<tr>
<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>
</tbody>
</table>

600-799: Graduate (postgraduate and senior undergraduate students with authorization - see “Seniors Taking Graduate Courses” on page 49).
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
When it is believed that a grading error may have occurred, 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 normally be changed only by submission by the instructor on 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 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 upon the written request (on a form available in the Office of Student Records) of the student involved and payment of a transcript fee. Faxed transcripts are available for a fee, but are not considered official documents. Transcripts may be issued to individual students; however, they will be marked as 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 by executing a withdrawal on our website, meeting with their advisor, or submitting a Registration/Schedule Adjustment form to Charger Central. After the tenth week, a student may withdraw from a course only under extenuating circumstances with appropriate documentation and approval of the graduate dean. After the tenth week, 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.

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 courses may be repeated with the previous grade 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: Debra M. Moriarity, B.S., Ph.D., Professor of Biological Sciences

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.

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 Degrees

College of Administrative Science
Accounting
M.Acc.
Management of Technology M.S.M.
Areas of Specialization:
Human Resource Management
Marketing
Management Information Systems (MIS)
Management Information Systems (MIS) M.S.M.I.S.

College of Engineering

Engineering - General

Options: M.S.E.

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

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 M.A.

Areas of Specialization:
- American Literature
- English Literature
- Reading Specialist
- Teaching of English to Speakers of Other Languages
- Technical Writing

History M.A.

Areas of Specialization:
- American History
- European History

Psychology M.A.

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

Public Affairs M.A.

College of Nursing M.S.N.

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

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

Biological Sciences  M.S.
Areas of Specialization
- Bioinformatics and Genomics
- Cell and Developmental Biology
- Environmental Biology
- Genetics and Molecular Biology
- Microbiology
- Physiology
- Plant Biotechnology
- Plant Pathology

Chemistry  M.S.
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  M.S.
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  M.A., M.S.
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 M.S.
Areas of Specialization:
Astrophysics
Materials
Optics
Quantum Electronics
Solar Physics
Space Science

Doctoral Level Programs Degrees

College of Engineering

Civil Engineering (joint with UAB) Ph.D.
Areas of Specialization:
Environmental Engineering
Experimental Mechanics
Geotechnical Engineering
Hazardous Waste Management
Hydraulic Engineering
Intelligent Transportation Systems
Natural Hazard Mitigation
Structural Dynamics
Structural Engineering
Water Resources Engineering
Water Quality Control

Computer Engineering (shared with UAB) Ph.D.
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 +* Ph.D.
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 Ph.D.
Areas of Specialization:
Engineering Management
Manufacturing Systems Engineering
Operations Research
Quality Assurance Engineering
Systems Engineering
Systems Simulation

39 Graduate Studies
**Mechanical Engineering**  Ph.D.

*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**  Ph.D.

*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

**Atmospheric Science**  Ph.D.

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

**Computer Science**  Ph.D.

*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**  Ph.D.

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

**Interdisciplinary Programs Degrees**

**Biotechnology Science & Engineering**  Ph.D.

*Areas of Specialization*
- Biomolecular Sciences
- Bioprocess Engineering
- Plant Biotechnology and Functional Genomics
- Structural Biology

Graduate Studies
Materials Science  M.S., Ph.D.
Areas of Specialization:
- Biomaterials
- Electronic, Optical and Magnetic Materials
- Macromolecular Materials
- Materials Processing
- Materials Structure and Properties
- Mechanical Behavior of Materials

Optical Science & Engineering  Ph.D.
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 recommendation for 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:

Certificate
- Environmental Science
- Family Nurse Practitioner (post masters)
- Information Assurance
- Nursing Education
- Software Engineering

Department
- Atmospheric Science, Biological Sciences
- Nursing
- Management Information Systems
- Nursing
- Computer Science,
- Electrical and Computer Engineering
- English

Teaching of English to Speakers of Other Languages
Technical Communication

English
The application procedure for admission to a certificate program is the same as that for a degree program. In certain cases, these certificates may be pursued concurrently with an advanced degree. Successful completion of the requirements of a graduate certificate program leads to the award of a certificate.

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 Charger Central at least 3 months before the end of the semester in which requirements are expected to be complete.

Cooperative Education Program
Ms. Suzanne Norris, Director
117 Engineering Building
Huntsville, AL 35899
(256) 824-6741
Email: coop@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. Work experiences are related to the student’s major, progressive in responsibilities, monitored by the University, and related to the students’ academic and career goals. Students accepted for Graduate Co-op assignments normally rotate semesters of full-time study with semesters of full-time work. On school terms, graduate students typically take six to nine credit hours. Some students may complete continuous part-time work assignments concurrently with a reduced class load.

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. A distinct feature of the UAH Co-op Program is the ability to complete work assignments in the Huntsville area, although opportunities exist in other locales. Co-op students earn sufficient money to pay a substantial portion of their university expenses.

To be considered as candidates for Graduate Co-op positions, students must meet several criteria, including the following:

- Admission to the School of Graduate Studies as a degree candidate
- A minimum of a 3.0 grade point average on all graduate course work
- Formal application to the UAH Co-op Office
- Program of Study on file with the School of Graduate Studies
- International students on the F1 Visa must provide appropriate documentation of in-status classification

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

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 Charger Central 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/main/gradStudies/

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/main/catalogs/. Campus tours on an individual or group basis are available by contacting the UAH Office of Admissions at 256-824-7142. 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 for a master's, doctoral or certificate program must 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 has a record of consistent professional and/or academic achievement as documented on a submitted resume.

An applicant for an additional graduate program (including a different degree in the same discipline or a certificate) 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 with fee.

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 (raw score + 2) x 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 470 on the Graduate Management Admissions Test (GMAT).
2. Have a minimum index score of 1040, determined by taking the undergraduate GPA x 200 + GMAT score + (10 x years of professional work experience up to 2 years) ≥ 1040. The foregoing are minimum requirements. Applicants meeting the requirements are not guaranteed admission to the MSM program. In making the admission decision the College Admissions Committee also considers the applicant’s baccalaureate program of study, verbal skills, and quantitative skills.

**Conditional Admission**

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

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.

**All programs except those in the College of Administrative Science**

In exceptional cases, an applicant may be admitted on a conditional basis if their scholastic record does not fully meet the requirements for unconditional admission. For specific information on conditional admission for the College of Administrative Science, see their section of the catalog.

**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 1) 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) prior to registering for classes, and
complete any required course work in English as a Second Language (ESL) as early as possible in their studies. 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 recommendation, 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 Graduate Studies.
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. Fewer than 13 hours remaining for degree completion;
4. A total course load of no more than 12 hours a semester;
5. Permission of the instructor.

Students initiate the request process by filling out the Request for Approval of Graduate Credit by UAH Senior, (Form 16), which is available in Charger Central, Room 118, University Center and 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 less than a one-half time appointment 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 from 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 selects 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.

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 departmental offices or http://www.gdeanoff.uah.edu/deanmessage.html.

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. A majority of 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).
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 and may not register for classes without approval from the graduate dean.
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.
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.

Academic Dismissal
The School of Graduate Studies reserves the right to dismiss students who, after due consideration by relevant authorities in the student’s department/program and college(s), are judged not to be making satisfactory progress toward a degree. The Graduate Dean may identify such cases and present them to the Graduate Council, who will recommend to the Graduate Dean whether or not the student should be dismissed. If the Graduate Council does recommend dismissal of the student, then the Graduate Dean will consult with the pertinent college dean(s), department chair (or program director) and, if applicable, supervisory committee. After due deliberation, and with the concurrence of the college dean, the Graduate Dean may dismiss the student from the School of Graduate Studies.

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, in order to assure that courses taken will apply to the degree.

Thesis
Degree requirements under this plan include completion of at least 24 semester hours of graduate coursework and at least 6 credit hours toward the writing of an acceptable thesis. Students working on a thesis must register for thesis credit each term in which they receive supervision or during which they are engaged in the formal preparation or defense of the 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. A final copy of the thesis will be submitted by the Office of Graduate Studies for microfilming to University Microfilms International (UMI).

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. A majority of the committee must be 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. If the committee chair is different from the advisor, the advisor must also be a full member of 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. Detailed procedures for submission of theses can be found at http://www.gdeanoff.uah.edu/.

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. Individual colleges or departments may have specific or additional requirements. 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. A student wishing to transfer credit for any course taken after his/her initial enrollment in UAH coursework must obtain prior approval to do so through a petition sent through the advisor to the School of Graduate Studies. All transferred credit may not be more than ten 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.

**Time Limit**
All requirements for the master's degree are expected to be completed within six years. Credit for individual graduate courses completed 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 cannot be validated.

Up to six hours of transfer courses that are more than six but less than ten years old may be validated by a committee of at least three members of the graduate faculty appointed by the department or program chair, with the results reported to the graduate dean.

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 and fee through Charger Central, UC 118 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 Graduate Studies
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 complete, 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 complete. It is available in Charger Central.

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 complete, 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.

Thesis submission
After the student has passed his/her thesis defense and at least six weeks before the end of the semester in which degree requirements are expected to be complete, a final draft of the thesis with supervisory committee, department/program chair, and college dean signatures must be submitted to the School of Graduate Studies, with personal contact information by the published deadline. After editing by the proofreader, the student will be contacted to make final corrections in the thesis. The final corrected document must then be submitted to the graduate dean for approval. Six copies of the final approved thesis must be submitted in the Office of Graduate Studies along with applicable forms and fees. 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. Detailed procedures for submission can be obtained at http://www.gdeanoff.uah.edu/ or by calling 256-824-6002.
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 satisfactorily complete 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 and approval of the graduate dean.

Continuous Registration Requirement
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.

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.

A student wishing to transfer credit for any course taken after his/her initial enrollment in UAH coursework must obtain prior approval to do so through a petition sent through the advisor to the School of Graduate Studies."

A majority 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)

Academic 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.

Graduate Studies 52
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. If the committee chair is different from the advisor, the advisor must also be a full member of 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.

Application for Degree
All candidates for a Ph.D. degree must apply for the degree by submitting the appropriate form and fee through Charger Central, UC 118, at least three months before the end of the semester in which degree requirements are expected to be complete.

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 complete.

A copy of the dissertation, approved by the Office of Graduate Studies for microfilming to University Microfilms International (UMI). 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 complete, 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 complete. (Available from Charger Central, UC 118.)

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 complete. A graduate faculty observer will be appointed to participate in this examination.

Dissertation submission
After the student has passed his/her dissertation defense and at least six weeks before the end of the semester in which degree requirements are expected to be complete, a final draft of the dissertation with supervisory committee, department/program chair, and college dean signatures must be submitted to the School of Graduate Studies, with personal contact information by the published deadline. After editing by the proofreader, the student will be contacted to make final corrections in the dissertation. The final corrected document must then be submitted to the graduate dean for approval. Six copies of the final approved dissertation must be submitted in the Office of Graduate Studies along with applicable forms and fees. Dissertations must comply with the regulations set forth in the Graduate School's
Interdisciplinary Programs

The University of Alabama in Huntsville has formalized areas of study which cross the traditional departments. These interdisciplinary areas of study encompass science and engineering, and the centers where organized research exists. The formalized programs are 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 Coordinator: Joseph D. Ng, Associate Professor (BYS)

Materials Science Building, Rm. 221
(256) 824-3715
Email: ngj@email.uah.edu
Homepage: http://www.biotech.uah.edu
Program Office: Materials Science Building, Room 206A
(256) 824-3192

Professors:
- Baird, J.K. (CH); protein crystal growth, fundamental mechanisms
- Bishop, A. (BYS); Neural and Physiology
- Campbell, P.S. (Emeritus) (BYS); reproductive physiology, sex steroid hormone action, endocrine disrupters
- Cerro, R.L. (CHE); bioprocessing, theoretical and experimental fluid mechanics, nanotechnology
- Chittur, K.K. (CHE); 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
- 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
- George, M. (CH); scanning probe microscopy
- Ng, J.D. (BYS); macromolecular crystallization, structure/function of extremophilic proteins
- Scholz, C. (CH); biodegradable polymers

Assistant Professors:
- Boyd, L. (BYS); gene function and expression, embryogenesis
- Chen, L. (CH; Research); protein crystallography, structural genomics, structure-based drug design
- Cisake, E. (CH; Research); protein crystallography
- Cseke, L. (BYS; Research); plant molecular biology, biotechnology, metabolic engineering
- Davis, M.R. (BYS); plant genomics
- Magnuson, R.D. (BYS); plasmid host interactions
- Paddison, S. (CH); computational materials chemistry
- Taconi, K. (CHE); Bioprocessing for fuel and specialty chemical production
- Vogler, B. (CH); drug discovery and structure elucidation
Adjunct Faculty
More than 10 scientists from NASA's Marshall Space Flight Center (Space Science Laboratory) and local biotechnology companies in Huntsville serve as adjunct faculty to the program and have expertise in at least one of the thrust areas of Biotechnology Science and Engineering.

Mission
The Biotechnology Science and Engineering Graduate Program (BSE) is an interdisciplinary program of the University of Alabama in Huntsville concerned with research and scholarly activity in the diverse areas of biotechnology. The program's mission is to provide Ph.D. level graduates who are broadly trained in the areas of science and engineering pertinent to biotechnology and who will benefit the economic, educational, and cultural development of Alabama. Graduates of the program are expected to be able to make significant contributions to biotechnology in academic, governmental, and business settings.

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
Applicants may be unconditionally admitted to the program if they have:
- A bachelor's degree in science or engineering from an approved college or university;
- 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;
- 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);
- 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: Biochemistry I
   - CH 562/BYS 548: 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 or NSF 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 (ARA). 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/BYS 547 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.

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

BYS 519 Gene Structure and Function 3 hrs.
Advanced studies of replication, transcription, and translation involved in the passage of genetic information and expression, with specific emphasis on RNA processing, editing, and structure. Macromolecular topology corresponding to biological function.

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 300, 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.

Interdisciplinary Programs
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 Coordinator 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, 300, 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; 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 2 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 3 hrs.  
Prerequisites: CH 661 and approval of instructor.

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 Interface 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 credit to be arranged.
CHE 747 Advanced Topics in Bioengineering
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 Materials Science Coordinator: James K. Baird (CH)
Telephone: (256) 824-2416
Email: chemch@uah.edu
URL: http://matsci.uah.edu/

Professors:
Baird, J.K. (CH); crystal growth, critical phenomena in solution
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. (CH); crystal growth in low gravity, space processing
Setzer, W.N. (CH); biomedical 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
George, M. (CH); sensors, thin film coatings
Gregory, D.A. (PH); optical processing
Kaukler, W.F. (CH; Research); solidification and interfacial energies, x-ray microscopy
Scholz, C. (CH); biosurfaces, biomaterials, polymers
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
Ciszak, E. M. (CH; Research); biomaterials and radiation effects
Ng, J. (BYS); molecular structure
Paddison, S. J (CH); computational chemistry applied to fuel cell materials
Sanghadasa, M (PH); non-linear optical materials, polymer physics
Twigg, P.D. (CH; Research); Protein characterization
Vogler, B. (CH); NMR
Waddell, E. A. (CH); laser ablation of solids
Ward, B. H. (CH); electromagnetic properties of inorganic and organic solids
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.

Interdisciplinary Programs
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, Perkin-Elmer high pressure liquid chromatograph, gas chromatographs and various CW and pulsed lasers. The university has a DEC AXP 7000 computer and has access to a Cray-XMP supercomputer at the Alabama Supercomputer Center located in Huntsville. The 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. Elementary 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.

61 Interdisciplinary Programs
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 and thesis supervisor, a supervisory committee will be appointed. This committee should consist of three members of the materials science faculty including the thesis supervisor as chair. A student must complete a written thesis and successfully defend it by an oral presentation before the supervisory committee.

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 one of the three 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 the existence of a separate Materials Science Department on any campus of the system. Instead, faculty members from the various departments on each campus constitute the Materials Science faculty. Participating 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.

The program is governed by a Tricampus Coordinating Committee consisting of faculty members representing each of the three campuses. The UAH faculty contingent is led by the UAH Materials Science Coordinator. Students successfully completing the program will receive a Ph.D. diploma issued jointly by all three universities. Although both science and engineering faculty participate, the curriculum stresses the science of materials, placing special emphasis on materials processing, the production of new materials, and on the application of materials to the needs of technology.

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.

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

Interdisciplinary Programs
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;
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 Materials Science Coordinator 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 three-part written examination covering the program’s core material and qualifies the student to begin research. The three parts are:

1. Structure and Properties of Materials
2. Characterization and Testing
3. Thermodynamics and Processing

The examination is administered by the Tricampus Coordinating Committee and is offered simultaneously on all three campuses on pre-announced dates. Students must pass all parts of the examination according to a schedule which is available from the Materials Science Coordinator.

After Program Examination I has been successfully completed, the student ordinarily chooses a faculty member to supervise the research for the dissertation. The supervisor chairs a dissertation supervisory committee consisting of no fewer than four additional members. The committee members will be selected based on the student’s academic interest and area 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 a UAH materials science faculty member from a department other than that of the dissertation supervisor. The dissertation committee is charged with supervision and approval of the student’s research and progress toward the completion of all requirements leading to the awarding of the degree.

Program Examination II is a comprehensive examination covering the subject of the student’s proposed dissertation and consists of two parts. In part one, the student answers written questions submitted by the members of the supervisory committee. In part two, the student describes the plan of his dissertation in an oral presentation before the members of the committee.

Program Examination III is administered by the supervisory committee and consists of an oral presentation and defense of the results of the dissertation. Grading of student performance in Program Examinations II and III is the responsibility of dissertation 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 student and the dissertation supervisor select courses appropriate to the student’s dissertation area and complete a Program of Study. Frequently included in the Program of Study are the five core courses listed under the requirements for the Materials Science M.S. degree that is described above. The Materials Science Ph.D. Program otherwise has no further specific course requirements. Students take courses to prepare for the Program Examination I or to complete their Program of Study as approved by their dissertation 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. 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 Examination I is to be taken at the first September offering immediately after the student enters the program. The Program Examination I 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 Examination II is to be attempted within a reasonable time after the Program Examination I. 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 Materials Science Coordinator, 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 having already communicated with a dissertation supervisor will initially be assisted in program planning and other academic matters by a temporary faculty advisor appointed by the Materials Science Coordinator. Also, 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 associated with the assistantship will 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.

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).

Interdisciplinary Programs
501 Structure, Composition and Properties of Materials I 3 hrs.
How structure and composition determine a material’s mechanical properties and performance. Topics covered include bonding and crystal structure, disorder, defects, phase diagrams, phase transitions, diffusion and other kinetic processes, deformation, fracture mechanics, strengthening processes as applied to metals, ceramics, semiconductors, polymers and composites. Prerequisite: CH 341 or permission of instructor.

502 Structure, Composition and Properties of Materials II 3 hrs.
How reactive, electronic, magnetic, thermal, and optical properties of metals, ceramics, semiconductors, and polymers are influenced by their structure and composition. Topics considered include corrosion, oxidation, degradation process, band structure, electrical and optical dielectric constants, magnetic susceptibility, electrical and thermal conductivity and superconductivity. Prerequisites: CH 343, MTS 501.

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 238.

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.)

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, 238. (Same as PH 451, PH 551, OSE 555, CH 553.) 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.) 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 MA 238, MA 244. (Same as PH 560.) 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: MTS
660 or PH 560. (Same as PH 561.) 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.

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
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
Kulick, J.H. (ECE); computer-generated holography, medical image processing
Lindquist, Robert (ECE), optoelectronics, optical devices, nanotechnology
Madarasz, F.L. (OSE); solid state optics, non-linear optics
Nordin, G.P. (ECE); diffractive optics, holography, physical optics, optoelectronics
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
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:
Geary, J.M. (CAO); optical testing and metrology, lens design
Stahl, H.P. (MSFC); optical testing, optical metrology
Smith, S. (MSFC); optical fabrication; optical testing
Wells, Mark (CAO); optomechanical design and fabrication
In addition, there are a dozen other adjunct faculty from UAH, UA, UAB, Alabama A&M, NASA Marshall Space Flight Center, and local industry.

Mission
The mission of the Optical Science and Engineering program is to develop and maintain a world class graduate education and research program in the rapidly advancing and expanding fields of optical science and engineering, to provide our students with exciting opportunities to learn and to do forefront research, and to prepare these students for productive and fulfilling careers.

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 satisfy the Seminar requirements of their home departments, as required, 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 believes 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**
3 hrs.
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**
3 hrs.

**653 Optical Testing Laboratory**
1 hr.
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**
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 Interdisciplinary Programs
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-Khinchine 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 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
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
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
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
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
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.

792 OSE Seminar no credit
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
- Master of Science in Management Information Systems

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 and Eminent Scholar: Gupta, J.; supply chain management, e-business, IS strategy, management science
Associate Professors:
- Bryson, R.E., Jr.; financial accounting
- Mok, W.Y.; workflow design, database management
- Patnayakuni, R.; information systems, supply chain management
- Pendley, J.; accounting information systems, internal auditing
- Ruppel, C.; information systems, e-commerce, ERP
Assistant Professors:
- Allport, C.; financial accounting, taxation
- Boyle, R.; telecommunications, IT security
- Hartono, E.; decision support systems, systems analysis & design
- Li, X.; supply chain effectiveness, data base management
- Maddocks, P.M.; auditing, accounting information systems
- Rai, A.; financial & managerial 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.P.; 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

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

Management and Marketing
355 Administrative Science Building
Mission
The College of Administrative Science serves business and society through the expertise of our alumni, students, and faculty. The College provides academically rigorous programs emphasizing the application of theory and skills in scientific, technological, and traditional business environments. The faculty develops and disseminates knowledge of business theories and practices.

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 organization consisting of more than 900 educational organizations and corporations. Its mission is excellence in business administration and management education in colleges and universities. 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.

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 the Huntsville metropolitan area’s economy by helping managers define and realize growth opportunities and solve specific problems. It serves organizations through consultative assistance, training programs, and applied research in business, economic, and public policy including disseminating economic information.

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 engineering, science, 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, science, business,
liberal arts, education, 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) are required for the applicant whose native
language is not English.

College of Administrative Science
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:

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<th>Preferred date for all materials</th>
<th>The latest date for all materials</th>
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<tbody>
<tr>
<td>Fall semester</td>
<td>June 1</td>
<td>August 10</td>
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<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>
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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 by a committee of graduate faculty when the applicant presents a score of at least 470 on the GMAT exam and a score of at least 1040 on the following index: (Undergraduate GPA x 200) + GMAT score + (10 x years of professional work experience up to 2 years) ≥ 1040. The foregoing are minimum requirements. Applicants meeting the requirements are not guaranteed admission to the MSM program. In making the admission decision the College Admissions Committee also considers the applicant’s baccalaureate program of study, verbal skills, and quantitative skills.

2. Conditional Admission

In exceptional cases, an applicant may be admitted on a conditional basis if their scholastic record does not fully meet the requirements for unconditional admission. However, such cases require the deviation from the unconditional admission standard in the GMAT score and the index score to be minimal. Conditional admission requires the recommendation of the College committee of graduate faculty with the approval of the Graduate Dean. Conditionally admitted students 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. Course work must be completed with a minimum grade of B. Students who are admitted conditionally and fail to obtain an overall grade point average of B (3.00) 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, NY 10113-0745. 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.

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
FIN 601 Financial Decisions Under Uncertainty
ECN 600 Foundations of Economics
MGT 600 Organizational Theory, Behavior & Environment
MKT 600 Survey of Marketing Management
MSC 600 Operations Management

3 hrs.
3 hrs.
3 hrs.
3 hrs.
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

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
ECN 626 Managerial Economics & Technology
MGT 601 Introduction to Technology Development
MGT 622 Management of Technical Professionals or MGT 631 Strategic Human Resource Management in Technological Environment
MGT 698 Strategic Management
MIS 634 Management of Information Technology
MKT 604 New Product Development
MKT 606 Marketing in a High Technology Environment

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 two graduate level MIS electives.
The area of specialization in Human Resource Management includes MGT 622, 631, and one of the following: MGT 560, 561, 562.
The area of specialization in Marketing includes MKT 604, MKT 606 and two graduate level Marketing electives.

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 achieved 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.

Master of Accountancy
Purpose
The purpose of the MAcc 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 MAcc degree in one additional year of full-time course work beyond the bachelor's level. Individuals interested in the MAcc program should contact the MAcc Program Advisor in Room 102 of the Administrative Science Building, or call (256) 824-6024.

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

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

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

Program Prerequisites
Program prerequisites may be satisfied by either of the following: (a) Possession of a Bachelor's degree in accounting from an AACSB accredited institution, or (b) Possession of a Bachelor's degree and satisfactory (i.e., "C" or higher) completion of the following list of basic skills, business core, and accounting courses.

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 MAcc 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, must be taken at UAH, and must be completed with a grade of A or B. A maximum of 12 semester hours of graduate work may be transferred from another institution. There are two program tracks in the program.

College of Administrative Science
General Accounting Track

The General Accounting Track is designed to allow students (working with the Graduate Advisor) to tailor a degree program in line with the student's background and career goals. The track consists of four required courses and seven elective courses. A sample program is presented below.

Accounting: 600-level courses (15 hrs):
ACC 614 Cost Management 3 hrs.
ACC 607 Advanced Accounting Information Systems 3 hrs.
ACC 6xx Accounting elective or thesis 3 hrs.
ACC 6xx Accounting elective or thesis 3 hrs.
Non-Accounting: 600-level courses (9 hrs):
MIS 634 Management of Information Technology 3 hrs.
Non-accounting 600-level electives 6 hrs.
Electives at the 500- or 600-level (6-9 hrs):*
Non accounting elective 3 hrs.
Free electives (may be accounting) 3-6 hrs.
Total for program 30-33 hours

*Students planning to sit for the CPA examination in Alabama 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

The ISAC Track 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.

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 (if you plan to sit for the CPA examination), 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:

Accounting: 600-level courses (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 courses (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: at the 500 level (6 semester hours):
MIS 597 Information Systems Design 3 hrs.
MIS 560 Telecommunications and Networking 3 hrs.
Total for program 30-33 hours

College of Administrative Science
Other recommended courses include; ACC 532 Advanced Auditing, BLS 511 Business Law for Accountants, MIS 520 Electronic Commerce, MIS 663 Computer Forensics, and MIS 677 Network Defense and Operating Systems.

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

1. Unconditional Admission
Requirements for unconditional admission are the same as those for the M.S.M. program.

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

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

Program Prerequisites
Program prerequisites include a bachelors 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 generally have completed all 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 the 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 hrs)
- 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 Systems
- MIS 6xx Elective

Non MIS: 600 level (9 hrs.)
- ACC 602 Managerial Accounting
- MSC 600 Operations Management
- FIN 601 Financial Decisions Under Uncertainty

MIS: 500 level (9 hrs.)
- MIS 520 Electronic Commerce*
- MIS 560 Telecommunications and Networking*
- MIS 597 Information Systems Design*

Recommended electives. *M.S.M.I.S. students with undergraduate degrees in MIS must substitute MIS 520, MIS 560, and MIS 597 with elective courses. At least two of three electives must be in MIS.
- ACC 607 Advanced Accounting Information Systems
- ECN 626 Managerial Economics and Technology
- MIS 516 Supply Chain Management & E-Business
- MIS 540 Web Programming and Database Integration
- 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 663 Computer Forensics
- MIS 670 Business Contingency Planning (and disaster recovery)
- MIS 675 Information Resource Management
- MIS 677 Network Defense & Operating Systems
- MIS 699 Master’s Thesis
- MGT 600 Organizational Theory, Behavior, and Environment
- MGT 622 Management of Technical Professionals.
Graduate Certificate in Information Assurance
The graduate certificate in Information Assurance is a network security program that is designed to prepare students to become Information Assurance (IA) professionals. The certificate program includes 17 semester hours. A subset of these courses may be used to satisfy elective requirements within the M.S.M.I.S. program. The required courses for the Information Assurance Certificate include the following:

- MIS 501 Introduction to Information Systems Assurance 2hrs.
- MIS 560 Telecommunications and Networking 3hrs.
- MIS 660 Information Security Management 3hrs.
- MIS 663 Computer Forensics 3hrs.
- MIS 670 Business Contingency Planning 3hrs.
- MIS 677 Network Defense and Operating Systems 3hrs.

Total 17 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 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 Research Assistantships (GRA) in the College are 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 GRAs assist faculty with specific 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/uh.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.

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.
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.

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.

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.

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.

600 Foundations of Accounting for Managers 3 hrs.
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. Prerequisite: MIS 146.

602 Managerial Accounting 3 hrs.
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.

603 Financial Statement Analysis 3 hrs.
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 3 hrs.
In-depth examination of accounting information systems. Emphasis on computer-oriented
systems and current developments in systems. Prerequisite: ACC 307.

614 Cost Management 3 hrs.
A study of alternative approaches to identifying and proactively managing the costs of
providing services and/or manufacturing and distributing products. The focus is on the
development of cost data useful to managers for decision making rather than for financial
reporting. Special attention is given to current issues in cost management. Prerequisites: ACC
602 or ACC 212 and ACC 314.

615 Advanced Financial Accounting 3 hrs.
Analysis of issues and alternatives in advanced problem areas including partnerships,
terscious investments, business combinations, and foreign exchange. Prerequisite:
ACC 311.

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

659 Selected Topics in Accounting 3 hrs.
An in-depth examination of a topic relative to accounting by one student or a group of students.
Prerequisite: ACC 602.
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.

699 Master’s Thesis 3 hrs.
Required each semester a student is working and receiving direction on a master’s thesis. A minimum of two semesters is required but not more than six hours of credit is allowed. Prerequisite: Permission of the Accounting Advisor.

Graduate Courses in Business Legal Studies (BLS)

500 Law, Ethics and Business 3 hrs.
An analytical review of corporate ethics addressed from a legal and business standpoint. Focus on codes of ethics, integration of “integrity” into corporate cultures, top management commitment to ethics, civic involvement, employer-employee relations, consumer protection, and international business.

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.

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.

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. Prerequisites: 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 and permission of the instructor.

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. Prerequisite: FIN 301.

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.

561 Portfolio Management 3 hrs.
Functional application of investment portfolio management with emphasis on theory and models of investment management. Use of models in effective investment decision making is stressed. Prerequisite: FIN 361.

570 Commercial Bank Management 3 hrs.
Financial management of commercial banks with emphasis on asset and liability management and techniques such as hedging and financial engineering to management interest rate risk. Prerequisite: FIN 352.

578 Long-term Capital Management 3 hrs.
Financial theory as it relates to corporate policy, the efficient market hypothesis, capital structure theory, long-term financing and dividend policies. Prerequisite: FIN 301.

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 3 hrs.
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 3 hrs.
Theory and application of both marketing and management strategies for start-up, operation and control of new ventures. The course also discusses the role of entrepreneurship in the economy (same as MKT 505). Prerequisites: MGT 600 and MKT 600.

540 Small Business Counseling 3 hrs.
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 3 hrs.
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.

College of Administrative Science
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.

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.

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, and 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., 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.

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.

629 Leadership: Theory and Practice
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.

631 Strategic Human Resource Management in a Technological Environment
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.

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

650 Selected Research Topics
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
Special topics in the management of technology. Prerequisite: Permission of instructor.

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

699 Master's Thesis
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
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)

500 Decision Support Systems and Expert Systems
Analysis of information system components and technologies which aid the manager in the decision making process. Concepts supported by use of current DSS/ES software. Prerequisites: MIS 301.

501 Introduction to Information Systems Assurance
This course is designed to provide a general overview of the concepts of information security to students, both from a management and a technology perspective. Students will be introduced to the complexity of the security issues facing today's networked organizations. Practices and standards will be presented to assess and plan for risks and the security needs to minimize the risks both technically and managerially. The integration of security concerns within the entire organizational planning and implementation processes and practices will be explored.

516 Supply Chain Management and E-Business
Development and management of effective supply chain especially in the e-business environment including the cutting-edge tools and techniques of supply chain management,
distribution and logistics network analysis, effective inventory control, value of integration of the supply chain components in a global context are emphasized using emerging information technologies. Prerequisites: MIS 301 and MSC 385.

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 520.

560 Telecommunications and Networking
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 501.

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.

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 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.

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** 3 hrs.
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** 3 hrs.
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.

**660 Information Security Management** 3 hrs.
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. Prerequisites: MIS 560 and MIS 501 or MIS 634.

**663 Computer Forensics** 3 hrs.
Examines computer forensics and investigations. It looks at the problems and concerns related to computer investigations. It blends traditional investigation methods with classic systems analysis problem solving technique and applies them to computing investigations. It implements common computer forensic tools in real-life scenarios. Prerequisite: MIS 660.

**670 Business Contingency Planning** 3 hrs.
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 501 or MIS 634.

**675 Information Resource Management** 3 hrs.
Overview of the management of information systems resources of the firm. Prerequisite: MIS 497.

**677 Network Defense and Operating Systems** 3 hrs.
Provides a foundation in network security. The primary emphasis is on intrusion detection. Examines developing a security policy and then implementing that policy. Security issues and practical applications related to Network Address Translation. Packet filtering, proxy servers and firewalls, and Virtual Private Networks will be addressed. This course assumes familiarity with the Internet and basic networking concepts such as TCP/IP, gateways, routers and Ethernet. Prerequisite: MIS 660.

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** 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 of thesis. Prerequisite: Permission of the MS-MIS Advisor.

College of Administrative Science 94
Graduate Courses in Management Science (MSC)

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

570 Special Topics in Management Science 3 hrs.
In depth study of a selected topic relevant to contemporary management science. Different sections of this course may address different topics.

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. Prerequisite: MSC 287.

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)

500 Strategic Issues in Logistics 3 hrs.
The course introduces students to practical logistical challenges and planning issues that are important in reconciling and rationalizing both strategic and tactical programs. Prerequisites: MKT 600 and MGT 600.

505 New Venture Strategies 3 hrs.
Theory and application of both marketing and management strategies for start-up, operation and control of new ventures. The course also discusses the role of entrepreneurship in the economy (same as MGT 505). Prerequisites: MKT 600 and MGT 600.

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.

520 Services Marketing 3 hrs.
The course focuses on the unique challenges of managing services and delivering quality service to customers. The course is equally applicable to organizations whose core product is services (e.g., banks, hospitals, aerospace and defense firms, non-profits organizations) and to organizations that depend on service excellence and services for competitive advantage (high technology firms, industrial firms). Prerequisites: MKT 301.

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.

575 Advanced Marketing Seminar 3 hrs.
Investigation of advanced marketing topics that are relevant to contemporary marketing practices. The course will focus on current issues related to marketing in a high technology
environment, relationship marketing, channel design and strategy, transportation, and logistics. Prerequisite: MKT 600.

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.

590 Special Projects 3 hrs.
Independent study in an area of interest to the student in the field of marketing. Prerequisite: Approval of department chair.

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.

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 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:
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., P.E., Professor of Electrical and Computer Engineering
Associate Dean: Richard M. Wyskida, B.S.E.E., M.S.I.E., Ph.D., P.E., Professor of Industrial and Systems Engineering
Associate Dean: Sherri L. Messimer, B.S.I.E., M.S.I.E., Ph.D., Associate Professor of Industrial and Systems Engineering

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.

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, the Army Aviation and Missile Command, 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 $21 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:

- Adhesion
- Aerospace Engineering
- Applied Mechanics
- Atmospheric Dynamics
- Biomaterials
- Bioseparations
- Combustion
- Communications
- Composite Materials
- Computational Fluid Dynamics
- Computer Architecture
- Control Theory
- Cryogenic Engineering
- Digital Signal Processing
- Electromagnetics
- Electronics
- Energy-Power
- Engineering Management
Environmental Engineering
Geographic Information Systems
Geotechnical Engineering
Heat and Mass Transfer
Human Factors Engineering
Hydrology
Information Assurance
Magnetohydrodynamics
Manufacturing Systems Engineering
Materials Engineering
Network Theory
Operations Research
Optics and Photonics
Optoelectronics
Parallel Processing
Process Dynamics
Propulsion
Quality Engineering
Radar
Reaction Engineering
Rotorcraft Engineering
Software Engineering
Solar Terrestrial Environment
Solid State Electronics
Structural Engineering
Surface Modification
Systems Engineering
Systems Simulation
Thermodynamics
Transportation Systems
Very Large Scale Integrated Circuits

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 ABET, Inc. at the time the degree was conferred. Exceptions to (3) are permissible for 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 an ABET accredited 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) publically 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 department 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 coursework 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.

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. The Industrial and Systems Engineering and Engineering Management (ISEEM) department has 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 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
Burkholder, J. E. (Adjunct); aerodynamics, prediction/modeling, fluid mechanics, propulsion.
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 spirogenesis profiling with microarrays.
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.
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:
Taconi, K.; bioprocesses, utilization of microorganisms for energy and environmental processes. Development of alternative energy sources and biotreatment of wastes.
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.
Schriver, J. (Adjunct); biomolecular NMR.

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.

Mission
The Department of Chemical and Materials Engineering is dedicated to developing and maintaining undergraduate and graduate programs that educate students in the safe control and manipulation of matter in industrially important chemical and materials systems. The faculty will continue to educate students and maintain its programs by providing intellectual leadership, innovative teaching, university and community service, while conducting internationally recognized research. Undergraduate and graduate programs within the department are continuously refined based on national standards and are designed to encourage interdisciplinary education. Research objectives focus on technology important to the further development of the university, the community, the state of Alabama, and the nation.

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, 347. (Same as CHE 441.)
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: CH 123 and 126, MAE 341, and parallel MAE 310/CHE 352. (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 CHE 450, 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 362 and 363. (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 362 and 363, CHE 560. (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 344 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: CH 341 and 440. (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. Prerequisites: CHE 352, and CH 341 or MAE 341.

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

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 CH 646, MTS 646.)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>649</td>
<td>Transport Phenomena</td>
<td>3 hrs.</td>
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<td>Mass, energy, and momentum transport in steady</td>
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<td>and transient motions in real and rheological</td>
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<td></td>
<td>substances. Prerequisite: CHE 442. (Same as MAE</td>
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<td>649.)</td>
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<tr>
<td>650</td>
<td>Principles of Liquid and Solid Interface</td>
<td>3 hrs.</td>
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<td>Applies basic principles in thermodynamics and</td>
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<td>kinetics to characterize surfaces and surface</td>
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<td>phenomena. Fundamental properties of gas-liquid,</td>
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<td>liquid-liquid, solid-liquid, and solid-gas</td>
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<td>interfaces and phenomena occurring at these</td>
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<td>interfaces. Prerequisite: CH 341. (Same as CH</td>
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<td>650 and MTS 650.)</td>
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<tr>
<td>652</td>
<td>Introduction to Air Pollution</td>
<td>3 hrs.</td>
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<td>Technology of air pollution dealing with air</td>
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<td>pollutants, effects, sources, combustion</td>
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<td>processes, and abatement and control technology.</td>
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<td>Engineering contributions to both the problems</td>
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<td>and their solutions. Nature of air pollution</td>
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<td>problem and fundamental technological approaches</td>
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<td>to its solution. Prerequisite: graduate standing.</td>
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<td>(Same as CE 652.)</td>
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<td>654</td>
<td>Multiphase Transport and Particulate Phenomena</td>
<td>3 hrs.</td>
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<td>Fundamental principles of gas-liquid/gas solid</td>
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<td>flows, particle size analysis, particle/droplet</td>
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<td>dispersion, pneumatic transfer, adhesion and</td>
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<td>agglomeration, atomization and spray, jump</td>
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<td>conditions at interface, numerical solutions.</td>
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<td>Prerequisite: CHE/MAE 649.</td>
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<td>657</td>
<td>Advanced Process Control</td>
<td>3 hrs.</td>
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<td>Application of modern control theory to chemical</td>
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<td>processes; multivariable control; estimation and</td>
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<td>adaptive control, optimal control. Prerequisite:</td>
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<td>CHE 445.</td>
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<td>658</td>
<td>Catalysis and Reactor Design</td>
<td>3 hrs.</td>
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<tr>
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<td>Treatment of homogeneous and heterogeneous</td>
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<td>reaction kinetics, transport in fluid-solid</td>
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<td>reactions, catalyst deactivation and their</td>
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<td>effects on the analysis and design of chemical</td>
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<td>reactors. Prerequisite: CHE 541.</td>
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<tr>
<td>659</td>
<td>Selected Topics in Chemical Engineering</td>
<td>Credit to be arranged</td>
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<tr>
<td>699</td>
<td>Master’s Thesis</td>
<td>1-9 hrs.</td>
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<td>Required each semester in which student is</td>
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<td>working and receiving direction on a master’s</td>
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<td>thesis. A minimum of two terms and six hours</td>
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<td>is required for M.S.E. students. A maximum of</td>
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<td>nine hours of credit is awarded upon successful</td>
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<td>completion of master’s thesis.</td>
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<td>747</td>
<td>Advanced Topics in Bioengineering</td>
<td>3 hrs.</td>
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<td>Engineering aspects of microbial processes and</td>
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<td>the processing of biological materials.</td>
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<td>Integrating knowledge of governing biological</td>
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<td>properties and principles with chemical</td>
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<td>engineering methodology. Emphasis on current</td>
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<td>literature in the areas of purification and</td>
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<td>separation technology, bioprocess development</td>
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<td>and biomaterials. Prerequisite: B.S. in chemical</td>
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<td>engineering or permission of instructor.</td>
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<td>749</td>
<td>Mass Transport</td>
<td>3 hrs.</td>
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<td>Mass transfer in solid and fluid systems under</td>
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<td>steady and transient conditions. Integration of</td>
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<td>momentum, heat and mass transfer equations with</td>
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<td>application to reactive, rheological and</td>
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<td>multicomponent systems. Prerequisites: MAE 643</td>
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<td></td>
<td>and 651. (Same as MAE 749.)</td>
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<td>757</td>
<td>Optical Techniques in Fluid Mechanics</td>
<td>3 hrs.</td>
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<td>Laser courses, molecular interactions with light</td>
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<td>and diatomic spectroscopy needed fluorescence,</td>
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<td>Brillouin scattering, four wave mixing, CARS</td>
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<td>and other applications in optical fluid</td>
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<td>diagnostics. Prerequisites: EE 542. (Same as MAE</td>
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<td>757.)</td>
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<tr>
<td>799</td>
<td>Doctoral Dissertation</td>
<td>3 or 6 hrs.</td>
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<td>Required each semester student is enrolled and</td>
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<td>receiving direction on doctoral dissertation.</td>
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CIVIL AND ENVIRONMENTAL ENGINEERING

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

Degrees: Master of Science in Engineering
          Doctor of Philosophy

Chair: James F. Cruise, Professor

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

Associate 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.
  Leonard, K.; environmental engineering, water quality control, groundwater contamination,
  hazardous waste remediation, environmental assessment, hydraulics and modeling, remote
  fiber optic chemical sensing, hydrologic systems.

Assistant Professors:
  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 the Intercampus Interactive Telecommunications System (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.

Mission
The mission of the Department of Civil and Environmental Engineering is to provide a high
quality civil and environmental engineering education that instills in our students the fundamental
knowledge, analytical skills, and practical abilities necessary to prepare them to be leaders in their
profession. Through excellence in teaching, research, and service, the Department promotes
opportunities for the intellectual, personal, and professional growth of our students, faculty, and
alumni, while providing graduates who are prepared to support the diverse needs of Huntsville,
the State of Alabama, the region, our nation, and the international community.
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 Design 3 hrs.
Driver, pedestrian, and vehicle characteristics. Principles of traffic flow for improved highway traffic service and safety. Designs 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 3 hrs.
Design and analysis of erodible and non-erodible channels. Uniform flow, channel roughness, gradually and spatially varied flow, rapidly varied flow, hydraulic jumps, gradually varied unsteady flow, flood routing, flow measurements, channel models, channel and culvert design. Prerequisite: CE 441.

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. Prerequisites: CH 123, 126, MAE 341 and parallel MAE 310/CHE 352. (Same as CE 449 and CHE 449/549.)

550 Environmental Control 3 hrs.
Engineering design and synthesis of environmental control systems. Control of multiphase systems with application to air and water pollution control. Prerequisite: MAE/CHE 442. (Same as CHE 550.)
552 Industrial Waste Treatment 3 hrs.
Advanced topics in the area of hazardous waste management and water quality control. Emphasis on industrial waste, including hazardous waste management. Topics include: generation, storage, collection, transfer, disposal, recycling, economic, environmental, and regulatory considerations. Prerequisite: CE/CHE 549.

553 Environmental Systems Sampling and Analysis 3 hrs.
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 3 hrs.
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 3 hrs.
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 310/CHE 352. (Same as CE 455.)

556 Water Quality Control Processes 3 hrs.
Principles of public water supply design. Source selection, collection, purification, and distribution for municipal use. Collection of waste waters, their treatment, and disposal. Prerequisite: CE/CHE 549. (Same as CE 456.)

557 Hydrology 3 hrs.
Occurrence and movement of water over the earth’s surface for engineering planning and design. Relationship of precipitation to streamflow with frequency analysis, flood routing, and unit hydrograph theory. Prerequisite: MAE 310/CHE 352. (Same as CE 457.)

558 Environmental Engineering Design 3 hrs.
Engineering design and project management of environmental quality/restoration systems. Students will complete a design project focusing on one of the following systems: sanitary landfill, municipal incinerator, or groundwater/site remediation. Lectures will address skills for technical presentations and proposal writing, as well as process design and decision making. Prerequisite or parallel: CE 449. (Same as CE 458.)

559 Selected Topics in Civil Engineering  Credit to be arranged

561 Vibrations of Elastic Systems 3 hrs.
Formulation of the equations of motion of discrete and continuous systems, analytical and numerical methods of solution, eigenvalue problems, and dynamic response. Prerequisite: MAE 488. (Same as CE 461 and MAE 461/561.)

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.

571 Advanced Soil Mechanics 3 hrs.
Continuum mechanics applied to soil behavior. Theoretical approaches to consolidation, shear strength, slope stability and soil stabilization. Prerequisite: CE 372. (Same as CE 471.)

572 Soil Dynamics 3 hrs.
Behavior of soils under dynamic, earthquake and blast loading. Analysis of foundation vibration and isolation. Prerequisite: CE 372. (Same as CE 472.)

573 Earth Structures Engineering 3 hrs.
Principles of earth structure design. Theories of earth pressures and the design of retaining wall systems including gravity, cantilever, mechanically stabilized earth, flexible sheet pile,
anchored wall systems. Methods of stability analyses for retaining walls, earth slopes, and embankment design. Prerequisites: CE 372, CE 373. (Same as CE 473.)

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: CE 370. (Same as CE 474 and MAE 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: CE 370 and junior standing. (Same as CE 477 and MAE 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. Prerequisite: CE 362, 370. (Same as CE 478 and MAE 478/578.)

580 Civil Engineering Materials 2 hrs.
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.)

581 Structural Analysis II 3 hrs.
Reactions, shears, moments and deformations in complex structural systems. Statically indeterminate systems, advanced geometric and energy methods. Prerequisite: CE 381. (Same as CE 481.)

584 Steel Design 3 hrs.
Principles of the design of steel structures using ASD methods. Analysis and design of structural elements including beams, columns, connection details. Prerequisite: CE 381 or consent of instructor. (Same as CE 484.)

585 Foundation Engineering 3 hrs.
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.)

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.)

587 Bridge Design 3 hrs.
Bridge loads, load distribution, composite beam bridges, bridge bearings, reinforced and prestressed concrete slab and T-beam bridges, bridge evaluations and ratings, and upgrade methodology. Prerequisites: CE 483. (Same as CE 487.)

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.
College of Engineering
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's, 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 1 hr.
Professional activities designed to promote the skills required to organize and deliver oral technical presentations and to broaden the individual's awareness of technical issues. 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 3 hrs.
Application-oriented student project designed to show competence in an area of civil engineering.

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

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

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 ECE Programs Director N.F. Audeh, Professor
Assistant Chair: C. Corsetti, Lecturer

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

Professors:
Abushagur, M.A.G. (Adjunct); optical signal processing, computing, metrology
Adhami, R.R.; digital signal processing, biometrics, 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
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
Wells, B. E.; computer architecture, parallel processing, real time systems

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
Joiner, L.L.; error control coding, communication systems
Jovanov, E.; computer architecture, embedded systems, wearable computing, biomedical systems.
Schneider, K. (Adjunct); communications
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
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 optics and photonics
M.S.S.E. software engineering
Ph.D. - computer engineering
Ph.D. - 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 optoelectronics. In addition, the M.S.E. degree is offered in Optics and Photonics, 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.

Mission
The mission of the Electrical and Computer Engineering Department is to develop and maintain high quality undergraduate and graduate programs in electrical, computer, and optical engineering to meet the needs of its constituents, and to participate in scholarly and productive research that contributes to the economic well being and quality of life for the residents of Huntsville, the State of Alabama, and the citizens of the United States of America.

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 his/her 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. 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.

**Foundation 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 foundation 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).

1. **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 II
   5. CS 555: Formal Program

   CPE 619: Modeling and Analysis of Computer and Communication Systems
   MA640: Graph Theory
   MA740: Combinatorial Algorithms
   EE 628: Analytical and Computational Methods in EE I
   CS 603: Formal Languages and
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 (MSSE) 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 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:**
**Thesis Option**
CS650 Software Engineering (3 hours)

One course taken from any two of the three CS areas identified in the non-thesis option (6 hours)
Three additional CPE electives from CPE (9 hours)

Software Engineering Studio I and II (6 hours)

Non-thesis Option

CS Core (12 hours)

CS650 plus one course from each of the following three areas

Area 1: Formal Methods
CS 617 Algorithms
CS 655 Formal Methods

Area 2: Software Engineering and Design
CS 652 Object Oriented Analysis and Design
CS 551 Software Modeling
CS 552 Analysis and Design Patterns

Area 3: Software Applications:
CS 553 Client Server Architecture
CS 658 Software Process and Product Improvement
CS 656 Software Testing

CM601, EE691, EE692 (3 hours)

Software Design Studio I and II (CPE 656, CPE 658), (6 hours)

Four courses selected from (12 hours)
CPE 538 Real Time and Embedded Systems,
CPE 536 Operating System Internals,
CPE 512 Parallel Processing,
CPE 548 Introduction to Networks,
CPE 549 Introduction to Information Assurance Engineering
CPE 628 Testing of Hardware Systems,
CPE 631 Advanced Architecture,
CPE 633 Fault Tolerant Computing,
CPE 645 Computer Network Security
CPE 647 Ubiquitous Computing
CPE 648 Advanced Networks,
CPE 649 Advanced Information Assurance Engineering
CPE 661 Code Optimization,
CPE 726 Algorithms for VLSI Design,
CPE 731 Distributed Shared Memory
CPE 748 Mobile and Wireless Networks

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
The M.S.E. program in optics and photonics 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 specialty.
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. 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 0 hrs.
Students enrolling in CPE 521L must enroll concurrently in CPE 521.

523 Hardware/Software Co-Design 3 hrs.
Study and design of Systems On a Chip (SOC). Emphasis on Field Programmable realizations of SOC systems. Prerequisites: CPE 522 or 526 or permission of instructor. (Same as CPE 423.)
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 bus 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.)

548L Laboratory Component of Introduction to Computer Networks
Students enrolling in CPE 548 must enroll concurrently in CPE 548L. Prerequisite: Parallel CPE 548.
549 Introduction to Information Assurance Engineering 3 hrs.
Introduction to cryptography and computer security through hardware and physical security to a knowledge of audit methods, security management, and public law. The course will introduce security engineering skills such as business process analysis, software security, IAE evaluation, and IAE testing. Prerequisite: CPE 548. (Same as CPE 449.)

549L Laboratory Component of Introduction to Information Assurance Engineering 0 hrs.
Students enrolling in CPE 549 must enroll concurrently in CPE 549L. Prerequisite: Parallel CPE 549.

551 Software Design & Engineering 3 hrs.
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 3 hrs.
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 3 hrs.
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.


621 Advanced Microcomputer Techniques 3 hrs.
Deeply embedded low-power wireless sensors. Low-power microcontroller architectures, sensor platform architecture, wireless intelligent sensors, low power wireless communication standards, battery powered systems, resource constrained operating systems, data aggregation/sensor synergy, and collaborative signal processing. Prerequisite: CPE/EE 421/521 or approval of instructor.

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 EE 625.)

626 Advanced VLSI Design 3 hrs.
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 3 hrs.
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.
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>635</td>
<td>Systolic Array Processing</td>
<td>3 hrs.</td>
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<tr>
<td>645</td>
<td>Computer Network Security</td>
<td>3 hrs.</td>
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<td>647</td>
<td>Ubiquitous Computing</td>
<td>3 hrs.</td>
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<tr>
<td>648</td>
<td>Advanced Computer Networks</td>
<td>3 hrs.</td>
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<td>649</td>
<td>Advanced Information Assurance Engineering</td>
<td>3 hrs.</td>
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<td>649L</td>
<td>Laboratory Component of Advanced Information</td>
<td>0 hrs.</td>
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<td>656</td>
<td>Software Engineering Studio I</td>
<td>3 hrs.</td>
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<td>658</td>
<td>Software Engineering Studio II</td>
<td>3 hrs.</td>
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<tr>
<td>661</td>
<td>Code Optimizations</td>
<td>3 hrs.</td>
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**633 Fault-Tolerant Computing Systems**
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**
Systolic structure of fast algorithms and switchable array realizations. Prerequisite: CPE 512.

**645 Computer Network Security**
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.

**647 Ubiquitous Computing**
The course is based on the new “anytime, anywhere” computing paradigm, also known as ubiquitous computing. This course is project oriented, and explores issues of mobile, wireless, and distributed computing in Internet environment, advanced human-computer interfaces, and power efficient computing. Prerequisite: Approval of instructor.

**648 Advanced Computer Networks**
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.

**649 Advanced Information Assurance Engineering**
Introduction to topics ranging from how to attack computer systems and networks to how to protect and recover from attacks on computer systems and networks. Basic process utilized by computer attackers in order to develop a complete understanding and appreciation of the threat to information assurance. Process of detecting, preventing, and recovering from information assurance attacks. Intrusion Detection and Prevention Systems, Auditing, Security Vulnerability Assessments, and the Incident Response process. Prerequisite: CPE 549

**649L Laboratory Component of Advanced Information Assurance Engineering**
Students enrolling CPE 649 must enroll concurrently in CPE 649L. Prerequisite: Parallel CPE 649

**656 Software Engineering Studio I**
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**
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**
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  
Prerequisite: Graduate Standing.  
Credit to be arranged

695 Project in Computer Engineering  
Prerequisite: Graduate Standing.  
Credit to be arranged

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 9 hours credit is awarded upon successful completion of master’s thesis. 
3 or 6 hrs.

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 in 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.

748 Mobile and Wireless Networks  
High-level issues in mobile and wireless networks. The main topics are mobile IP, Mobile Ad hoc NETworks (MANETs), wireless sensor networks, wireless LAN, Bluetooth, cellular networks, satellite systems, and security issues in mobiles and wireless networks. Prerequisites: CPE 648 or CS 670.  
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  
Required each semester student is enrolled and receiving direction on doctoral dissertation.  
3, 6, or 9 hrs.

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  
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.)  
3 hrs.
503 Communications Systems and Simulation with Laboratory 3 hrs.
Modern test equipment and computer-based simulation methods are used to conduct experiments in the area of communication systems. Hands-on experiments are conducted using digital oscilloscopes, arbitrary waveform generators, vector impedance meters and other relevant test and measurement equipment. Methods are investigated for signal modulation and demodulation; studies are conducted on AM, FM, PSK, PCM and delta modulation circuits and systems. Several types of filters are investigated, both analytically and experimentally. Properties and behavior of phase-locked loop are studied by using both hardware and numerical simulations. Prerequisites/Corequisite: EE 426, (Same as EE 423.)

504 Introduction to Data Communication Networks 3 hrs.
Overview of historic development of modern telephone and data communication system, system architecture, standards, broadband switching systems, modems, protocols, personal and mobile communications, digital modulation techniques. Prerequisite: EE 383. (Same as EE 424.)

505 Introduction to Control and Robotic Systems 3 hrs.
The basic theories and analytical techniques for modeling, analysis and control of dynamical systems. Transfer functions, block-diagrams, frequency response, stability criteria, series and feedback controller design, digital control. Introduction to the dynamic analysis and control of robotic systems. Prerequisite: EE 382 or permission of instructor. (Same as EE 425.)

506 Communication Theory 3 hrs.
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.)

510 Selected Topics in Electrical Engineering Credit to be arranged

512 Advanced Senior Design Project in Electrical Engineering 3 hrs.
Individual design project under the direction of an EE faculty member. Prerequisite: Senior standing.

516 Digital Electronics 3 hrs.
Introduction to digital electronics. The Metal-Oxide-Semiconductor (MOS) transistor. MOS inverters 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.)

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 421. (Same as EE 421, CPE 421, CPE 521.) Students enrolling in EE 521 must enroll concurrently in EE 521L.

521L Laboratory Component of Microcomputers 0 hrs.
Students enrolling in EE 521L must enroll concurrently in EE 521.

522 Advanced Logic Design 3 hrs.
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.

522L Laboratory Component of Advanced Logic Design 0 hrs.
Students enrolling in EE 522L must enroll concurrently in EE 522.
527 Electromagnetic Waves 3 hrs.
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. (Same as EE 447.)

528 Analytical & Computational Methods in Electrical Engineering I 3 hrs.
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 3 hrs.
Introduction to the geometrical design and analysis of optical systems, and to the design principles of lens systems. Prerequisite: EE 541 or equivalent. (Same as EE 452.)

534 Optical Fiber Communications 3 hrs.
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 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 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 OSE 542 and PH 542.)

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

603 Random Signals in Communication 3 hrs.
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 3 hrs.

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. Perturbational 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, Sommerfield's diffraction integral, Fourier Transform, angular spectrum, coherent and incoherent imaging, optical transfer function. (Same as OSE 632 and PH 632.)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>633</td>
<td>Electro-Optical Engineering</td>
<td>3 hrs.</td>
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<tr>
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<td>Propagation of optical beams in homogeneous and</td>
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<td>guiding media, optical resonators, and</td>
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<td></td>
<td>spectrum analyzers, theory of laser oscillation,</td>
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<td>some specific laser systems, parametric</td>
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<td>oscillators, electro-optical and</td>
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<td>acousto-optical modulators. Prerequisite: EE 541.</td>
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<tr>
<td>634</td>
<td>Optical Communications</td>
<td>3 hrs.</td>
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<td>Optical communication systems; counting</td>
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<td>statistics; the optical detector response</td>
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<td>process; direct detection; heterodyne detection</td>
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<td>parameter estimation in optical communications;</td>
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<td>pointing, spatial acquisition and tracking.</td>
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<td></td>
<td>Prerequisite: EE 506/426. (Same as OSE 634.)</td>
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<tr>
<td>642</td>
<td>Data and Digital Communications</td>
<td>3 hrs.</td>
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<td>Introduction to digital and data</td>
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<td>communications; transmission channels;</td>
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<td>modulation and coding; telephone networks;</td>
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<td>data communication standards; noise and</td>
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<td>distortion; computer interfacing; protocols.</td>
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<td>Prerequisite: EE 500/420.</td>
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<td>648</td>
<td>Digital Signal Processing</td>
<td>3 hrs.</td>
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<td>Theory and applications of signal processing by</td>
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<td>digital techniques. Difference equations, Z-</td>
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<td>transform theory, digital-filter design, fast</td>
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<td>Fourier transform, quantization effects, and</td>
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<td>discrete estimation. Applications in digital</td>
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<td>filtering, signal processing, data analysis</td>
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<td>and smoothing, and image processing. Prerequisite:EE 528/448.</td>
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<td>672</td>
<td>Digital Processing of Random Signals I</td>
<td>3 hrs.</td>
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<td></td>
<td>Discrete signals, linear systems, spectral</td>
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<td>analysis and probability; and random</td>
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<td>discrete-time signals. Introduction to</td>
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<td>statistical interference, time-series analysis</td>
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<td>and spectral estimation of random discrete-time</td>
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<td>signals. Cross correlation and cross</td>
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<td>spectra, multitaper spectrum estimation and</td>
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<td>multivariable spectral analysis. Prerequisite:</td>
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<td>EE 603 or equivalent.</td>
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<tr>
<td>673</td>
<td>Digital Processing of Random Signals II</td>
<td>3 hrs.</td>
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<td></td>
<td>Parametric models for random signal processing;</td>
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<td>AR (autoregressive), MA (moving average), ARMA</td>
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<td>(autoregressive moving average), and Prony</td>
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<td>method. Two-dimensional spectral estimation;</td>
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<td>higher-order spectral analysis and</td>
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<td>multiresolution signal analysis. Prerequisite:</td>
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<td>EE 672.</td>
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<td>690</td>
<td>Uniform Geometrical Theory of Diffraction</td>
<td>3 hrs.</td>
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<td>Geometrical optics fields, geometrical optics</td>
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<td>reflected fields, two-dimensional wedge</td>
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<td>diffraction (GTD and UTD), three-dimensional</td>
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<td>wedge diffraction and corner diffraction,</td>
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<td>equivalent currents, diffraction at a smooth</td>
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<td>convex conducting surface, radar cross section.</td>
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<td></td>
<td>Prerequisite: EE 447/527.</td>
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<td>691</td>
<td>Graduate Seminar I</td>
<td>1 hr.</td>
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<td>Seminar presentations by representatives from</td>
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<td>industry and/or faculty members to promote the</td>
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<td>skills required to organize and deliver oral</td>
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<td>and written presentations. Presentations</td>
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<td>introduce students to a wide variety of current</td>
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<td>topics relevant to the technical and career</td>
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<td>aspects of electrical, computer, and</td>
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<td>optical engineering. Students are required to</td>
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<td>present a summary of their research interests.</td>
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<td>Prerequisite: CM 601.</td>
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<tr>
<td>692</td>
<td>Graduate Seminar II</td>
<td>1 hr.</td>
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<td>Written reports and oral presentations by</td>
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<td>students on individual research or on journal</td>
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<td>articles. Prerequisite: EE 691.</td>
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<tr>
<td>699</td>
<td>Master's Thesis</td>
<td>3 or 6 hrs.</td>
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<td>Required each semester student is working and</td>
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<td>receiving direction on a master's thesis.</td>
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<td>Minimum of two semesters and 6 hours required</td>
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<td>for M.S.E. students. A maximum of nine hours of</td>
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<td>credit is awarded upon successful completion of</td>
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<td>master's thesis.</td>
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<td>700</td>
<td>Sampled Data Control Systems</td>
<td>3 hrs.</td>
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<td>Classical and modern methods for analysis and</td>
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<td>design of sampled data-control systems; Z-</td>
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<td>transforms, transport lags, z and w plane</td>
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<td>analysis, state variables, and the transition</td>
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<td>matrix. Prerequisite: EE 701.</td>
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<td>701</td>
<td>Advanced Linear Control Theory</td>
<td>3 hrs.</td>
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<td>Modern techniques for analysis and design of</td>
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<td>linear control systems. Matrix formulation,</td>
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<td>multivariable control systems, state variable</td>
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<td>concepts. Linear transformation, controllability,</td>
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<td>observability, discrete-time systems. Prerequisite:EE 605 or permission of instructor.</td>
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<tr>
<td>703</td>
<td>Modern Control Design</td>
<td>3 hrs.</td>
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<tr>
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<td>Use of modern (state-variable) control concepts</td>
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<td>and theories to design high-performance</td>
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<td>controllers for multi-input/multi-output set-</td>
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<td>point regulation and servo-tracking/pointing</td>
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College of Engineering
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**

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**

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**


**717 Space Applications of Electromagnetics**

Plasma as a dielectric; dielectric functions for cold, warm, isotropic and anisotropic plasmas, body-plasma interaction; space craft electro-dynamics, 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**


**719 Advanced Electromagnetic Field Theory**


**720 Computer-Aided Design of Control Systems**

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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>721</td>
<td>Robust and Adaptive Control</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Introduction to fundamental ideas of robust and</td>
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<td>adaptive control. Effects of parameter and</td>
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<td>disturbance uncertainties, H-infinity and mu-</td>
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<td>synthesis ideas; parameter estimation techniques;</td>
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<td>adaptive control algorithms; stability</td>
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<td>considerations; model-reference and linear</td>
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<td></td>
<td>adaptive control techniques. Prerequisite: EE</td>
<td></td>
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<tr>
<td></td>
<td>701.</td>
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<tr>
<td>722</td>
<td>Sliding Mode Control</td>
<td>3 hrs.</td>
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<td></td>
<td>The basic and advanced theories and analytical</td>
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<td></td>
<td>techniques for modeling and analysis of systems</td>
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<tr>
<td></td>
<td>dynamics in sliding manifolds. Traditional and</td>
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<tr>
<td></td>
<td>High Order Sliding mode controller design.</td>
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<td></td>
<td>Discontinuous and equivalent control, robustness.</td>
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<td></td>
<td>Applications to control of electro-mechanical</td>
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<tr>
<td></td>
<td>systems, reusable launch vehicle, air craft,</td>
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<td></td>
<td>spacecraft, and DC-to-DC power converters.</td>
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<tr>
<td></td>
<td>Prerequisites: EE 701.</td>
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<tr>
<td>725</td>
<td>Advanced Radar Techniques</td>
<td>3 hrs.</td>
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<tr>
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<td>Modern radar systems for search and tracking are</td>
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<td></td>
<td>analyzed with emphasis on signal processing.</td>
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<td></td>
<td>Modeling and simulation of system and environment.</td>
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<td></td>
<td>Advanced techniques include CFAR, binary</td>
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<tr>
<td></td>
<td>modulation, frequency agility, polarization</td>
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<tr>
<td></td>
<td>agility, and synthetic aperture. Prerequisites:</td>
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<tr>
<td></td>
<td>EE 603, 619.</td>
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<tr>
<td>726</td>
<td>Decision and Estimation Theory</td>
<td>3 hrs.</td>
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<tr>
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<td>Classical detection theory, including maximum</td>
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<td></td>
<td>likelihood, Neyman-Pearson, Bayes and minimax</td>
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<td></td>
<td>criteria. Estimation theory concepts and criteria;</td>
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<td></td>
<td>linear estimators, Kalman filters, maximum</td>
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<td></td>
<td>likelihood and least-squares estimator, matched</td>
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<td></td>
<td>filters, Cramer-Rao lower bound. Introduction to</td>
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<td></td>
<td>pattern recognition. Prerequisite: EE 603.</td>
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<tr>
<td>727</td>
<td>Numerical Methods in Electromagnetics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Review of concepts in electromagnetics, antennas</td>
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<td></td>
<td>and scattering problems, method of moments and</td>
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<td></td>
<td>applications, finite difference and finite element</td>
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<td></td>
<td>methods, numerical solutions of transient</td>
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<td></td>
<td>problems associated with broadband systems,</td>
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<td>impulse response, direct solution of field</td>
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<td></td>
<td>equations in time domain. Prerequisite: EE 609.</td>
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<td>733</td>
<td>Nonlinear Optical Devices and Applications</td>
<td>3 hrs.</td>
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<td></td>
<td>Modeling of optical nonlinearities; Kerr, thermal</td>
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<td>and photorefractive effects; nonlinearity-induced</td>
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<td>beam distortion; applications of nonlinearities</td>
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<td></td>
<td>in crystals and fibers; quantum well and SEED</td>
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<td>devices; soliton-based communication system;</td>
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<td>nonlinear optical switches, deflectors and</td>
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<td>limiters; measurements of nonlinearities.</td>
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<td>Prerequisite: EE 633.</td>
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<td>734</td>
<td>Fiber Optics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Propagation in dielectric slab and fibers with</td>
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<td>step and graded index of refraction; electromagnetic</td>
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<td>and ray optical methods; eikonal equations;</td>
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<td>ray trajectory; WKB method; paraxial approximation</td>
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<td></td>
<td>weakly guiding structures. Prerequisites: EE 609</td>
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<td>or a graduate level EM theory course.</td>
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<td>735</td>
<td>Statistical Optics</td>
<td>3 hrs.</td>
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<tr>
<td></td>
<td>Introduction to random variables and random</td>
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<td>processes; first-order properties of light waves;</td>
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<td>coherence of optical waves, partial coherence</td>
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<td>and imaging systems, imaging in randomly</td>
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<td>inhomogeneous media, fundamental limits in</td>
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<td>photoelectric detection of light. Prerequisite:</td>
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<td></td>
<td>EE 506/426.</td>
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<tr>
<td>737</td>
<td>Channel Characterization and Communication in</td>
<td>3 hrs.</td>
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<td>Random Media</td>
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<td></td>
<td>Modeling stationary and not strictly stationary</td>
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<td></td>
<td>random media; scatter communications channels;</td>
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<td></td>
<td>line of sight communication channels – weak</td>
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<td></td>
<td>scattering and strong scattering. Prerequisites:</td>
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<td></td>
<td>EE 506, 609.</td>
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<td>738</td>
<td>Optical Transforms and Pattern Recognition</td>
<td>3 hrs.</td>
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<td>Systems and transforms in diffraction theory;</td>
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<td>two-dimensional Fourier transform; Hankel</td>
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<td>transforms; generalized Hankel transforms;</td>
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<td>optical signals, correlation coherence; filtering;</td>
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<td>apodization; applications to optical pattern</td>
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<td>recognition. Prerequisite: EE 632.</td>
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<tr>
<td>744</td>
<td>Coding Theory and Spread Spectrum</td>
<td>3 hrs.</td>
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<td>Linear block coding techniques, convolutional</td>
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<td></td>
<td>codes and the Viterbi decoding algorithm,</td>
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<td>probability of error bounds, channels with</td>
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<td>intersymbol interference and additive Gaussian</td>
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<td>noise. Introduction to spread spectrum direct</td>
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<td>sequence and frequency hopping methods. Prerequisite: EE 642.</td>
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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 Boltzmann 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
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
Wyskida, 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
Gholston, S.; quality engineering, applied statistics, manufacturing
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
Youngblood, A.; performance measurement, cost estimation, decision modeling

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.

**Vision and Mission**
The ISEEM Department vision is to be known as the best applications oriented department in the southeastern U.S. in the areas of industrial engineering, systems engineering, and engineering management. This vision encompasses three tightly coupled areas: students, faculty, and research. The department focus on student development is strengthened by applicable research and faculty service. Creative problem solving and the ability to work in teams are considered critical skills for the students. Students will possess good verbal and writing skills and be able to articulate their ideas. The department recruits and attracts a diverse, academically superior student body. The mission of the department is to provide a high quality education to students both in the Huntsville area and beyond in industrial engineering, systems engineering, and engineering management.

**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 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, queueing, 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.

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 examination, satisfactory completion of the comprehensive and qualifying examination, 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 Work Design
3 hrs.
Introduces the portion of the design process that uses basic principles of methods analysis and ergonomics to fit a task and workstation to the human operator. 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 390 or 690. (Same as ISE 424 and PY 524.)
526 Design and Analysis of Experiments  
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  
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  
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  
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  
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  
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. (Same as PY 624.)

626 Introduction to Operations Research  
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  
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  
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  
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  
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.

637 Systems Modeling & Analysis  
System analysis and modeling of large complex systems using systems engineering fundamentals. Life cycle simulations developed as a focus for the multidisciplinary analysis integration using computational systems engineering techniques including probability, statistics, design of
experiments, response surfaces, and optimization. State of the art software tools will be used for simulation development. Prerequisite: ISE 627 or MAE 635, ISE 690, programming proficiency.

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

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

641 Advanced Quality Control 3 hrs.
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.

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

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.

690 Statistical Methods for Engineers 3 hrs.
Application of statistics for estimation and inference using parametric and nonparametric methods. Descriptive statistics, sampling distributions, point and interval estimates, tests of hypotheses, ANOVA, and linear regression. Prerequisites: ISE 390 or permission of instructor.

697 Industrial and Systems Engineering Project I 3, 6, or 9 hrs.
Application oriented student project designed to show competence in Industrial and Systems Engineering.

698 Industrial and Systems Engineering Project II 3, 6, or 9 hrs.
Application oriented student project designed to show competence in Industrial and Systems Engineering. Continuation of ISE 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.

723 Engineering Economic Analysis 3 hrs.
Mathematical models for expenditure analysis under uncertainty. Relationship between investment decision criteria and microeconomic theory. Capital planning and budgeting. Decisions involving expansion, acquisitions, replacement, and disinvestment. Prerequisite: ISE 390 or 690, ISE 321 or instructor approval.

726 Systems Modeling 3 hrs.
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.

728 Optimization Methods in Operations Research 3 hrs.
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.

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: Graduate standing.

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

667 Labor Relations 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, 6, or 9 hrs.
Application-oriented student project designed to show competence in engineering management.

698 Engineering Management Project II 3, 6, or 9 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.

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 Managing Change in High Technology Organizations 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.

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: maeograd@uah.edu

Degrees:
Master of Science in Engineering
Doctor of Philosophy

Chair: Mark V. Bower, P.E.

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
- 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
- Snider, J. R. (Research); rotorcraft engineering, helicopter theory, astrodynamics
- Wallace, D.B.; solar energy, photovoltaics, computer aided engineering analysis, robot dynamics
- Wessling, F.C.; design of apparatus for use in low gravity, heat transfer, and materials studies in low gravity

Associate Professors:
- Bower, M.V.; metallic and nonmetallic materials, composite materials, solid and structural mechanics; viscoelasticity and hyperelasticity, fracture mechanics, CAEDM
- 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
- Moser, M. (Research); solid and liquid rocket combustion, laser-based diagnostics, instrumentation

Assistant Professors:
- Cassibry, J. (Research); magneto-hydrodynamics, plasma propulsion, electric propulsion
- Richardson, G.; computational fluid dynamics, numerical method development, magneto-hydrodynamics, plasma dynamics and the design of thermal systems
- Li, Z. (Research); advanced propulsion
- Ooi, T. (Adjunct); dynamics, solid mechanics, aerospace structures, smart structures
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.

Mission Statement
The mission of the Department of Mechanical and Aerospace Engineering is to provide undergraduate and graduate education, research, and public service in the engineering profession in general and in the mechanical and aerospace engineering disciplines in particular and to support the diverse mechanical and aerospace engineering needs of Huntsville, the State of Alabama, the region, our nation, and the international community.

To accomplish this Mission the Department seeks to
- inspire students to attain the highest levels of intellectual and personal growth throughout their lives;
- enable students and faculty to make lasting contributions to the advancement of knowledge and the creative practice of engineering;
- equip students with the ability to use modern engineering tools for design, analysis, experimentation, and development;
- engage the faculty in service that enhances the public’s understanding of technology for the betterment of society;
- provide leadership in engineering education, research, and practice;
- promote equality of opportunity for engineering education;
- produce graduates who are well prepared to meet the challenges of a modern, dynamic engineering environment; and
- capitalize on the unique opportunities for collaboration with the local high technology community.

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, space environment, missile design, and rotorcraft engineering. 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 Graduate Seminar, MAE 683, for one semester. For M.S.E. students with a Plan of Study in Rotorcraft Systems Engineering, Helicopter Theory, MAE 657 is required in lieu of Continuum Mechanics, MAE 671, and the Rotorcraft Systems Seminar, MAE 684, is required in lieu of the Graduate Seminar, MAE 683. All MSE students in Mechanical and Aerospace Engineering are encouraged to consult the MAE Graduate Handbook for more details.

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 department chair or see the MAE Graduate Student Handbook.)

**Graduate Courses in Mechanical Engineering (MAE)**

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<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
<th>Description</th>
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<tbody>
<tr>
<td>520</td>
<td>Compressible Aerodynamics</td>
<td>3 hrs.</td>
<td>Principles of compressible flow including area change, friction, and heat transfer. Fundamentals of acoustic waves, one and two-dimensional shock and expansion waves, shock-expansion theory, and linearized flow with applications to inlets, nozzles, wind tunnels, and supersonic flow over aerodynamic bodies and wings. Prerequisites: MAE 341, 310. (Same as MAE 420.)</td>
</tr>
<tr>
<td>530</td>
<td>Fundamentals of Aerodynamics</td>
<td>3 hrs.</td>
<td>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, 410. (Same as MAE 430.)</td>
</tr>
<tr>
<td>531</td>
<td>Introduction to Plasma Dynamics</td>
<td>3 hrs.</td>
<td>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.)</td>
</tr>
<tr>
<td>542</td>
<td>Internal Combustion Engines</td>
<td>3 hrs.</td>
<td>Application of principles of thermodynamics, heat transfer, and fluid mechanics to combustion engines and turbines. Basic engine types, engine components, idealized cycles, combustion, fuels, engine variables, testing, exhaust gas analysis, and air pollution as related to spark-ignition, compression-ignition, and turbine engines. Prerequisites: MAE 342, 410, MAE 450.</td>
</tr>
<tr>
<td>545</td>
<td>Heat Distribution System Design</td>
<td>3 hrs.</td>
<td>Design of hydronic and air distribution systems used in heating and air conditioning. Piping design, pump selection, heat coils, room air distribution, ducting design, fan selection, controls, and complete systems. Prerequisite: MAE 410; MAE 445 recommended.</td>
</tr>
<tr>
<td>548</td>
<td>Energy Conversion and Power Generation</td>
<td>3 hrs.</td>
<td>Application of principles of thermodynamics, heat transfer, and fluid mechanics to combustion engines and turbines. Basic engine types, engine components, idealized cycles, combustion, fuels, engine variables, testing, exhaust gas analysis, and air pollution as related to spark-ignition, compression-ignition, and turbine engines. Prerequisites: MAE 342, 410, MAE 450.</td>
</tr>
<tr>
<td>556</td>
<td>Turbomachinery</td>
<td>3 hrs.</td>
<td>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, 410.</td>
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<tr>
<td>559</td>
<td>Selected Topics in Mechanical Engineering</td>
<td>Credit to be arranged</td>
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<tr>
<td>561</td>
<td>Vibrations of Elastic Systems</td>
<td>3 hrs.</td>
<td>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.)</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
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<td>563</td>
<td>Intermediate Dynamics</td>
<td>3 hrs.</td>
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<td>568</td>
<td>Elements of Spacecraft Design</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>576</td>
<td>Mechanics and Fabrication of Composite Materials</td>
<td>3 hrs.</td>
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<td>577</td>
<td>Experimental Techniques in Solid Mechanics</td>
<td>3 hrs.</td>
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<td>578</td>
<td>Matrix Methods in Structural Mechanics</td>
<td>3 hrs.</td>
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<td>580</td>
<td>Aircraft Stability and Control</td>
<td>3 hrs.</td>
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<tr>
<td>585</td>
<td>Numerical Methods and Computation II</td>
<td>3 hrs.</td>
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<tr>
<td>586</td>
<td>Numerical Engineering Analysis</td>
<td>3 hrs.</td>
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<tr>
<td>589</td>
<td>Computer-Aided Engineering</td>
<td>4 hrs.</td>
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<tr>
<td>623</td>
<td>Computational Fluid Dynamics I</td>
<td>3 hrs.</td>
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<tr>
<td>631</td>
<td>Rotorcraft Design I</td>
<td>3 hrs.</td>
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The following courses are open to graduate students only

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<td>Rotorcraft Design I</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>
632 Rotorcraft Design II
Students work together on this application to complete the preliminary design stage of a specific rotorcraft. Participants are exposed to disciplinary and interdisciplinary issues. Prerequisite: MAE 631.

635 Aerospace Systems Engineering
Introduction to Integrated Product and Process Development (IPPD) and life cycle analysis with application to Aerospace Systems. Systems engineering and quality engineering methods and tools. Top-down design decision support process. Computer integrated environment and robust design simulation will be addressed. Prerequisite: MAE 631.

639 System Safety
The process of system safety—from the creation and management of a safety program on a system under development to the analysis that must be performed as this system is designed and produced to assure acceptable risk in its operation. Full discussion of the management and analysis processes and procedures. Incorporates the safety procedures used by the Department of Defense and NASA. Basic statistical methods and network analysis methods which provide an understanding of the engineering analysis methods that follow are covered. Prerequisite: ISE 638.

641 Advanced Thermodynamics
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 Advanced Heat and Mass Transfer
Continuation of MAE 450 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 450.

644 Information Retrieval in Remote Sensing
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
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
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
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
Mass, energy, and momentum transport in steady and transient motions in real and rheological substances. Prerequisite: MAE 450. (Same as CHE 649.)

651 Viscous Fluid Mechanics
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 410.

657 Helicopter Theory
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
Torsional and transverse rotor vibration, critical speed and stability analysis, response to College of Engineering
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 660.)

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

662 Nonlinear Dynamics and Chaos  
3 hrs.  
Nonlinear and chaotic dynamical systems, phase plane, periodic and strange attractors, stability analysis, critical points, Pianunov exponents, bifurcation points, solitons, logistic maps, Poincare and Henon iterative maps, fractals, Mandelbrot and Julia sets, chaos in complex dynamical systems. Prerequisites: MA 244, MA 238.

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.

664 Astronautical Engineering  
3 hrs.  
Astronautical engineering, rocket propulsion, aerodynamics, spacecraft design, and flight dynamics. Prerequisite: MAE 563.

665 Fluid Dynamics  
3 hrs.  
Fluid mechanics, flow in pipes and channels, turbulence, and boundary layers. Prerequisite: MAE 563.

666 Mechanical Systems Design  
3 hrs.  
Design of mechanical systems, including rotordynamic systems. Prerequisite: MAE 563.

667 Controls Engineering  
3 hrs.  
Introduction to control systems, including state-space and frequency-domain methods. Prerequisite: MAE 563.

670 Computational Fluid Dynamics  
3 hrs.  
Numerical methods for solving partial differential equations in fluid dynamics. 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 310, 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.  

677 Optical Techniques in Solid Mechanics  
3 hrs.  
Overview of conventional methods for experimental stress analysis. Introduction to applied optics with emphasis on non-destructive, laser-based testing methods, fiber optic recording systems, photoelectronic-numerical data acquisition, and computer aided analysis. Prerequisite: MAE 477/577 or permission of instructor. (Same as CE 677.)

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

680 Performance Flight Testing  
3 hrs.  
Fundamentals of rotorcraft test and evaluation. Topics include: test planning, requirements analysis, helicopter performance evaluation, fundamentals of propulsion testing, aviation safety,
use of modeling and simulation in flight testing, Department of Defense and Federal Aviation Administration requirements and procedures. Prerequisite: MAE 580, 657.

683 Graduate Seminar 1 hr.
Professional activities designed to promote the skills required to organize and deliver oral technical presentations and to broaden the individual’s awareness of technical issues. 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.)

684 Rotorcraft Systems Seminar 0 hrs.
Seminar course for students in the final semester of the M.S.E. (Aerospace) Rotorcraft Systems Engineering program of study. Students participate in seminars on specific aspects of rotorcraft systems engineering, including avionics system integration and weapon systems integration. Prerequisite: Graduate Standing.

692 Graduate Engineering Analysis I 3 hrs.
Ordinary differential equations (ODEs), Bessel functions, Legendre polynomials, Laplace transformations, simultaneous differential equations, application of ODEs to mechanical systems, partial differential equations (PDEs) and boundary-value problems, application of PDEs to mechanical systems. Prerequisite: MA 238.

693 Graduate Engineering Analysis II 3 hrs.
Green's functions, Fourier series and integrals, linear algebra, vectors, vector analysis and integral theorems, introduction to tensor analysis, analytical functions of a complex variable, Taylor and Laurent expansions, the residue theorem, stability criteria, and Calculus of Variations. Prerequisites: MA 238.

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

723 Computational Fluid Dynamics II 3 hrs.
Continuation of Computational Fluid Dynamics I, advanced topics in finite difference, finite element, finite volume, and spectral element methods. Prerequisite: MAE 623.

724 Computational Fluid Dynamics III 3 hrs.
Grid generation techniques, adaptive methods, vectorization, parallel processing as applied to computational fluid dynamics. Prerequisite: MAE 623.

725 Computational Fluid Dynamics IV 3 hrs.
Application of FDM, FEM, FVM, and SEM in acoustics, turbulence, hypersonics, reacting flow, combustion, and radiative heat transfer problems. Prerequisite: MAE 623.

726 Rotorcraft Computational Fluid Dynamics 3 hrs.
Full potential, Euler, Navier-Stokes approaches, structural and unstructured grids, wake capturing, turbulence, and acoustics. Prerequisite: MAE 651 or permission of instructor.

740 Aerothermodynamics 3 hrs.
Description of the dynamic and thermal fluid flow environments associated with hypervelocity vehicles and propulsion systems with emphasis on thermochemical nonequilibrium behavior. Topics include thermostatiical 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 520.

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 520.

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 520.

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 530, 520, 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.
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 for 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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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 P-12</td>
<td>Yes</td>
<td>NA NA NA NA Yes</td>
</tr>
<tr>
<td></td>
<td>M.A.</td>
<td>M.A. English as a Second Language P-12</td>
<td>Yes Yes Yes Yes Yes</td>
<td></td>
</tr>
<tr>
<td>History</td>
<td>M.A.</td>
<td>M.A. English Language Arts 6-12</td>
<td>Yes Yes Yes Yes Yes</td>
<td></td>
</tr>
<tr>
<td>Biology**</td>
<td>M.S.</td>
<td>6-12</td>
<td>Yes Yes Yes Yes Yes</td>
<td></td>
</tr>
<tr>
<td>Chemistry**</td>
<td>M.S.</td>
<td>6-12</td>
<td>Yes Yes Yes Yes Yes</td>
<td></td>
</tr>
<tr>
<td>Mathematics**</td>
<td>M.A.</td>
<td>6-12</td>
<td>Yes Yes Yes Yes Yes</td>
<td></td>
</tr>
<tr>
<td>Physics**</td>
<td>M.S.</td>
<td>6-12</td>
<td>Yes Yes Yes Yes Yes</td>
<td></td>
</tr>
</tbody>
</table>

* For those who have already earned appropriate graduate degrees, but who seek teacher certification

**COMMUNICATION ARTS**

342 Morton Hall
Telephone: (256) 824-6645
Email: comm@uah.edu
Associate Professor Rountree (Chair); Assistant Professor Ferris

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, mass media, and engineering.

**Mission**

The Department of Communication Arts offers a variety of classes that critically examine the public, professional, cultural and personal dimensions of human communication. Our comprehensive program strategically weaves together core courses in the humanistic tradition of rhetorical theory and practice with social-scientific perspectives on communication. This
curriculum capitalizes on the field's far-reaching theoretical span, having roots in ancient Greco-Roman civilizations, where rhetoric became the capstone of education and the lifeblood of civic activity, and having fecund branches in the communication media of the present and future.

Our department features teacher-scholars who support majors seeking work in professional communication, in business, and in other areas, or attending graduate school; minors who wish to supplement their majors with a focus on communication; and students from various colleges who rely on us to teach them practical communication skills or to learn to appreciate theatre. Our faculty will continue to serve student groups, the university, the community, and our profession.

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).

530 Mass Media in America 3 hrs.
This course encourages students to recognize the role media play in our everyday lives and in our construction of culture. The class also works to critically trace a media product through its production, content, audiences, and social impact. The course emphasizes current research perspectives in media and its contemporary texts, primarily film, television, and mass marketed magazines. The course requires attention to and development of a media literacy campaign. Prerequisite: Graduate student status.

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
Coward, F.; educational psychology
Dillihunt, M.; elementary education and educational psychology
Eaker, L.; social and cultural foundations of education

Mission
The Department of Education, one of twelve departments in the College of Liberal Arts at The University of Alabama in Huntsville, is a member of a diverse academic community of teacher scholars that challenges teacher candidates to strive for excellence in all aspects of their lives. The professional environment affords the Department of Education unique opportunities to make a difference in the lives of elementary, middle, and high school students regardless of socioeconomic backgrounds. In addition, the Department educates teacher candidates who will live and work effectively in increasingly complex societies. Consistent with the mission of the College of Liberal Arts
university, the Department of Education defines its mission through three focal elements: 1) to prepare teachers and other school personnel who are academically strong, competent in both theory and practice, and prepared to contribute to the needs of a dynamic, complex world; 2) to provide an environment that encourages the department faculty to model sound pedagogy, engage in research and scholarly activities, and become leaders in their area of expertise; and 3) to make our teaching, research, and service available to the entire community in order to meet the changing needs of schools, organizations, and professional communities in our region, state, nation, and international community. The mission of the Department of Education is communicated through our shared vision and articulated in our theme, Through Teaching, We Lead. The establishment of this theme codifies the major purpose of our department: to graduate teachers who are exceptionally well-prepared in disciplinary, pedagogical, and professional knowledge, who understand and are prepared to address the needs of all learners, and who are committed to serving as leaders in the educational community to ensure that all students receive a high-quality public or private education.

PROGRAMS
The Department of Education, in conjunction with the College of Liberal Arts and the College of Science offers three options graduate certification. Two traditional Class A programs are available for teachers already certified at the baccalaureate level and seeking advanced level certification. Traditional certification programs are available in biology, chemistry, English language arts, history, mathematics, physics, ESL, and reading specialist. A nontraditional fifth year program is also available for individuals seeking initial certification. Certification for nontraditional programs is available in the following areas: biology, chemistry, English language arts, history, mathematics, physics and ESL.

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 Elementary and Secondary Teacher Resource Centers 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 located in Shelby King 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.

General Information
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 for appropriate forms. Written approval from the Department Chair is required. 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 who receive a D in a professional education or teaching field courses must repeat the course at UAH.

Program Completion. If a student does not complete requirements for the graduate degree within a period of seven years from the date of admission to UAH, 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.

Preadmission Requirements
File an Application for Admission to the Teacher Education Program with the Certification Officer as soon as a decision is made to seek graduate level certification and apply for a Program of Study (POS) with the college advisor. In addition, students must meet the following requirements:

1. Meet UAH requirements for unconditional admission to the University and the major department as stated in the UAH Graduate Catalog.
2. Completion of undergraduate major in teaching field or, if an academic major is not on the transcript, 32 semester hours in the teaching field including at least 19 hours of upper division courses.
3. Completion of undergraduate general education courses, including work in humanities, social science, science, and humanities.*

College of Liberal Arts
148
4. Minimum GPA of 3.0 or higher in undergraduate teaching field courses.
5. Completion of CM 113 or comparable public speaking course.

Admission to the Teacher Education Program
Admission to the University does not guarantee admission to the Teacher Education Program. Students must have an Application for Admission to the Teacher Education Program on file with the Certification Officer and must verify that an approved Program of Study (POS) is on file in the UAH Department of Education before or during the first semester of education courses. In addition, students must meet the following requirements:
1. Successfully complete ED 301.*
2. Minimum 3.0 GPA in first semester of graduate education courses with no grade lower than C.
3. Satisfactory completion of first semester Field Experiences.
4. Satisfactory ratings on Interview and Dispositions Assessments.
5. Satisfactory rating on Application Essays.

*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.

Continuation in the Teacher Education Program
Requirements include:
1. Minimum 3.0 GPA in Education and teaching field courses with no grade lower than C.
2. Satisfactory completion of all Field Experiences.
3. Satisfactory ratings on Dispositions Assessments.
5. Passing Score on the Alabama Prospective Teacher Test (APTT).*

*Applies only to candidates enrolled in the Nontraditional Fifth Year Program who are seeking initial certification.

Field Experiences
The Alabama State Department of Education requires that all candidates seeking initial certification complete a minimum of 150 hours of field experiences in diverse settings prior to the internship. To meet this requirement, candidates will systematically be placed in area schools for approximately 40 hours of experience each semester. Field experience requirements will be individualized for teachers who hold valid teaching certificates in the same field they are seeking advanced, graduate level certification.

Internship Requirements
In addition to the satisfactory completion of required coursework and satisfactory completion of 150 hours of field experience in diverse settings, candidates seeking initial certification Class A must meet the following requirements:
1. Minimum 3.0 GPA in Education and teaching field courses with no grade lower than C.
2. Satisfactory ratings on Dispositions Assessments.
4. Passing score on a comprehensive written exam covering the content of the curriculum.

Application dates: January 31 for the following Fall Semester and June 30 for the following Spring Semester. Internships must be taken during the last semester before graduation. All internship placements are coordinated by the Department of Education faculty. At UAH, the internship is a full-time, full semester assignment of 15 weeks. Candidates should not expect to enroll in other courses during the internship semester.
1. Secondary education candidates seeking initial certification must complete a middle and
2. All P-12 ESL education candidates must complete an early childhood/elementary and a middle/secondary school placement.

3. Candidates adding the Collaborative Teacher-Special Education certification will complete an additional internship in a special education setting.

4. Candidates who are seeking a master's degree or adding an endorsement in a teaching field different from their Class B certificate, must complete an internship in the new field. This includes, but is not limited to ESL, Reading Specialist, and special education.

Certification Requirements

Alabama teaching certificates are the legal responsibility of the Alabama State Department of Education. Colleges and universities cannot issue professional teaching certificates. In order to be recommended for certification, candidates must complete a state approved program. Approved graduate certification programs offered by the UAH Department of Education are designed to prepare candidates for professional Class A certification with a master's degree.

Initial Certification

It is the candidate's responsibility to initiate the application for the initial certificate. To be recommended for an initial certificate, nontraditional fifth year candidates must:

Meet all program requirements including satisfactory completion of the internship.

1. Satisfactorily complete the Exit Portfolio Review and all written comprehensive examinations in education and the teaching field.

2. Individuals seeking advanced level certification must also complete all written comprehensive examinations in education and the teaching field.

3. Submit a fingerprint card to the Alabama State Department of Education with the appropriate fee in the form of a money order or cashier's check made payable to the Alabama Department of Education and successfully pass a background review conducted by the Alabama Bureau of Investigation and the Federal Bureau of Investigation. 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 Superintendent of Education.

4. Individuals who hold a valid Alabama substitute teacher's license must submit to the certification officer a copy of the substitute license along with all certification application paperwork.

5. Candidates who expect to teach in states other than Alabama are responsible for knowledge of the licensure requirements of those states. Such candidates should inform the certification officer of their intentions.

Certificate Renewal

1. The Class A certificate is valid for five years. This certification may be renewed upon verification of successful teaching for three years and completion of an approved professional development program or additional graduate level credits in the certification area.

2. Individuals who allow their certificates to lapse for more than 6 months will also be required to renew their certificates and to obtain another background clearance for the issuance of a renewed certificate or license. The UAH Department of Education in accordance with the Alabama State Board of Education provides courses for persons who hold expired certificates and wish to reinstate them.

Ensuring the Competence of Graduates

For a period of two years of the valid date of the Professional Educator certificate, 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 or 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 evaluations recognized and approved by the State Board of Education. This policy is consistent with the Alabama State Code of Education.

College of Liberal Arts
Master of Arts or Master of Science: Traditional Certification Programs

Traditional Certification Programs (Strengthened Subject Matter or Technology Option) are available to individuals who hold valid Alabama Class B certificates. Completion of these programs leads to advanced level Class A Certification. Certification for all programs is available in the following areas:

**Secondary/High School (6-12 Certification)**
- Biology: Master of Arts
- English Language Arts: Master of Arts
- Mathematics

**P-12 Certification**
- English as a Second Language: Master of Arts in English option
- Reading Specialist: Master of Arts in English option

**Strengthened Subject Matter Options**
6-12 Certification
- Biology, Chemistry, English Language Arts, History, Math, Physics

The Strengthened Subject Matter Option is designed for individuals who hold valid Alabama teaching certificates.

**Professional Education Requirements (12-15 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: 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 430 - Mass Media 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)
- Strengthened Subject Matter Option

Teaching English as a Second Language (P-12 Certification)**
The ESL Certification Program will prepare teachers to assist and support second language learners in P-12 school settings. The Strengthened Subject Matter Option is designed for individuals who hold valid Alabama teaching certificates.
Professional Education Requirements (21-24 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.
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.
ED 605 - Reading Research and Instruction 3 hrs.
ED 699 - P-12 Internship 6 hrs.

Teaching Field Requirements (18 hrs.)

EHL 508 - History of the English Language: Applied English Linguistics III, or EHL 509 - Special Topics in Applied English Linguistics, or EH 601 - Writing Pedagogy 3 hrs.
EHL 608 - Second Language Acquisition: Applied English Linguistics IV 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
The Technology Option is designed for individuals who hold valid Alabama teaching certificates.
6-12 Certification
Biology, Chemistry, English Language Arts, History, Math, and Physics

Professional Education Requirements (21-24 hrs)

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 430 – Mass Media 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. The Technology Option is designed for individuals who hold valid Alabama teaching certificates.

Professional Education Requirements (30-33 hrs)
- 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 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 hrs.)
- 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
The Reading Specialist Program (P-12) is designed to serve practicing teachers who hold valid Alabama Class B certificates. The program will prepare them to become a reading specialist for school systems or to return to the classroom with greater knowledge of effective, research-based reading instruction.

Professional Education Requirements (9-12 hrs. hours)
- ED 604 - Contributions of Psychology to Education
- ED 607 - Educator as Evaluator
- A technology course (ED 520, 560, or 620)
- ED 593 - Educating Exceptional Children and Youth

*Required for students who have not previously satisfied the Special Education requirement.

Teaching Field Courses (21 hours)
- EH 601 - Writing Pedagogy
- EHL 505 - Survey of General Linguistics: Applied English Linguistics I or
- EHL 507 - Advanced English Grammar Studies: Applied English Linguistics II*
- EHL 609 - Strategies for Research and Teaching Methods in TESOL: Applied English Linguistics IV
- EH/ED 613 - Children’s and Adolescent Literature
- ED 605 - Reading Research and Instruction
- ED 608 - Expanding Reading Ability through Content Area Instruction
- ED 612 - Reading Diagnosis and Acceleration

Capstone Courses (7 hrs.)
- ED 691 - Portfolio Seminar and Symposium
- ED 699 - P-12 Internship

*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; and
5. Pass a comprehensive written examination covering the content of the curriculum.
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 Chemistry Master of Science
   English Language Arts Master of Arts History

2. P-12 Certification
   Master of Arts

   English as a Second Language - Master of Arts in English option

Alternative Fifth-Year Program (6-12 Certification)

Master of Science

Major: Biology

Preadmission Requirement
   ED 301 - Introduction to Education 1 hr.

Graduate Education Courses (25 hrs.)
   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 hrs.)

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 hrs.
Ancillary requirements:

Chemistry:
- CH 121, 125 - General Chemistry I & Lab I
- CH 123, 126 - General Chemistry II & Lab II
- CH 331, 335 - Organic Chemistry I & Lab
- CH 332, 336 - Organic Chemistry II & Lab
- CH 361, 362 - General Biochemistry & Lab

Physics:
- PH 111, 114 - Physics with Calculus I & Lab
- PH 112, 115 - Physics with Calculus II & Lab

**Alternative Fifth-Year Program (6-12 Certification)**

**Master of Science**

**Major: Chemistry**

**Preadmission Requirement**
- ED 301 - Introduction to Education

**Graduate Education Courses (25 hrs.)**
- ED 593 - Education of Exceptional Children and Youth
- ED 604 - Contribution of Psychology to Education
- ED 606 - Principles of Curriculum Development
- ED 607 - The Educator as Evaluator
- ED 608 - Expanding Reading Ability through Content Area Instruction

A technology course: ED 520, 560, or 620.
- ED 690 - Seminar in Teaching
- ED 698 - High School Internship

**Teaching Field Requirements (24 hrs.)**

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
- CH 123/126 - General Chemistry II & Lab
- CH 223/224 - Quantitative Analysis & Lab
- CH 315 - Chemical Demonstrations
- CH 331/335 - Organic Chemistry I & Lab
- CH 332/336 - Organic Chemistry II & Lab
- CH 347 - Biophysical Chemistry I
- CH 348 - Biophysical Chemistry II
- CH 361/362 - General Biochemistry I & Lab

**TOTAL**

**Ancillary Courses:**
- PH 111/114, 112/115, 113/116 - General Physics with Calculus
- MA 171, 172, 201 - Calculus A, B, C
- BYS elective minimum of one course in GER

College of Liberal Arts

156
Alternative Fifth-Year Program (6-12 Certification)
Master of Arts
Major: English Language Arts

Preadmission Requirement
ED 301 - Introduction to Education 1 hr.

Graduate Education Courses (25 hrs.)
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 hrs.)
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 430 - 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 360) 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; 340 or 540 with topic in Am Lit.) 3 hrs.
English Literature (EH 380, 381, 390, 391, 418, 421, 450, 460, 470, 492, 493, 520, 522, 551, 571, 572, 592; 340 or 540 with topic in English Lit.) 3 hrs.
The Novel (EH 430, 431, 492, 493; 339, 340, 530 with a topic covering the novel) 3 hrs.
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 hrs.
Speech and Communication (CM 113 and 231) 6 hrs.
Communication Arts Elective (CM 309 or 310) 3 hrs.
Drama and Theatre (CM 122 and 221) 6 hrs.
Media Writing (CM 205) 3 hrs.
Mass Media (CM 430) 3 hrs.

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
Preadmission Requirement
ED 301 - Introduction to Education 1 hr.

Professional Education Courses (25 hrs.)
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 hrs.)
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 or 6 hrs. (GER).
HY 103, 104 - World History 6 hrs.
HY 221, 222 - American History 3 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
Preadmission Requirement
ED 301 - Introduction to Education 1 hr.

Professional Education Courses (25 hrs.)
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.
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
- MA 172 - Calculus B
- MA 201 - Calculus C
- MA 244 - Linear Algebra
- MA 330 - Foundations of Math
- MA 385 - Intro. to Probability 3 hrs.
- MA 442 - Algebraic Structures with Applications
- MA 452 - Intro. to Real Analysis
- MA 333 - Intro. to Geometry
- MA/ST 487 - Intro. to Math Statistics
- MA elective with at least one 500+ course
TOTAL 31 hrs.

Ancillary Courses:
- CS 121 - Computer Science
- PH 111/114 and 112/115 Physics

Alternative Fifth-Year Program (6-12 Certification)

Master of Arts
Major: Physics

Preadmission Requirement
- ED 301 - Introduction to Education

Professional Education Courses (25 hrs.)
- ED 593 - Education of Exceptional Children and Youth
- ED 604 - Contribution of Psychology to Education
- ED 606 - Principles of Curriculum Development
- ED 607 - The Educator as Evaluator
- ED 608 - Expanding Reading through Content Area Instruction
- A technology course: ED 520, 560, or 620
- ED 690 - Seminar in Teaching
- ED 698 - High School Internship

Teaching Field Requirements (24 hrs)

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.

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
- PH 111, 114 - Physics with Calculus I
- PH 112, 115 - Physics with Calculus II
- PH 113, 116 - Physics with Calculus III
- AST 106 - Exploring the Cosmos I
- AST 107 - Exploring the Cosmos II
- PH 337 - Electronics

49 Semester Hours Required for this Degree
PH 351 - Introduction to Modern Physics 3 hrs.
PH 499 - Physics Practicum 3 hrs.
TOTAL 33 hrs.

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.

Preadmission Requirement
ED 301 - Introduction to Education 1 hr.

Professional Education Courses (25 hrs.)
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)
EHL 508 - History of the English Language: Applied English Linguistics III 3 hrs.
OR EHL 509 - Special Topics In Applied English Linguistics 3 hrs.
ED 601 - Writing Pedagogy 3 hrs.
EHL 608 - Second Language Acquisition: Applied English Linguistics IV 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.

College of Liberal Arts 160
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 Baikanur 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. Intensive field experience 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. Intensive field 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. Intensive field experience required.

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. Intensive field experience 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. Intensive field experience 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. Intensive field experience required.

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. Intensive field experience required.

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.) Intensive field experience required.

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.)

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.

690 Seminar in Teaching 1 hr.
Provides opportunity for reflection and discussion of student teaching experiences in light of current trends and problems in education. To be taken concurrently with student teaching.

691 Portfolio Seminars and Symposium 1 hr.
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.

695 Supervised Teaching 1 hr.
Provides graduate teaching assistants with theoretical background, knowledge, skills, and practical strategies needed to develop, implement and assess appropriate instructional experiences which adult learners need to succeed. For graduate teaching assistants only.

698 High School Internship 6 hrs.
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 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 and permission of the chair. ED 690 is to be taken concurrently with student teaching.

699 P-12 Internship 6 hrs.
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. Permission of the chair required.

ENGLISH

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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:
Bell, D.; Rhetoric and composition pedagogy
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 Professor:
Kennedy, K.; Medieval literature

Mission
The Department of English is committed to excellence in teaching, research, and service in the following disciplines: British, American, and global literature in English; business writing and technical communication; writing pedagogy and composition theory; applied linguistics (English as a Second Language and Teaching English to Speakers of Other Languages); teacher education; and creative writing. The department serves non-majors, majors, and graduate students by providing a wide array of courses that foster sound research; intellectual curiosity; critical thinking and reading; and clear, graceful, and persuasive writing and speaking. Through its programs, graduates, and faculty, the department contributes significantly to the cultural and academic enrichment and the quality of life of the campus, community, state, and region.

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 (ED 699) 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
ED 604 Contributions of Psychology to Education, or
a Technology Course (ED 520, 560, or 620)
ED 607 Educator as Evaluator
ED 593 Education of Exceptional Children and Youth* 3 hrs.
3 hrs.
3 hrs.

College of Liberal Arts
Teaching Field Courses:
EH 601: Writing Pedagogy 3 hrs.
ED 605 Reading Research and Instruction 3 hrs.
ED 608 Expanding Reading Ability Through Content Area Instruction 3 hrs.
EH/ED 613 Children’s and Adolescent Literature 3 hrs.
ED 612 Diagnosis and Acceleration of Reading Ability 3 hrs.
Capstone Courses:
ED 691 Portfolio Seminar and Symposium 1 hr.
ED 699 P-12 Internship 6 hrs.
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 a 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).

College of Liberal Arts
Graduate Courses in English (EH)

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

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
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
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
Selected authors, genres, and issues.

629 Studies in Twentieth-Century Literature
Selected poetry and prose with an emphasis on the Anglo-American Modernist tradition.

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

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

649 Special Studies
Study of significant issues in literature, technical communication, or composition studies, announced in advance.

650 Chaucer
The Canterbury Tales, Troilus and Criseyde, and other works, especially in relation to relevant literary and religious traditions.

651 Middle English Literature
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
Selected Shakespearean plays, with special attention to the major criticism, problems of interpretation, and current issues in Shakespearean study.

665 Renaissance Poetry and Prose
The period defined in terms of its principal movements, with attention to the major English authors such as More, Wyatt, Sidney, Spenser, Marlowe, and Shakespeare, and selected continental predecessors.

670 Milton
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)

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 3 hrs.
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 3 hrs.
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 3 hrs.
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.

609 Strategies for Research and Teaching Methods in TESOL:

Applied English Linguistics V 3 hrs.
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@uah.edu

Degree: Master of Arts

Chair: Andrew J. Dunar, Professor

Distinguished Professor:
Boucher, P.P.; early modern Europe, early modern European expansion

Professors:
Dunar, A.J.; 20th century U.S.; U.S. diplomatic
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 Britain
Waring, S.P.; Modern U.S., U.S. intellectual; U.S. labor and business

Assistant Professors:
Johnson, M.W.; 19th and 20th century Europe, women’s history, modern Germany
Shuck-Hall, S. M.; Native American, 18th and 19th century U.S., U.S. Women’s History, Public History

Mission
The Department of History is committed to excellence in the areas of teaching, research and service. It offers an undergraduate B.A., as well as a minor, and a Master’s degree aimed primarily at fostering stronger middle and secondary school education in history. Since historical study embraces the entire record of human accomplishments and failures, the department’s traditional Western Civilization sequence (HY 101, 102) and new World History offerings (HY 103, 104) are a fundamental component of the General Education Requirements of the Colleges of Liberal Arts and Science. The department’s commitment to these courses reflects its belief that history’s very scope makes it an invaluable tool in interpreting the present. It illustrates the interdependence of all forms of knowledge and bridges gaps among disciplines by putting ideas into a social context and their place in time. For students who choose to pursue history as a course of study, the curriculum seeks to provide depth and perspective on complex social problems, and its critical approach to the human past cautions against simplistic solutions. Through an examination of the flow of events, historical study demonstrates how the forces of continuity and change intersect. By demonstrating the role of chance and contingency, and of purposeful activity in human affairs, historical study assists students in acquiring discrimination, understanding and balanced judgment. Students are taught that because the sheer abundance of historical documentation demands selection, interpretation, creativity, and clarity of expression to make them meaningful to the current generation, history is both an art and a science.

The History curriculum is also a component of the Foreign Language and International Trade program, as well as the new Global Studies cognate. The department’s majors who complete Class A & B certificates in education meet all the requirements of the “No Child Left Behind” law. Beyond offering classes, the department actively pursues links with county and city schools for pedagogical and recruitment purposes through on-campus programs and off-campus collaboration. To sustain excellence in teaching and to foster individual professional growth, the department expects faculty to pursue activities in research and publication and to participate actively in professional organizations

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 requirements of UAH’s graduate school, the History Department requires the following for the Master of Arts degree:

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 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;
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:

171 College of Liberal Arts
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, the Department may ask the applicant to take 6 to 12 course hours at the 400-level (senior undergraduate) in order to fill the deficiency before admitting him or her to the program. 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.

510 Public History 3 hrs.
Public history and its application in areas such as public policy, historical editing, local and community history (including historical societies), archival collection (including electronic databasing) and historic preservation, oral history, museum programs, and historical sites interpretation.

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, and international conflicts from 1700 through the Revolutionary War to 1812.

528 The Republic in Crisis 3 hrs.
Political, social, and economic changes in the United States and its sections from 1812 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.

615 Studies in Early American History 3 hrs.
Research, writing, and critical examination of selected topics in early American history from 1607 to 1800.

Research, writing, and critical examination of selected topics in nineteenth-century American history.

Research, writing, and critical examination of selected topics in twentieth-century American history.

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.

PHILOSOPHY

Chair: Andrew Cling, Associate Professor  
Morton Hall 325  
(256) 824-2334  
clinga@uah.edu

The Department of Philosophy offers a comprehensive program of study leading to a Bachelor of Arts degree in Philosophy. It also offers the following course for graduate students, especially for those enrolled in the Primary Care Certificate Program and in graduate programs in Biology or Biotechnology.

Graduate Courses in PHILOSOPHY (PHL)

515 Biomedical Ethics 3 hrs.  
Introduces basic concepts of biomedical ethics; fosters careful reflective thought about the challenging value questions raised by advances in biology, medicine, and medical technologies. Prerequisites: 6 hours of PHL, graduate standing, admission to Primary Medical Care Certificate Program, or permission of instructor.

POLITICAL SCIENCE - PUBLIC AFFAIRS PROGRAM

250 Morton Hall  
Telephone: (256) 824-6192  
Email: publicaff.grad@uah.edu

Degree: Master of Arts

Co-Coordinators: Roy L. Meek and Allan Spitz, Professors Emeriti

Professors Emeriti:
  Meek, R.L.: American national government, judicial politics, public policy and law
  Spitz, A.: American national government, constitutional development, political philosophy

Associate Professors:
  Hawk, K. H.; national security policy, international relations, comparative politics

College of Liberal Arts  
174
Pottenger, J.R.; political theory and public policy  
Reeves, A.E.; American governments, federalism, legislative politics, public policy, research methods  
Williams, T.J.; American governments, intergovernmental relations, public administration  

Assistant Professors:  
Marcus, R.R.; international relations, comparative politics, public management  

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 public and/or private sectors of American society. The program provides the foundation for productive participation in organizations dedicated to the development, implementation, and evaluation of public policies in the United States. It is expected that the typical graduate will function within public organizations at the national, state, or local levels. In addition, the skills and expertise that are developed in the program will enhance the ability of graduates to contribute to the success of non-profit and for-profit private sector organizations 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 program’s design. Therefore, the acquisition of relevant skills in quantitative and qualitative analyses is a central expectation for all students who complete the program.

Clientele  
The program is designed to serve the needs of students who hold the bachelor’s degree in any field. The criteria for admission to the program are those specified for the master’s degree by the Graduate School at The University of Alabama in Huntsville. Admission does not depend on any particular subject matter expertise. The goals and interests of students rather than subject matter proficiency are the primary criteria for the selection of students for participation in the program. Students will be expected to complete a statistics course, such as SOC 333, PY 300, or AHS 300, if they have not taken one. Instruction in the program assumes the level of intellectual development and maturity expected of an above average college graduate.

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. Typically, these students will be employed by public or private sector organizations in which the principles and practices of public affairs are relevant. Successful completion of the program is expected to lead to enhanced organizational contributions and provide opportunities for career advancement. The program also is appropriate for the person who aspires to shift careers toward public policy activities. The design and scheduling of courses in the program assume that most students will have significant practical experience and will enroll in the program on a part-time basis. The program also is appropriate for persons with limited organizational experience, and every effort is made to make it possible for such students to enroll in the program on a full-time basis. Generally, in cases where students don’t have practical experience, a degree in one of the social sciences or a field of administrative science would be 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. 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.

175  
College of Liberal Arts
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 600-level.
2. A minimum of 18 hours at the 600-level.
3. Foundation courses - 12 hours. All of the following courses are required.*
   - PSC 600 The American Polity
   - PSC 601 The Public Policy Process
   - PSC 610 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. Political Science Electives (18 hours)
   - PSC 520 Intergovernmental Relations
   - PSC 551 Public Policy and the Law
   - PSC 565 American Foreign Policy
   - PSC 568 National Security Policy
   - PSC 580 Special Topics in Political Science
   - PSC 605 Public Policy Seminar
   - PSC 611 Public Personnel Administration
   - PSC 615 Special Topics in Administration
   - PSC 630 Public Values and Public Policy
5. Other options (6 hours)
   - Courses in other disciplines. Student should consult with department chair to determine appropriate course work from other disciplines.
   - PSC 695 Internship in Government (3-6 hours)
   - PSC 699 Master’s Thesis (6 hours)

Graduate Courses in Political Science (PSC)
520 Federalism and Intergovernmental Relations 3 hrs.
Examination of the theory and practice of American federalism with emphasis on the constitutional framework, intergovernmental relations and the changing roles of state and local governments.

551 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.

565 American Foreign Policy 3 hrs.
Analysis of major theories explaining foreign policy and various controversies surrounding policy processes and issues.

568 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.

580 Special Topics in Political Science 3 hrs.
Selected topics in local, state, national and world politics.

600 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.

601 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.

605 Public Policy Seminar 3 hrs.
Focuses on specific policy areas of the national government such as foreign policy, science policy, or national security policy.

610 Public 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.

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.

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.

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 3-6 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

Assistant Professors:
Edwards, J.; development and aging; cognitive aging
Morris, A.; human factors, perception
Neuschatz, J.; false memories; forensics
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 coursework 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.

Mission
The focus of the Department of Psychology is threefold: teaching, scholarship, and service. Consequently, the mission of the department centers upon development of students, development of faculty and scholarly activities, and service to scholarly and professional societies as well as to appropriate communities, including those within UAH.

The Department of Psychology supports the Mission of the College of Liberal Arts in a variety of ways. We provide close interactions between teachers and learners in our seminar courses, as well as in our research courses and internship opportunities. The Department of Psychology encourages personal and professional growth in its promotion of students' career exploration, knowledge acquisition, skill development (i.e., critical thinking, technical writing, oral communication, and statistical analyses), and valuation of diversity.

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 (empirical report) 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 Psychopharmacology  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.

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. (Same as ISE 524.)

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.

536 Psychobiology of Stress and Illness  3 hrs.
Overview of physiological stress responses and their influence on health behavior and illness. Prerequisite: Senior/graduate standing. (Same as BYS 536.)

601 Advanced Developmental Psychology  3 hrs.
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  3 hrs.
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.

607 Professional Development in Research and Teaching  1 hr.
Introduction to professional issues, such as grant proposal writing, course development and teaching methods, clinical and research ethics, and teaching processes. Presentations of faculty research to familiarize students with the fields of psychology represented among the faculty. Required of first-year students. Prerequisite: Graduate standing in psychology.
608 Graduate Practicum in Teaching and Career Exploration 1 hr.
Focus on developing knowledge and skills relevant to future goals, such as career exploration, internship opportunities, resume writing, and graduate program exploration. Students will also be given the opportunity to provide supervised guest lectures in undergraduate courses. Presentation of graduate student research. Required of first-year students. Prerequisite: Graduate standing in psychology; PY 607.

610 Experimental Design 3 hrs.
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: PY 300, PY 302, and graduate standing in psychology.

611 Statistics for Experimental Methods 4 hrs.
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 3 hrs.
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: PY 300, PY 302, and graduate standing in psychology.

615 Graduate Seminar 3 hrs.
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.

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 in psychology. (Same as ISE 624.)

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 or 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 1, 2, 3, 6 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.
College of Nursing

210 Nursing Building
Telephone: (256) 824-6742
Email: nursing.grad@uah.edu

Degree: Master of Science in Nursing

Dean: C. Fay Raines, B.S.N., M.S.N., Ph.D., Professor
Associate Dean: Marsha Dowell, B.S.N., M.S.N., Ph.D., Associate Professor

Professor:
Raines, C.F.; psychiatric nursing, health policy

Clinical Professor:
Williamson, J.W.; adult nurse practitioner

Associate Professors:
Dowell, M.; adult acute care, health policy, administration
Lacey, S.; high risk maternal child nursing
Rozell, B.; rural health and community health nursing, administration, case management

Clinical Associate Professor:
Herrin, D.; administration, health care workforce

Assistant Professors:
Anderson, F.; administration, community health
Foote, D.; family nurse practitioner, gerontological nurse practitioner
Hays, M.; long term care, administration
McClellan, L.; pediatrics, stress in children
McElroy, E.; psychiatric nursing

Clinical Assistant Professors:
Busby, S.; family nurse practitioner
Lawson, M.; adult health, oncology
Newman, K.; family nurse practitioner, home health care, case management
Primeau, M.; family nurse practitioner
Warboys, I.; case management

Mission
The fundamental purpose of the College of Nursing is to prepare clinically excellent baccalaureate and master’s level nurses to deliver health care services to a culturally diverse population within a variety of health care settings. Our graduates practice as professionals, able to utilize critical thinking skills for therapeutic interventions, disease prevention and health promotion. The graduate, undergraduate and continuing education programs provide opportunities for participation in collegial, interdisciplinary learning activities that promote intellectual development and life-long learning. In support of the mission of the university, the College of Nursing, through its graduates, faculty activities, and programs, contributes to the health and well-being of the community.

Overview
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.
Graduate Program Objectives

1. Demonstrate clinical decisions making skills in the delivery and management of care for diverse populations in a variety of settings.
2. Utilize theoretical bases and scholarly inquiry to intervene therapeutically to improve patient outcomes.
3. Utilize leadership, communication and political skills in augmenting optimal health care outcomes and policies.
4. Incorporate human, fiscal and technology resources in providing and managing advanced care.
5. Successfully complete national certification appropriate to areas of specialty.
6. Continue life-long learning and are prepared to pursue doctoral education in nursing.

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.

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, clinical nurse leader 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.
Clinical Nurse Leader
The Clinical Nurse Leader is prepared to oversee the care coordination of distinct groups of patients and has advanced technical skills for care of complex patients at the bedside. This nurse collects and evaluates patient outcomes, assesses cohort risk, and has decision-making authority to change plans of care when necessary. This nurse will incorporate outcomes-based practice, use informatics in healthcare and quality improvement strategies in practice. This nurse is a leader in the health care delivery system across all settings in which health care is delivered.

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 serves 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 unencumbered registered nurse 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. Students may also be required to have criminal background checks prior to attending selected clinical agencies
5. Documentation of current license to practice as a registered nurse must be provided to the College of Nursing Office of Student Affairs prior to enrollment in a nursing class. Registered nurse students must submit proof of an unencumbered current license. If a student is permitted to meet course clinical requirements in a state other than Alabama, the student must be licensed in that state. Registered nurse students will not be allowed to continue in the program if any nursing license is placed on probation, suspended, or revoked. Licensure must be maintained throughout the program.

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  FNP I, II, III, IV
Nursing Administration I, II  ACNS I, II, III, IV
Advanced Health Assessment
CNL I, II, III, IV
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. For initial enrollment, 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. Documentation of the completed series is required for continued enrollment and must be received by the College 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.

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.
- Primary Care of Adults (NUR 610) 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.

Clinical Nurse Leader 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.
- Clinical Nurse Leader I (NUR 680) 6 hrs.
- Clinical Nurse Leader II (NUR 681) 6 hrs.
- Clinical Nurse Leader III (NUR 682) 6 hrs.
- Clinical Nurse Leader IV (NUR 683) 6 hrs.
A minimum of 42 semester hours is required in the Clinical Nurse Leader 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.
- Primary Care of Adults (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 Primary Care of Adults: 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: 2-4 hrs.
- Advanced study of selected area of interest in nursing. Elective. Prerequisite: Approval of instructor. Lab Fee: $30. Fall, Spring, Summer.

524 Healthcare and the Law: 3 hrs.
- Introduction to basic health law in the context of application to nursing practice. Content relates to involvement with legal principles in nursing and healthcare. Federal, state and local aspects of law are included. (Cross listed with NUR 424) Lab Fee $30. Summer

525 Human Sexuality: 3 hrs.
- Theory and issues related to human sexuality in health and illness. Emphasis on theory and values, clarification of human sexuality needs. Elective, open to all university students. (Cross listed with NUR 425) Lab Fee: $30. 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. (Cross listed with NUR 434) 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. (Cross listed with NUR 437) 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 Primary Care of Adults 6 hrs.
Clinical course that introduces advanced nursing concepts and skills necessary for assessment, health promotion and illness prevention, and health management of the adult client within primary health care settings. Pre/co requisites: 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. Pre/co requisite: 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.
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.

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, 622. 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 6 hrs.
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 6 hrs.
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 3 hrs.
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 3 hrs.
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 3 hrs.
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 3 hrs.
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 3 hrs.
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 3 hrs.
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 3 hrs.
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. Pre or co requisites: NUR 640, 641, 642. 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. Pre/co-requisites: 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. Pre/co-requisites: 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 College of Nursing
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.

670 Epidemiology in Rural Health 6 hrs.
Overview of epidemiologic methods with discussion of application to diagnosis and choice of therapy. Concepts and mechanisms related to transmission, acquisition of disease, trends and distribution of patterns of disease discussed. The application of epidemiology to human health problems and rural settings is emphasized. Pre-requisites: Graduate standing or permission of instructor. Lab fee $30. Fall

671 Foundations of Primary Care with Practicum 5 hrs.
Development of a foundation of knowledge related to being involved in the primary care of patients. Includes understanding the various roles of primary care providers; the various elements of primary care; means of evaluating quality of care; identifying the components of cost of care and how information systems are used to assist in analysis. Practicum includes instruction in meeting the needs of the public through the development of primary care skills. Understanding the need for collaboration in a primary care setting. Evaluating the effectiveness and efficiency of a primary care operation. Developing some key skills by the primary care provider. Pre-requisite: Permission of instructor. Lab fee $150. Summer

670 Epidemiology in Rural Health 6 hrs.
Overview of epidemiologic methods with discussion of application to diagnosis and choice of therapy. Concepts and mechanisms related to transmission, acquisition of disease, trends and distribution of patterns of disease discussed. The application of epidemiology to human health problems and rural settings is emphasized. Pre-requisites: Graduate standing or permission of instructor. Lab fee $30. Fall

671 Foundations of Primary Care with Practicum 5 hrs.
Development of a foundation of knowledge related to being involved in the primary care of patients. Includes understanding the various roles of primary care providers; the various elements of primary care; means of evaluating quality of care; identifying the components of cost of care and how information systems are used to assist in analysis. Practicum includes instruction in meeting the needs of the public through the development of primary care skills. Understanding the need for collaboration in a primary care setting. Evaluating the effectiveness and efficiency of a primary care operation. Developing some key skills by the primary care provider. Pre-requisite: Permission of instructor. Lab fee $150. Summer

680 Clinical Nurse Leader I 6 hrs.
This course will introduce key concepts that impact today’s healthcare environment and patient population as well as relevant quality management tools that improve patient care delivery and outcomes. In addition, the role of the clinical nurse leader will be explored. Pre- or co-requisites: NUR 605, 606. Lab fee $180. Fall

681 Clinical Nurse Leader II 6 hrs.
Case 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. Pre-requisite: NUR 680, Pre or co-requisite: NUR 606 or 607. Lab fee $180. Cross listed with NUR 661. Spring.

682 Clinical Nurse Leader III 6 hrs.

683 Clinical Nurse Leader IV 6 hrs.
This course serves as the capstone course for the Clinical Nurse Leader track where students will apply their knowledge to projects and presentations of the relevant issues facing today’s healthcare setting. Pre-requisite: NUR 682. 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. Pre/co-requisites: 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/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: Daniel M. Rochowiak, B.S., Ph.D., Associate Professor of Computer Science

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
  Atmospheric Science
  Biological Sciences
  Chemistry
  Computer Science
  Mathematics
  Physics
  Interdisciplinary programs offered in cooperation with the College of Engineering include:
    Biotechnology Science and Engineering
    Materials Science
    Optical Science and Engineering
  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
Knupp, K.R.; severe storms, radar meteorology
Newchurch, M.J.; atmospheric chemistry and air pollution
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

Assistant Professors:
Mecikalski, J.; data assimilation

Mission
The UAH Atmospheric Science Department is devoted to providing high-quality education to graduate and under-graduate students and to contributing international-caliber research principally in the area of remote sensing with emphases in atmospheric chemistry and air pollution, radiative transfer, microwave radiometry, severe storms, numerical modeling, and climate-change modeling and measurements.

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 four core courses:

ATS 509 Applications of Computers in Meteorology
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), 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 four core courses (above), at least two
semester hours of credit in ATS 780 and 781 (Seminar series), 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 four common core courses (ATS 509, 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 (ATS 541, 551, and 561) 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). These three semester hours may not be used to meet minimum degree requirements.

197
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.)

**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 238, PH 112. (Same as ATS 441, ES 441, ES 541.) Fall.

551 Atmospheric Fluid Dynamics 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 238 and PH 112. (Same as ATS 451, ES 451, ES 551.) Fall.

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 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 238, 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
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 238, ATS 541, 551. Spring, odd years.

651 Atmospheric Fluid Dynamics II
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.

652 Synoptic Meteorology
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.

655 Boundary Layer Meteorology
General survey of atmospheric boundary layer properties. Individual topics include a review of turbulence theory, convective and stable boundary layers, surface processes, boundary layer discontinuities, cloud-topped mixed layers, modeling, and parameterization. A variety of UAH instruments are utilized extensively to enhance understanding of ABL processes. Prerequisites: ATS 509, 541, 551. Spring, odd years.

656 Tropical Meteorology
Course draws together concepts in the dynamics and climatology of the tropical atmosphere, and of significant precipitation systems in the Tropics. Topic areas include synoptic climatology, dynamics of tropical flows (e.g., Kelvin waves, Equatorial flows), convective scale dynamics, island meteorology, tropical cyclones, and the forces driving tropical circulations (e.g., ENSO, radiative-convective equilibrium, latent heating distributions, gregarious cloud systems). Prerequisites: ATS 541, 551.

670 Satellite Remote Sensing I
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 238, PH 112. Fall, odd years.

671 Ground-Based Remote Sensing
Basic principles of active and passive ground-based remote sensing systems; Doppler and polarization diversity weather radars, wind profiling radars, lidars, Doppler sodar, and passive radiometer systems. Ground-based remote sensing techniques that probe atmospheric composition, atmospheric structure and processes; extensive "hands on" usage of a variety of ground-based remote sensing instruments. Prerequisite: ATS 541. Spring, even years.

675 Atmospheric Data Assimilation
Data assimilation methods and concepts; Topics in objective analysis, interpolation and initialization, as relevant to numerical weather prediction and data analysis; Emphasis on variational methods, successive correction, optimal interpolation, adjoint and gradient concepts, general estimation theory, and assimilation approaches for various types of observations; Other concepts: singular vectors, Kalman filters and nudging. Applications with 1D and 2D assimilation.

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/ATS 551. (Same as ES 681.)
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.

762 Microparticle Optics and Radiometry 3 hrs.
Contemporary issues in the propagation of electromagnetic radiation. Emphasis on interactions with particulate matter and microstructures, including microparticle cavity resonances. Applications in remote sensing, aerosol & cloud climatology, photonics, astronomy & astrophysics, biomedical optics, and spectroscopy. Topics will include: Maxwell's equations, Kramers-Kronig analysis, Mueller matrices & Stokes vectors, Rayleigh theory, scattering & absorption by single & multispher lockdown: and internal fields, geometric optics approximations, discrete dipole approximation, and T-matrices.

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:
Boyd, D.L.; developmental biology, genetics
Johnson, A.D.; nutritional physiology
Leahy, J.G.; environmental microbiology, molecular physiology, evolution of biodegradative microorganisms
Magnuson, R.D.; signaling and regulation of bacterial gene expression

Assistant Professors:
Bishop, A.; neurobiology, Alzheimer's disease
Davis, M.R.; plant molecular biology, genomics and biotechnology
Ng, J.; structural biology, biochemical evolution of RNA, microgravity protein crystallization

Mission
The UAH Department of Biological Sciences aspires to provide one of the best programs in the Southeast U.S. contributing to meeting these challenges through undergraduate and graduate education and research. Best is understood in terms of both quality and efficiency. At the undergraduate level, we want majority of UAH undergraduates to have at least one course in biology to provide some biological science literacy for their lives as adults. For biological science majors, we want to ensure forward-looking, comprehensive curricula that meet the highest national standards. This must include instruction and laboratory experience in each of the principal areas within biological sciences, and supporting course work in mathematics, chemistry and communications and bioethics. In addition, we want to provide our undergraduate majors with support and research experience necessary to build careers beyond the undergraduate level in employment and graduate and professional schools. At the graduate level, the ultimate objective of the Department of Biological Sciences is to educate and train students the critical, problem solving and independent thinking skills that form the foundation for graduate research. Through our programs in M.S and the interdisciplinary Biotechnology Ph.D degree and at the Postdoctoral level we aspire to provide thorough training and mentoring to cultivate future scientists, who are trained in cutting edge science to serve the national needs in both education and industry

A student may elect a program leading to either a Bachelor of Arts or a Bachelor of Science degree. In most areas of biological interest, a Bachelor of Science degree is deemed more desirable; however, a Bachelor of Arts degree may be preferred in Programs of Study relating biological sciences to the humanities, social sciences, and economics. In either case, the biological sciences department is committed to high quality undergraduate instruction, with the ultimate goal to produce accomplished graduates who can pursue advanced degrees in the health or life sciences or who can develop meaningful careers in the biological sciences.
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 300 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 3 hrs.
Advanced studies of replication, transcription, and translation involved in the passage of genetic information and expression, with specific emphasis on RNA processing, editing, and structure. Macromolecular topology corresponding to biological function. Prerequisites: BYS 219 and BYS/CH 361.

532 Animal Physiology 4 hrs.
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 201 or 331 or graduate standing.

535 Advanced Microbiology 3 hrs.
Aspects of microbial behavior, development, morphogenesis or physiology. Prerequisites: BYS 321 and BYS/CH 361.

536 Psychobiology of Stress and Illness 3 hrs.
Overview of physiological stress responses and their influence on health, behavior, and illness. Prerequisite: 9 hrs. BYS or PY. (Same as PY 536.)

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 300; BYS/CH 361 recommended.

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, 300, and 519 (may be taken concurrently) or approval of instructor. One 2-hour and one 5-hour lab per week. Lab Fee: $250.

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.
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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</table>
| 564        | Limnology                                        | 3 hrs.
|            | Fresh-water environments and organisms exemplified by lakes, ponds, and streams in North Alabama. |       |
| 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.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>510</td>
<td>Radiation Biology</td>
<td>4 hrs.</td>
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<td></td>
<td>Characteristics of radioisotopes, detection and counting techniques and instrumentation, tracer techniques, health and safety system. Prerequisite: Consultation with instructor.</td>
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<tr>
<td>511</td>
<td>Biological Control</td>
<td>4 hrs.</td>
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<td>Components of resistance, use of parasites, predators and microorganisms, foreign exploration, shipment, release and establishment of imported parasites and predators.</td>
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<tr>
<td>512</td>
<td>Histotechniques</td>
<td>3 hrs.</td>
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<td></td>
<td>Microscopic study of the various tissues and organs of the animal systems.</td>
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<tr>
<td>522</td>
<td>Microbial Physiology</td>
<td>3 hrs.</td>
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<td></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>
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<td></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>
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<td>Lines of phycomyces 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, orders and families. Lab Fee: $40.</td>
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<tr>
<td>526</td>
<td>Microbial Ecology</td>
<td>4 hrs.</td>
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<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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<td>533</td>
<td>Medical Physiology I</td>
<td>4 hrs.</td>
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<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>
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<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>
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<td></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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</tbody>
</table>

205 College of Science
540 Molecular Biology
Structure, behavior, and function of larger biological molecules including biological oxidations, metabolism of carbohydrates, lipids, amino acids, and genetic aspects of metabolism. Prerequisite: Organic Chemistry.

541 Cell Physiology
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.

542 Analytical Biochemistry Laboratory
Advanced laboratory dealing with modern techniques of molecular biology and biochemistry. Prerequisite: Organic Chemistry.

546 Cytogenetics
Analysis of composition, morphology, and behavior of genes, especially as they relate to function, development, and heredity. Prerequisite: BIO 406.

551 Insect Physiology
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.

552 Insect-Pest Management
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
Classification of insects, external and internal anatomy of insects, with emphasis on the comparative and functional aspects. Prerequisite: BIO 455.

560 Environmental Biology
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

570 Plant Pathology
History, nonparasitic, and parasitic diseases incited by bacteria, fungi, plasmodiophable, nematodes, and viruses. Disease control through exclusion, eradication, protection, and post resistance. Prerequisite: BIO 344.

571 Plant Anatomy
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
Principles of classifying, naming, and identifying vascular plants with emphasis on flowering plants. Ecologic factors influencing vegetational distribution.

590 Problems in Biological Sciences
(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
Examine by microbiological assay sewage disposal and wastewater treatment plants. Microorganisms of industrial importance in biological production of antibiotics, vitamins, organic

College of Science
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 3 hrs.
Mechanisms of cardiac muscle excitation and interaction. Analysis of peripheral circulation. Neural regulation of circulation. Angiograph, electrocardiography, and vectorcardiography as diagnostic tools. Prerequisites: Medical Physiology I and II.

642 Advanced Cell Physiology 4 hrs.
Biochemical and biophysical cytology. The cell as matter, life history of the cell, molecular basis of cellular activities, enzymes and energy conversions, functional localizations in subunits of the cell, mechanisms of motility, structure and function of cell membranes, effects of radiation on cells, biochemical control mechanisms, cellular differentiation and interaction between cells, hypotheses of cellular origins. Laboratory included. Prerequisites: molecular biology, physics, cytology, biochemistry.

645 Human Cytogenetics and Its Clinical Application 3 hrs.
Review of normal human chromosome structure and normal chromosome segregation and morphology with clinical consideration.

652 Advanced Applied Entomology 4 hrs.
Economic thresholds, economic injury levels, population dynamics, residues in food crops, chemical control, insect transmission of plant disease, and livestock. Prerequisite: General entomology.

653 Taxonomy of the Immature Insect 4 hrs.
Literature, comparative morphology and techniques of identification of immature stages of the insect, methods of collecting and preserving the immatures. Lab Fee: $40. Prerequisite: BYS 455 or approval of instructor.

CHEMISTRY

C203 Materials Science Building
Telephone: (256) 824-6153
Email: apply@matsci.uah.edu
Web Site: http://chemistry.uah.edu/

Degree: Master of Science

Chair: James K. Baird, Professor

Professors:
- Baird, J.K.; crystal growth, 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
- Naumann, R. J.; heat and mass transfer in materials science
- Radonovich, L.J.; x-ray crystallography, organometallic chemistry
- Riley, C. (Emeritus); electrodeposited materials, biocompatible surfaces
- Setzer, W.N.; biomedical aspects of biologically active phytochemicals
- Shriver, J.S.; NMR spectroscopy

Associate Professors:
- Chen, L. (Research); x-ray diffraction of large molecules
Mission
The mission of the Department of Chemistry is to provide high quality undergraduate and graduate education in all aspects of chemistry, with a special emphasis in materials science and biotechnology. Our goal is to educate our students in chemistry, and to provide them with life-long learning skills allowing them to adapt to an ever-changing environment. Our faculty and students strive to generate new knowledge through research and other creative activities that will benefit the residents of Huntsville, the state of Alabama, the nation, and the world.

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

Field Courses
2. Inorganic Chemistry: CH 600 Advanced Inorganic Chemistry should be used to satisfy this requirement, then CH 549 Spectroscopy and Molecular Structure can be taken if needed.
5. Polymer Chemistry: CH 540 Polymer Synthesis and Characterization, and CH 645 Polymer Physical Chemistry.

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, 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 coursework 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”). Ph.D. research in the area of biotechnology (including biochemistry, structural biology, molecular biology and natural products) is possible under the direction of chemistry faculty within the guidelines and requirements of the Biotechnology Science and Engineering 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, 238. (Same as PH 451, PH 551, OSE 555, MTS 651.) Fall.

College of Science 210
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 Electrodynamicas 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 238.

**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 238, 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.

**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 238.

**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
Modeling and Simulation
Information Assurance

Chair: Heggere S. Ranganath, Professor

Professors:
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
Etzkorn, L.H.; software re-use, object oriented software development
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

Assistant Professors:
Cox, G.; computer architecture, networks, distributed systems
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

Mission
The overriding objective or mission of the Computer Science program is to prepare students to become contributors to the computer science profession, whether they find themselves in industrial, government, research, or university environments. The educational objectives of the Computer Science Department, which are based on the department's commitment to excellence in teaching, research, and service, and overall development of students are consistent with the mission statement of the University.

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, modeling and simulation, and 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, 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. Any student who completes CS 650 and 15 additional semester hours selected from the following will receive the software engineering certificate. The courses in this area include:

- CS 551 Software Modeling
- CS 552 Analysis and Design Patterns
- CS 553 Client Server Architectures
- CS 650 Software Engineering (required for the certificate)
- CS 652 Object-Oriented Analysis and Design

Additional courses include:
- CS 651 Formal Methods in Software Engineering
- CS 654 Software Testing
- CS 658 Software Process and Product Improvement
- CS 666 Software Studio I
- 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

Additional courses include:
- CS 543 Introduction to Multimedia Systems
- 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 581 Modeling and Simulation I
- CS 582 Modeling and Simulation II
- CS 585 Introduction to Computer Security
- CS 587 Database Systems
- CS 543 Introduction to Multimedia Systems
- CS 643 Multimedia Systems
- CS 685 Computer Security

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 553 Client/Server Architectures

Additional courses include:
- CS 570 Computer Networks
- CS 613 Computer Architecture

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 635 Computational Models of Cognition
- CS 537 Introduction to Neural Networks
The languages and systems area includes instruction in programming languages, systems programming, operating systems, and their use in problem solutions.

**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 551, 552, 553, 652, 655, 656, 658, 666, or 668. Students desiring to complete the certificate program should have either industrial experience in software development or have undergraduate courses in software development. Students pursuing an MSSE degree are not eligible for the Software Engineering Certificate.

**Modeling and Simulation Certificate**
The certificate in Modeling and Simulation will provide post-baccalaureate students with the opportunity to acquire knowledge and skill in the use of computational theories and skills for the development of software models and simulation. The courses in the certificate program may be applied to the M.S. in Computer Science. Students in the certificate program must be admitted to the graduate school, have a bachelor's degree in science or engineering, have taken linear algebra, calculus, discrete math and probability, and be proficient in programming and data structures. The certificate program consists of 5 courses, to include:

- **Two core courses:** CS 581 (Modeling and Simulation I) and CS 582 (Modeling and Simulation II)
- **Two courses from one of the following groups:**
  1. **Object-oriented programming and software engineering**
     - CS 551 (Software Modeling)
     - CS 552 (Analysis and Design Patterns)
     - CS 650 (The Software Engineering Process)
  2. **Visualization**
     - CS 545 (Introduction to Computer Graphics)
     - CS 548 (Human Computer Interaction)
     - CS 645 (Computer Graphics)
     - CS 646 (Computer Geometry Modeling)
  3. **Information Systems**
     - CS 530 (Expert Systems and Heuristic Programming)
     - CS 553 (Client/Server Architectures)
     - CS 630 (Artificial Intelligence I)
     - CS 670 (Computer Networks)
     - CS 687 (Data Base Systems)

One additional course from those listed above, or an approved domain course.

**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
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 M.S. 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. 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 424 or 524 as a prerequisite to the MSSE program.
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 27 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 form their advisor.

Plan II. (non-thesis) A minimum of 33 semester hours of coursework is required. A Plan II student must pass a written comprehensive examination over the 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 three core courses (9 semester hours):
CS 617 Design and Analysis of Algorithms
CS 650 The Software Engineering Process
CS 655 Formal Methods in Software Engineering

All students completing the M.S.S.E. must take one of the following (3 semester hours) as their fourth core course:
CS 613 Computer Architecture
CS 690 Advanced Operating Systems

All students completing the M.S.S.E. must take the following four courses (12 semester hours):
CS 652 Object-Oriented Analysis and Design
CS 656 Software Testing
CS 666 Software Studio I (personal software process)
CS 668 Software Studio II (group software process)

Students completing the M.S.S.E. under Plan II (non-thesis) must take 9 additional semester hours of general elective courses. Students completing the M.S.S.E. under Plan I (thesis) must take 3 additional semester hours of a general elective course. A general elective can be any graduate-level course that is pre-approved by the advisor.

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. 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 is 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  
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. Review of Machine and Assembler language programming. Architectural trade-offs. Lab Fee: $50.

517 Data Structures and Algorithm Analysis  
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  
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  
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.

543 Introduction to Multimedia Systems 3 hrs.
Multimedia authoring, color models for image and video, introduction to image and video compression, digital audio, multimedia networks. Prerequisite: CS490. Lab Fee: $50.

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.

551 Software Modeling 3 hrs.
A survey of techniques and methodologies for software modeling. General modeling (e.g., UML), formal models, model checking, limitations of modeling, validation of models, domain modeling, model-driven architecture. Comparison of different approaches, considering their advantages and disadvantages. Prerequisite: CS 317 or 617, or approval of instructor based upon applicable industrial software development experience. Lab fee $40.

552 Analysis and Design Patterns 3 hrs.
An in-depth examination of analysis Patterns and Design Patterns and how they can enable better analyses and designs (primarily more reusable and extendable). Advanced C++ and Java programming and techniques, concepts, and styles and how these apply to design patterns. Lab Fee: $40. Prerequisite: CS 307 or 321.

553 Client/Server Architectures 3 hrs.
Conceptual and practical aspects of client/server architectures, a software development paradigm that requires an understanding of object-oriented software technologies, World Wide Web technologies, networking and standardized middleware such as CORBA and J2EE. Fundamental concepts of distributed object computing. Students will apply the concepts in the development of practical distributed programs. Prerequisite: CS 307 or 321 (CS 470 recommended). Lab Fee $50.

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.

581 Modeling and Simulation I 3 hrs.
A general introduction to the computer science and software engineering aspects of modeling and simulation. Application of simulation analysis to the design and development of computer software and systems including modeling of computer and software components. Design, implementation, and application of discrete event simulation software. Lab Fee: $40. Prerequisites: CS214, CS221, MA244, MA385. Proficiency in programming.

582 Modeling and Simulation II 3 hrs.
Advanced methods in the application of modeling and simulation to computer science problems. Includes probability methods for modeling computer software and systems, design of experiments for computing systems, and analysis of alternate computing configurations. Development of software for advanced simulation systems including high-performance parallel simulations and real-time distributed simulations. Lab fee: $40. Prerequisites: CS581.

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. Prerequisite: CS490. Lab Fee: $40.

590 Programming Environments with UNIX 3 hrs.
Advanced strategies for the design and development of systems and programs in the UNIX environment. Emphasis on automated tool and system development using UNIX tools. Parallel and supercomputer issues as treated by UNIX and C. Advanced shell concepts and programming including control flow and interrupt handling. Process and interprocess communications. Prerequisite: CS 390 or two years experience in UNIX. Lab Fee: $40.

595 Independent Study 3 hrs.
Individual directed study under the supervision of an instructor. Prerequisite: approval of instructor.

596-598 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.

603 Formal Languages and Automata Theory 3 hrs.
Formal definition of programming languages. Definition of formal grammars: regular, context-free, context sensitive, and phrase-structure. Definition of automata: finite-state, pushdown, linear-bounded automata, Turing Machines. Relationship between formal languages and automata. Prerequisites: CS 317, CS 424 or 524; CS 403 recommended. Lab Fee: $40.

613 Computer Architectures 3 hrs.
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 3 hrs.
Strategies of algorithm synthesis and analysis. Design methodologies of classical algorithm categories such as: divide-and-conquer, greedy method, dynamic programming, search and traversal, back-tracking, and branch-and-bound. Computational complexity and important theoretical results from lower- and upper-bound studies, NP-hard, and NP-complete problems. Prerequisite: CS 317 or CS 517. Lab Fee: $40.

620 Curriculum Integration Technology 3 hrs.
Prepares teachers to plan curriculum integration by using computer technology and software in various curriculum areas for both regular and special students. Also develops competency in instructional design and production 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 3 hrs.
AI concepts and methods for problem solving, heuristic search, planning, hypothesis formation, modeling and knowledge representation, knowledge acquisition (learning), and AI's programming methodologies and tools. Applications of AI in areas of automatic programming, theorem proving, game playing, machine vision, natural language systems, and robots. Prerequisites: CS 317, CS 424 or 524. Lab Fee: $40.

635 Computational Models of Cognition 3 hrs.
Computational models of human information processing covering topics of current interest to both artificial intelligence and cognitive psychology. Use of computer simulations to test psychological theories. Application of psychological research to building AI systems. Prerequisite: CS 630. Lab Fee: $40.

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.

643 Multimedia Systems 3 hrs.
Lossless and lossy compression algorithms, image compression standards, video compression standards, MPEG video standards, audio compression, multimedia networking, multimedia synchronization, content-based retrieval. Prerequisite: CS 543. Lab Fee: $50.

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.

652 Object-Oriented Analysis and Design 3 hrs.
A survey of formal and informal techniques and methodologies for software analysis, requirements, architecture and design. Emphasis is on effective development processes. Comparison of different approaches, considering their advantages and disadvantages. Prerequisites: CS 650 or equivalent and either CS 307 or CS 321 or equivalent, or approval of instructor based on applicable industrial software development experience. Lab Fee: $40.

Formal mechanisms to specify, validate, and verify software systems. Propositional and predicate calculi. Program verification through Djikstra's weakest preconditions and Hoare's method. Formal specification via algebraic specifications and abstract model specifications. Prerequisites: CS 650, either CS 317 or CS 617, and either CS 307 or CS 321. Lab fee $40.
656 Software Testing
3 hrs.
Advanced software testing techniques, including white box, black box, integration testing, and system testing. Other topics may include test data adequacy, test data selection, and output oracle, including functional, structural, and fault-based testing methods. Prerequisite: CS 650. Lab fee $50.

658 Software Process and Product Improvement
3 hrs.
Software quality assurance as an umbrella activity. Use of process, project, quality and product metrics to gain insight into the software development activity. Use of metrics to drive incremental process improvement techniques. Examination of CASE tools and how they affect the software process. Prerequisite: CS 650. Lab Fee $50.

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 Transport Layer, 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.

717 Advanced Algorithm Design and Analysis
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
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
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
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.

790 Operating Systems Seminar
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
Individual directed study under the supervision of an instructor. Prerequisite: Approval of instructor.

796-798 Advanced Selected Topics in Computer Science
Course offered by an instructor in a specialized area of computer science. Prerequisite: Approval of instructor. Lab fee $40.

799 Doctoral Dissertation
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 that 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.)

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.) Fall.

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 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 that 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 College of Science
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 238, 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 238 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 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, ATS 554, ES 454.)

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 238, PH 112. (Same as ATS 461, ATS 561, ES 461.) Spring.

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

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: ES 520 or consent of instructor. (Same as ATS 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
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. 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: ES 501 or consent of instructor. (Same as ATS 622.)

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
- Ravindran, S.S.; computational fluid dynamics
- Zhang, G.H.; graph theory, combinatorics

Assistant Professors:
- Ai, S.; differential equations, dynamical systems

Mission
The Department of Mathematical Sciences is dedicated to education, research, and service in mathematics.
education of our students through our courses and degree programs. As the language of science, mathematics is of fundamental importance to the general education of UAH students, particularly students planning careers in science and engineering. Through our bachelor’s, master’s and doctoral degree programs, our goal is to help produce the new generations of well-educated mathematicians that are critical for the progress of mankind.

Our mission in research and scholarship is to discover and disseminate new mathematics and to apply mathematics to problems in engineering and in the physical, biological, and social sciences.

Our service mission is to promote and communicate the importance of mathematics in society and to help maintain standards of excellence in mathematics through refereeing and reviewing. Our service mission is to work with other departments and units in UAH to achieve the goals of the College of Science and the university as a whole.

We offer 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.

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 cannot 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 cannot 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. Prerequisites: 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 3 hrs.
Complex algebra, analytic functions, Cauchy-Riemann equations, exponential, trigonometric, and logarithmic functions, integration, Cauchy integral theorem, Morera's theorem, Liouville's theorem, maximum modulus theorem, residue theory, Taylor and Laurent series, and applications. Prerequisites: MA 201 and one MA course at the 300 level or above, or approval of instructor.

506 Methods of Partial Differential Equations 3 hrs.
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 238 and MA 244. No credit given to students who have successfully completed MA 526.

508 Applied Linear Algebra 3 hrs.
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 238. No credit given to students who have successfully completed MA 544.

Graduate Courses in Mathematics (MA)

515 Introduction to Numerical Analysis 3 hrs.
Analysis and derivation of numerical methods for: the approximate solution of nonlinear equations; interpolation and integration of functions; approximating solutions of ordinary differential equations. Prerequisites: MA 244, 238, CS 121 or equivalent, plus one 500-level (or higher) MA course, or graduate standing in the Department of Mathematical Sciences. Lab Fee: $40.

520 Intermediate Differential Equations 3 hrs.
This is a second course in differential equations. Course topics include series solutions for second order differential equations and the method of Frobenious; eigenvalue and eigenvector methods for solving systems of linear first order equations; the qualitative theory of nonlinear equations; boundary value problems and the Sturm-Liouville theory. Prerequisites: MA 201, MA 244, and MA 238. This course is taught as MA 420/520. Course completion and/or grade requirements for the MA 520 course will differ from those for the MA 420 course.

524 Dynamical Systems I 3 hrs.
Scalar autonomous equations; existence, uniqueness, stability, elementary bifurcations; planar autonomous equations; general properties and geometry, conservative systems, elementary bifurcations, linear systems, reduction to canonical forms, stability and instability from
linearization. Liapunov functions, center manifolds, Hopf bifurcation. Prerequisites: MA 244, MA 238, and MA 452.

526 Partial Differential Equations I 3 hrs.
Introduction to the theory for solving partial differential equations. No graduate credit given to students who have completed MA 506 for graduate credit. Topics include second-order equations, reduction to canonical form, well-posedness, the classical equations (wave, heat, and Laplace's) in one and several dimensions, separation of variables, Fourier series, general eigenfunction expansions, Sturm-Liouville theory, first-order linear and quasilinear equations, and shocks. Prerequisites: MA 502, one other 500-level MA course. (MA 506 is NOT a prerequisite.)

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

540 Combinatorial Enumeration 3 hrs.
Counting, pigeonhole principle, permutations and combinations, generating functions, recurrence relations, principle of inclusion and exclusion, Polya's theory of counting. Prerequisites: MA 442 or approval of instructor.

542 Algebra 3 hrs.
Topics from group theory and ring theory: subgroups, normal subgroups, quotient groups, homomorphisms, isomorphism theorems, ideals, principal ideal domains, Euclidean domains, fields, extension fields, elements of Galois theory. Prerequisites: MA 442 or approval of instructor.

544 Linear Algebra 3 hrs.
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 3 hrs.
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 238. 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 3 hrs.
(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 238, acquaintance with classical Fourier analysis (such as covered in MA 460.)

565 Intermediate Mathematical Modeling 3 hrs.
Designed for beginning graduate students. No prior experience in a formal mathematical modeling course is required. In-depth discussion of some types of models from physics, the life sciences, and/or the social sciences, with formulation, analysis, and criticism of the models. Process of and factors involved in formulating a model will be of prime importance. Content will be divided into approximately one-half deterministic modeling and one-half stochastic modeling. Prerequisites: MA 244, MA 238, MA 385, one MA course at 400-level or above, and CS 121 or equivalent.

585 Probability 3 hrs.
Course topics include probability spaces, random variables, conditional probability, independence, modes of convergence, and an introduction to sigma-algebras and measurability; distributions, including discrete, continuous, joint and marginal distributions, transformations of random variable, distribution and quantile functions, and convergence in distribution; expected value, including properties of general expected value, mean, variance, covariance, generating
functions, and conditional expected value; special models and distributions, including Bernoulli trials and the binomial and negative binomial distributions, the Poisson model and the Poisson and gamma distributions, the normal distribution, finite sampling models and the hypergeometric distribution; the law of large numbers and the central limit theorem. 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. Prerequisites: MA 238. (Same as PH 607.)

609 Mathematical Methods II
Continuation of MA 607. Prerequisite: MA 607. (Same as PH 609.)

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 506 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 Poincaré 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 506 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. Prerequisites: 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. Prerequisites: 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. Prerequisites: 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. Prerequisites: MA 508 or MA 544, MA 503 or MA 656 recommended.

645 Combinatorial Design 3 hrs.
Systems of distinct representatives, difference sets, coding theory, block designs, finite geometries, orthogonal Latin squares, and Hadamard matrices. Prerequisites: MA 540, MA 544.

653 Real Analysis I 3 hrs.
Countable sets, characterization of open and closed sets, Heine-Borel theorem, Riemann integral, Lebesgue measure and outer measure, measurable functions, Lebesgue integral, Fatou’s lemma, and Lebesgue-dominated convergence theorem. Prerequisites: MA 538 and one MA course at the 540 level or above.

654 Real Analysis II 3 hrs.
Differentiability of monotone functions, functions of bounded variation, absolute continuity, convex functions, Minkowski and Holder inequalities, Lp spaces, Riesz-Fischer representation theorem, Fubini’s theorem and selected topics. Prerequisites: MA 653.

656 Complex Analysis I 3 hrs.
Topology of the complex plane, analytic functions of one complex variable, elementary functions and their mapping properties, power series, complex integration, Cauchy’s theorem and its consequences, isolated singularities, Laurent series, residue theory. Prerequisites: MA 502 or approval of instructor.

658 Introduction to Functional Analysis 3 hrs.
Normed and inner product spaces, finite dimensional spaces, product and quotient spaces, equivalent norms, Hahn-Banach theorem, principle of uniform boundedness, openmapping theorem, Riesz representation theorem, complete orthonormal sets, Bessel’s inequality, Parseval’s identity, and conjugate spaces. Prerequisites: MA 538.

661 Special Functions 3 hrs.
Gamma and beta functions, probability integral and applications, orthogonal polynomials, Bessel functions, and their applications, spherical harmonics and their applications, hypergeometric functions. Prerequisites: MA 503 or MA 656.

662 Asymptotics and Perturbation Methods 3 hrs.
Asymptotic series, regular and singular perturbation theory, asymptotic matching, Laplace’s method, stationary phase, steepest descents, WKB theory. Prerequisites: MA 502, MA 504 or MA 624, MA 503 or MA 656 recommended.

667 The Calculus of Variations and Optimal Control 3 hrs.
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 238, MA 502.

685 Stochastic Processes with Applications I 3 hrs.
Discrete and continuous Markov chains, Poisson processes, counting and renewal processes, and applications. Prerequisites: MA 585, MA 244 or approval of instructor.

686 Stochastic Processes with Applications II 3 hrs.
Gaussian and Wiener processes, general Markov processes, special types of processes from queueing and risk theory, and selected advanced topics. Prerequisite: MA 685 or approval of instructor.

690 Special Topics in Mathematics 3 hrs.
Offered upon demand. Advanced selected topics of interest in areas such as discrete mathematics, numerical analysis, differential equations, and stochastic processes.

695 Graduate Seminar 1 hr.
Selected topics in advanced mathematics, conducted as a research seminar.

699 Master’s Thesis 3 hrs.
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.

Finite element methods for parabolic, elliptic, and hyperbolic partial differential equations; error
analysis, stability, and convergence. Prerequisites: MA 538, MA 615. Lab Fee: $50.

**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. Prerequisites: 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 (Acting): A.V. Pakhomov, Associate Professor

Professors:
Mission
The mission of the Department of Physics encompasses the three areas of teaching, research, and service. Our undergraduate program prepares students for employment as industrial physics or for further graduate work in physics or related fields, including astrophysics, optics, biophysics, engineering, or medicine. We further play a vital role in the education of other science and engineering students, and promote the understanding and appreciation of science through our general study courses. Externally funded research is the foundation of our graduate program that prepares students for the many challenges and opportunities for new discoveries in private industry, government labs or at other universities. Finally we promote the advancement of science through publications, public outreach, and activities within our profession.

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**

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<td>PH 607</td>
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<td>Special Topic*</td>
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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. 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 andchromatic 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 even years.

**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 even years.

College of Science 238
551 Introductory Quantum Mechanics 3 hrs.
Waves and particles; Bohr's model of the atom; de Broglie waves, wave packets and the uncertainty principle; postulates of quantum mechanics. Prerequisites: PH 113, PH 351 or CH 343, MA 244, MA 238. (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; solids; magnetic fields, defects, impurities; relativistic quantum mechanics. Prerequisite: PH 551 or CH 553. (Same as PH 452, CH 554, MTS 652.) Spring.

553 Introduction to Particle Physics 3 hrs.
Survey of elementary particle physics with emphasis on the Standard Model of quarks, leptons, and gauge bosons. Lorentz transformations, four-vectors, relativistic kinematics, angular momentum. Lifetimes, cross-sections, and Feynman rules. Quantum electrodynamics, Dirac equation, renormalization. Physics beyond the Standard Model. Pre- or Co-requisite: PH 551. Fall even years.

560 Introduction to Solid State Physics I 3 hrs.
Crystal binding and crystal structure. Crystal structure determination. Phonons and lattice vibrations. Free and bound electrons. Prerequisite: 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, magnetism and superconductivity. 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; review of photorefractive effects. The role of coherence, detection, and diffraction calculations. Examination of systems and circuits; blindness, relay. Prerequisite: EE 541. Fall.

571 Astrophysics 3 hrs.
Advanced radiation theory: black-body radiation, radiative escape, quantum electrodynamics. Stellar atmospheres, stellar evolution, the characteristics of stellar atmospheres, stellar evolution, the characteristics of stellar atmospheres. Prerequisite: AST 371. Fall.

572 Advanced Astrophysics & Cosmology 3 hrs.
Hubble expansion, Friedmann equation, age of the universe, the standard cosmological model. Prerequisite: AST 371. Fall.

573 High Energy Astrophysics 3 hrs.
Quantum field theory; black-hole radiation, radiation from black holes. Prerequisite: PH 571. Fall odd years.

574 Introduction to General Relativity 3 hrs.
Geometry as physics. Newtonian gravity, gravitational and inertial mass, equivalence principle. Prerequisite: PH 571. Fall, even years.

575 Introduction to Quantum Mechanics I 3 hrs.
Quantum mechanics: the Schrödinger equation, probability density, quantum states. The quantum mechanical model of the hydrogen atom, quantum mechanics. Prerequisite: PH 571. Fall, odd years.

601 Classical Dynamics I
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 238. (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 matrix mechanics, 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, Sommerfeld’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.

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.

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 are 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
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Web site: www.coned.uah.edu
Director: Karen Mack Clanton, B.S.B.A., M.S.M.

The Division of Continuing Education is committed to meeting the diverse needs of organizations, agencies, and individuals through non-credit and credit programs that are timely, relevant, and in accordance with the strategic directions of the University. The Division provides access to quality education and training for individuals; partners with businesses and government for workforce development; enhances public awareness of the instructional and research strengths of the University; promotes lifelong learning fostering continued growth, human fulfillment, and positive social change; and supports economic development throughout North Alabama. This objective is carried out through the following programming departments: Professional Development, Educator Programs, Academy for Lifetime Learning, and Health and Physical Education.

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 state of the art computer labs for cutting edge engineering and computer training, and a distance learning production/classroom that allows production of high quality programs for presentation in a hybrid CD ROM/Web based format. 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
Certificate Programs and Short Courses
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 a student the choice of attending individual courses of interest, or to complete a more structured certificate program leading to a Certificate of Professional Achievement. Courses are offered day, evening, and through eTraining Solutions, our hybrid CD ROM/Web based distance learning format, to help accommodate the busiest of schedules. Students are offered an atmosphere conducive 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.

Certificate programs and professional review series include:
Aerospace Propulsion Systems
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Federal Contract Management Essentials
Federal Contract Management Specialization
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Java Developer
Linux
Modeling and Simulation
Net Application
Oracle Database
Oracle Developer
Procurement Management
Project Management
Customized Training

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. Training programs can also be developed in several convenient distance learning formats. 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.

Listener's License

The Division of Continuing Education 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.

For Information:
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Web Site: www.coned.uah.edu
FAX (256) 824-6934

EDUCATOR PROGRAMS

The Department of Educator Programs designs, develops, and conducts quality credit and non-credit professional development programs to meet the in-service needs of K-12 administrators, teachers, and staff. Partnerships are developed with local schools, government agencies, and the private sector to design unique programs to meet institutional needs and achieve educational objectives. Specific programs may be conducted in local, national, and international settings. Current programs include a hands-on graduate level course, Exploring Space: The Classroom Connection, offered in conjunction with the U.S. Space and Rocket Center.

For Information:
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Continuing Education
THE ACADEMY FOR LIFETIME LEARNING, INC.
The Academy for Lifetime Learning, Inc. (The Academy) provides lifelong learning courses and enrichment activities designed to fulfill the educational needs of the mature, usually retired, residents of the Tennessee Valley. The Division's goal is to engage mature adults in lifelong learning and to maximize the outreach and resources of the university to the community and its constituents. The Academy is a member-governed, member-led, non-profit, volunteer organization. The Academy sponsors 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 much more. Courses are offered during fall, winter, and spring, with most meeting one day a week for eight weeks for approximately 1.5 hours each class. Each course is taught by qualified volunteer instructors, and course activities require no tests or grades.

For Information:
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Web Site: www.ALLUAH.com

HEALTH & PHYSICAL EDUCATION
The Department of Health and Physical Education (HPE) supports the mission of the university by providing quality teaching and service through a variety of health, wellness, fitness, and recreational courses and by developing partnerships with organizations that are responsive to the needs of our students and the greater community. The unique and diverse courses are based upon timely, relevant, and basic and applied research that will promote an establishment of healthy activities for a lifetime. Emphasis is placed upon enhancing and maximizing health, physical performance, lifetime fitness, and disease prevention for students, faculty, and staff, and increasing public awareness of the social implications of current health issues. The HPE Department works to update and improve academic offerings to keep pace with the continually growing fields of physical education, health, exercise science, recreation, leisure, and sports.

Facilities
The Department of Health and Physical Education is housed primarily in two buildings: Spragins Hall and the University Fitness Center. Renovated in 2003, Spragins Hall features a gymnasium, racquetball courts, tennis courts, weight room, exercise floor, and training facility. The University Fitness Center opened in 2001 and is equipped with several group exercise rooms, 70 piece weight room, and a 40 piece cardiovascular center. It also has a swimming pool, three basketball courts, and a suspended indoor track.

Activity Courses
The HPE department offers a wide variety of knowledge and experience in physical fitness, recreation, sports, and healthy activities through its 100-level courses. These courses are continually updated to utilize the latest equipment and practices within the field. Students will have opportunities to improve fitness, learn skills, and participate in a variety of activities while gaining the knowledge to implement healthful practices.

Professional Courses
The HPE department offers professional courses (200-level and above) in nutrition, health, athletic training, exercise science, and related fields. These courses provide both skills and
academic training preparing the student for further studies or careers in Health and Physical Education. Many of these courses complement degree programs with an athletic training or exercise physiology emphasis.

**HPE Registration**
Students register for HPE credit courses through Charger Central. Dates, times, procedures and eligibility requirements for registration are published in the UAH Schedule of Classes, which is available in Charger Central, the Academic Advising offices, and on the UAH website. Please consult your department of major for specific guidelines on elective courses. *NOTE:* Part-time students (registered for less than 12 credit hours) taking HPE classes that meet in the University Fitness Center (UFC) will be required to purchase membership to the UFC. Membership rates are based on the total number of credit hours for which you are enrolled. Fees apply for the duration of the course.

**For Information:**
Health and Physical Education Program
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Web site: www.coned.uah.edu/health.cfm

**CE REGISTRATION SERVICES**
The Continuing Education (CE) Business Office, located in Wilson Hall, Room 124, provides registration services for all non-credit and select credit courses offered by the Division. Call (256) 824-6010 or 1-800-448-4031 to obtain a current course catalog, or visit our Web Site at http://www.coned.uah.edu. There is no application process for non-credit courses, and enrollments are taken throughout the year.

**Non-Credit Courses**
One CEU is awarded for each ten contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction. UAH awards Continuing Education Units (CEUs) and a certificate of completion to each person who successfully completes a CEU designated non-credit course. Transcripts are available upon written request from the Continuing Education Business Office, for a $4 fee per transcript.

**HPE Credit Courses**
Students register for HPE credit courses through Charger Central. Dates, times, procedures and eligibility requirements for registration are published in the UAH Schedule of Classes, which is available in Charger Central, the Academic Advising offices, and on the UAH website. Please consult your department of major for specific guidelines on elective courses.

**For Information:**
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250
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261 Faculty
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## INDEX

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Appeals Process</td>
<td>30</td>
</tr>
<tr>
<td>Academic Calendars</td>
<td>4,5</td>
</tr>
<tr>
<td>Academic Honesty</td>
<td>30</td>
</tr>
<tr>
<td>Academic Honor Societies</td>
<td>17</td>
</tr>
<tr>
<td>Academic Information</td>
<td>27</td>
</tr>
<tr>
<td>Academic Probation and Dismissal</td>
<td>49</td>
</tr>
<tr>
<td>Academic Responsibility</td>
<td>29</td>
</tr>
<tr>
<td>Accountancy, Masters of (MAcc)</td>
<td>81</td>
</tr>
<tr>
<td>Accounting &amp; Information Systems Department</td>
<td>73</td>
</tr>
<tr>
<td>Accounting (ACC) Graduate Courses</td>
<td>87</td>
</tr>
<tr>
<td>Accreditation</td>
<td>7</td>
</tr>
<tr>
<td>Activities, Student</td>
<td>16</td>
</tr>
<tr>
<td>Administration, UAH</td>
<td>248</td>
</tr>
<tr>
<td>Administrative Science, College of</td>
<td>73</td>
</tr>
<tr>
<td>Admission Categories</td>
<td>44</td>
</tr>
<tr>
<td>Admissions Information, Graduate</td>
<td>43</td>
</tr>
<tr>
<td>Admission of International Students</td>
<td>45</td>
</tr>
<tr>
<td>Admission Requirements</td>
<td>44</td>
</tr>
<tr>
<td>Affirmative Action Policy</td>
<td>27</td>
</tr>
<tr>
<td>Appeals, Academic</td>
<td>30</td>
</tr>
<tr>
<td>Application Procedure</td>
<td>44</td>
</tr>
<tr>
<td>Application for Degree, Masters Program</td>
<td>50</td>
</tr>
<tr>
<td>Application for Degree, Ph.D. Program</td>
<td>53</td>
</tr>
<tr>
<td>Applied Mathematics</td>
<td>228</td>
</tr>
<tr>
<td>Assistantships</td>
<td>47</td>
</tr>
<tr>
<td>Association for Campus Entertainment (ACE)</td>
<td>16</td>
</tr>
<tr>
<td>Athletics, Intercollegiate</td>
<td>20</td>
</tr>
<tr>
<td>Atmospheric Science Department</td>
<td>195</td>
</tr>
<tr>
<td>Atmospheric Science (ATS) Graduate Courses</td>
<td>198</td>
</tr>
<tr>
<td>Attendance, Class</td>
<td>31</td>
</tr>
<tr>
<td>Billing and Payment Procedure</td>
<td>24</td>
</tr>
<tr>
<td>Biological Sciences Department</td>
<td>202</td>
</tr>
<tr>
<td>Biological Sciences (BYS) Graduate Courses</td>
<td>204</td>
</tr>
<tr>
<td>Biological Sciences (BYS) Graduate Courses at AAMU</td>
<td>205</td>
</tr>
<tr>
<td>Biology, Fifth-Year Program</td>
<td>203</td>
</tr>
<tr>
<td>Biotechnology Science &amp; Engineering Program</td>
<td>55</td>
</tr>
<tr>
<td>Biotechnology Science &amp; Engineering (BSE) Graduate Courses</td>
<td>58</td>
</tr>
<tr>
<td>Board of Trustees</td>
<td>247</td>
</tr>
<tr>
<td>Bookstore</td>
<td>15</td>
</tr>
<tr>
<td>Business Legal Studies (BLS) Graduate Courses</td>
<td>89</td>
</tr>
<tr>
<td>Calendar, Academic</td>
<td>4</td>
</tr>
<tr>
<td>Campus Map</td>
<td>12</td>
</tr>
<tr>
<td>Career Services</td>
<td>2</td>
</tr>
<tr>
<td>Center for Management of Science &amp; Technology (CMOST)</td>
<td>74</td>
</tr>
<tr>
<td>Center for Management &amp; Economic Research (CMER)</td>
<td>75</td>
</tr>
<tr>
<td>Certificate Programs, Graduate</td>
<td>41</td>
</tr>
<tr>
<td>Change of Grade</td>
<td>32</td>
</tr>
<tr>
<td>Chemical &amp; Materials Engineering Department</td>
<td>101</td>
</tr>
<tr>
<td>Chemical Engineering (CHE) Graduate Courses</td>
<td>102</td>
</tr>
<tr>
<td>Chemistry Department</td>
<td>207</td>
</tr>
<tr>
<td>Chemistry, Fifth Year Program</td>
<td>210</td>
</tr>
<tr>
<td>Civil &amp; Environmental Engineering Department</td>
<td>105</td>
</tr>
<tr>
<td>Civil Engineering (CE) Graduate Courses</td>
<td>106</td>
</tr>
</tbody>
</table>

Index 268
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Attendance</td>
<td>31</td>
</tr>
<tr>
<td>Collaborative Programs</td>
<td>42</td>
</tr>
<tr>
<td>College of Administrative Science</td>
<td>73</td>
</tr>
<tr>
<td>College of Engineering</td>
<td>97</td>
</tr>
<tr>
<td>College of Liberal Arts</td>
<td>144</td>
</tr>
<tr>
<td>College of Nursing</td>
<td>181</td>
</tr>
<tr>
<td>College of Science</td>
<td>194</td>
</tr>
<tr>
<td>Communication Arts Department</td>
<td>145</td>
</tr>
<tr>
<td>Communication Arts (CM) Graduate Courses</td>
<td>146</td>
</tr>
<tr>
<td>Computer Engineering (CPE) Graduate Courses</td>
<td>117</td>
</tr>
<tr>
<td>Computer Science Department</td>
<td>213</td>
</tr>
<tr>
<td>Computer Science (CS) Graduate Courses</td>
<td>220</td>
</tr>
<tr>
<td>Conditional Admission</td>
<td>45</td>
</tr>
<tr>
<td>Confidentiality of Records</td>
<td>28</td>
</tr>
<tr>
<td>Continuing Education, Division of</td>
<td>243</td>
</tr>
<tr>
<td>Cooperative Education (Co-op)</td>
<td>42</td>
</tr>
<tr>
<td>Counseling Center</td>
<td>11</td>
</tr>
<tr>
<td>Course Load, Student</td>
<td>30</td>
</tr>
<tr>
<td>Course Numbering System</td>
<td>31</td>
</tr>
<tr>
<td>Course Repeat Policy</td>
<td>33</td>
</tr>
<tr>
<td>Credit to Audit</td>
<td>31</td>
</tr>
<tr>
<td>Dean's List, Graduate</td>
<td>49</td>
</tr>
<tr>
<td>Dean's Office, Graduate Studies</td>
<td>35</td>
</tr>
<tr>
<td>Degree Programs, Graduate</td>
<td>35</td>
</tr>
<tr>
<td>Degree Requirements, Graduate</td>
<td>48</td>
</tr>
<tr>
<td>Degree Requirements, Masters Degrees</td>
<td>49</td>
</tr>
<tr>
<td>Degree Requirements, Ph.D. Degrees</td>
<td>52</td>
</tr>
<tr>
<td>Disabled Student Services</td>
<td>12</td>
</tr>
<tr>
<td>Discrimination Policy</td>
<td>27</td>
</tr>
<tr>
<td>Dismissal, Academic</td>
<td>49</td>
</tr>
<tr>
<td>Dissertation</td>
<td>53</td>
</tr>
<tr>
<td>Dissertation Submission</td>
<td>54</td>
</tr>
<tr>
<td>Division of Continuing Education</td>
<td>243</td>
</tr>
<tr>
<td>Doctor of Philosophy Degree</td>
<td>52</td>
</tr>
<tr>
<td>Economics &amp; Finance Department</td>
<td>73</td>
</tr>
<tr>
<td>Economics (ECN) Graduate Courses</td>
<td>89</td>
</tr>
<tr>
<td>Education Department</td>
<td>146</td>
</tr>
<tr>
<td>Education (ED) Graduate Courses</td>
<td>146</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering Department</td>
<td>160</td>
</tr>
<tr>
<td>Electrical Engineering (EE) Graduate Courses</td>
<td>111</td>
</tr>
<tr>
<td>Engineering, College of</td>
<td>121</td>
</tr>
<tr>
<td>Engineering Management (EM) Graduate Courses</td>
<td>97</td>
</tr>
<tr>
<td>English Department</td>
<td>133</td>
</tr>
<tr>
<td>English, Fifth-Year Program</td>
<td>163</td>
</tr>
<tr>
<td>English (EH) Graduate Courses</td>
<td>160</td>
</tr>
<tr>
<td>English Language Arts, Fifth-Year Program</td>
<td>167</td>
</tr>
<tr>
<td>English Language Proficiency Test (ELPT)</td>
<td>157</td>
</tr>
<tr>
<td>English, Linguistics and TESOL (EH) Graduate Courses</td>
<td>44</td>
</tr>
<tr>
<td>English Proficiency</td>
<td>160</td>
</tr>
<tr>
<td>Environmental Science Program</td>
<td>31</td>
</tr>
<tr>
<td>Environmental Science (ES) Graduate Courses</td>
<td>225</td>
</tr>
<tr>
<td>Environmental Science Program</td>
<td>225</td>
</tr>
<tr>
<td>Equal Opportunity and Affirmative Action Policy</td>
<td>27</td>
</tr>
<tr>
<td>Topic</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Examinations</td>
<td>31</td>
</tr>
<tr>
<td>Executive Education Program</td>
<td>75</td>
</tr>
<tr>
<td>Facilities</td>
<td>8</td>
</tr>
<tr>
<td>Faculty, Graduate</td>
<td>249</td>
</tr>
<tr>
<td>Family Nurse Practitioner, Graduate Certificate</td>
<td>41,188</td>
</tr>
<tr>
<td>Fellowships</td>
<td>48</td>
</tr>
<tr>
<td>Fifth Year Programs</td>
<td>41</td>
</tr>
<tr>
<td>Final Examination, Masters Programs</td>
<td>50</td>
</tr>
<tr>
<td>Final Examination, Ph.D. Programs</td>
<td>54</td>
</tr>
<tr>
<td>Finance (FIN) Graduate Coursees</td>
<td>90</td>
</tr>
<tr>
<td>Financial Aid</td>
<td>25</td>
</tr>
<tr>
<td>Financial Information</td>
<td>22</td>
</tr>
<tr>
<td>General Academic Information</td>
<td>30</td>
</tr>
<tr>
<td>General Information</td>
<td>7</td>
</tr>
<tr>
<td>Grade, Change of</td>
<td>32</td>
</tr>
<tr>
<td>Grade-point Average</td>
<td>32</td>
</tr>
<tr>
<td>Grade Reports</td>
<td>32</td>
</tr>
<tr>
<td>Grading System</td>
<td>32</td>
</tr>
<tr>
<td>Graduate Admissions Information</td>
<td>43</td>
</tr>
<tr>
<td>Graduate Application Procedure</td>
<td>44</td>
</tr>
<tr>
<td>Graduate Assistantships</td>
<td>47</td>
</tr>
<tr>
<td>Graduate Dean's List</td>
<td>49</td>
</tr>
<tr>
<td>Graduate Degree Programs</td>
<td>35</td>
</tr>
<tr>
<td>Graduate Faculty</td>
<td>249</td>
</tr>
<tr>
<td>Graduate Management Admissions Test (GMAT)</td>
<td>44</td>
</tr>
<tr>
<td>Graduate Programs, Collaborative</td>
<td>42</td>
</tr>
<tr>
<td>Graduate Record Examination (GRE)</td>
<td>44</td>
</tr>
<tr>
<td>Graduate Record Examination Fee Waiver</td>
<td>25</td>
</tr>
<tr>
<td>Graduate Studies, Dean's Office</td>
<td>35</td>
</tr>
<tr>
<td>Graduate Studies, School of</td>
<td>35</td>
</tr>
<tr>
<td>Greeks</td>
<td>16</td>
</tr>
<tr>
<td>Health Services</td>
<td>12</td>
</tr>
<tr>
<td>History Department</td>
<td>170</td>
</tr>
<tr>
<td>History, Fifth-Year Program</td>
<td>158,172</td>
</tr>
<tr>
<td>History (HY) Graduate Courses</td>
<td>172</td>
</tr>
<tr>
<td>History of UAH</td>
<td>7</td>
</tr>
<tr>
<td>Honors Societies, Academic</td>
<td>17</td>
</tr>
<tr>
<td>Housing, University</td>
<td>13</td>
</tr>
<tr>
<td>Identification Cards</td>
<td>14</td>
</tr>
<tr>
<td>Industrial &amp; Systems Engineering &amp; Engineering Management Department</td>
<td>128</td>
</tr>
<tr>
<td>Industrial &amp; Systems Engineering (ISE) Graduate Courses</td>
<td>130</td>
</tr>
<tr>
<td>Information Assurance, Graduate Courses</td>
<td>41,86,112,216</td>
</tr>
<tr>
<td>Information, General</td>
<td>7</td>
</tr>
<tr>
<td>Information, Student</td>
<td>11</td>
</tr>
<tr>
<td>Insurance, (Health)</td>
<td>47</td>
</tr>
<tr>
<td>Intercollegiate Athletics</td>
<td>20</td>
</tr>
<tr>
<td>Interdisciplinary Programs</td>
<td>55</td>
</tr>
<tr>
<td>Interfraternity Council</td>
<td>16</td>
</tr>
<tr>
<td>International Students, Admission of</td>
<td>45</td>
</tr>
<tr>
<td>Liberal Arts, College of</td>
<td>144</td>
</tr>
<tr>
<td>Library</td>
<td>10</td>
</tr>
</tbody>
</table>

Index 270
<table>
<thead>
<tr>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>271</td>
</tr>
</tbody>
</table>

<p>| Linguistics and TESOL (EHL) Graduate Courses | 169 |
| Loans | 25 |
| Management &amp; Marketing Department | 73 |
| Management (MGT) Graduate Courses | 90 |
| Management Information Systems (MIS) Graduate Courses | 92 |
| Management of Technology | 74 |
| Management Science (MSC) Graduate Courses | 95 |
| Marketing (MKT) Graduate Courses | 95 |
| Map, Campus | 2 |
| Masters Degree | 49 |
| Materials Science Program | 60 |
| Materials Science (MTS) Graduate Courses | 65 |
| Mathematical Sciences Department | 228 |
| Mathematics, Fifth-Year Program | 159,230 |
| Mathematics (MA) Graduate Courses | 231 |
| Mathematics Learning Center | 11 |
| Mechanical &amp; Aerospace Engineering Department | 135 |
| Mechanical Engineering (MAE) Graduate Courses | 137 |
| Miller Analogies Test (MAT) | 44 |
| Mission Statement | 7 |
| Multicultural Affairs | 12 |
| Music Organizations | 19 |
| Non-Degree Admission | 46 |
| Nondiscrimination Policy | 27 |
| Northeast Alabama Regional Small Business Development Center | 75 |
| Nurse Practitioner | 183 |
| Nursing, College of | 181 |
| Nursing Education, Graduate Certificate | 183,189 |
| Nursing (NUR) Graduate Courses | 189 |
| Nurse Traineeship Program | 25 |
| Operations Research, Masters of Science in | 99 |
| Optical Science &amp; Engineering Program | 67 |
| Optical Science &amp; Engineering (OSE) Graduate Courses | 70 |
| Payment Methods | 24 |
| Ph.D. Degree | 52 |
| Philosophy | 174 |
| Physics Department | 235 |
| Physics, Fifth-Year Program | 159,237 |
| Physics (PH) Graduate Courses | 238 |
| Plagiarism | 30 |
| Political Science Department | 174 |
| Political Science (PSC) Graduate Courses | 176 |
| Post-Master's Family Nurse Practitioner Program | 188 |
| Preschool Learning Center | 14 |
| Probation and Dismissal, Academic | 49 |
| Programs, Graduate | 35 |
| Programs of Study | 49,51 |
| Provisional Admission | 46 |
| Psychology Department | 177 |
| Psychology (PY) Graduate Courses | 179 |
| Public Affairs Program | 174 |
| Publications, Student | 21 |</p>
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualifying Examination, Ph.D. Programs</td>
<td>53</td>
</tr>
<tr>
<td>Reading Specialist Option, MA in English</td>
<td>165</td>
</tr>
<tr>
<td>Records, Confidentiality of</td>
<td>28</td>
</tr>
<tr>
<td>Refunds</td>
<td>25</td>
</tr>
<tr>
<td>Registration</td>
<td>30</td>
</tr>
<tr>
<td>Repeating a Course</td>
<td>33</td>
</tr>
<tr>
<td>Research Assistantships</td>
<td>48</td>
</tr>
<tr>
<td>Residence Requirement, Doctoral Programs</td>
<td>52</td>
</tr>
<tr>
<td>Residency Status</td>
<td>22</td>
</tr>
<tr>
<td>Responsibility, Academic</td>
<td>29</td>
</tr>
<tr>
<td>Retroactive Withdrawal Policy</td>
<td>33</td>
</tr>
<tr>
<td>Schedule Adjustments</td>
<td>30</td>
</tr>
<tr>
<td>Scholarships</td>
<td>48</td>
</tr>
<tr>
<td>School of Graduate Studies</td>
<td>35</td>
</tr>
<tr>
<td>Science, College of</td>
<td>194</td>
</tr>
<tr>
<td>Second Master's Degree</td>
<td>51</td>
</tr>
<tr>
<td>Seniors Taking Graduate Courses</td>
<td>47</td>
</tr>
<tr>
<td>Software Engineering, Graduate Certificates</td>
<td>41, 216</td>
</tr>
<tr>
<td>Software Engineering, Masters of Science in, Computer Engineering Track</td>
<td>112</td>
</tr>
<tr>
<td>Software Engineering, Masters of Science in, Computer Science Track</td>
<td>215</td>
</tr>
<tr>
<td>Sports Program (Intramural)</td>
<td>21</td>
</tr>
<tr>
<td>Statistics (ST) Graduate Courses</td>
<td>235</td>
</tr>
<tr>
<td>Student Activities</td>
<td>16</td>
</tr>
<tr>
<td>Student Affairs</td>
<td>11</td>
</tr>
<tr>
<td>Student Government Association (SGA)</td>
<td>16</td>
</tr>
<tr>
<td>Student Organizations</td>
<td>16</td>
</tr>
<tr>
<td>Summary of Checkpoints toward Completion of Degree Requirements (Masters)</td>
<td>51</td>
</tr>
<tr>
<td>Summary of Checkpoints toward Completion of Degree Requirements (Ph.D.)</td>
<td>54</td>
</tr>
<tr>
<td>Supervisory Committees, Masters Degrees</td>
<td>49</td>
</tr>
<tr>
<td>Supervisory Committees, Ph.D. Degrees</td>
<td>53</td>
</tr>
<tr>
<td>Teaching Assistantships</td>
<td>47</td>
</tr>
<tr>
<td>Technical Communication, Graduate Certificate</td>
<td>166</td>
</tr>
<tr>
<td>TESOL (EHL) Graduate Courses</td>
<td>169</td>
</tr>
<tr>
<td>TESOL, Graduate Certificate</td>
<td>166</td>
</tr>
<tr>
<td>TESOL Option, MA in English</td>
<td>164</td>
</tr>
<tr>
<td>Test of English as a Foreign Language (TESOL)</td>
<td>44</td>
</tr>
<tr>
<td>Testing Service</td>
<td>44</td>
</tr>
<tr>
<td>Time Limit, Masters Degree</td>
<td>50</td>
</tr>
<tr>
<td>Time Limit, Ph.D. Degree</td>
<td>53</td>
</tr>
<tr>
<td>Transcripts</td>
<td>32</td>
</tr>
<tr>
<td>Transfer Credit, Master's Degree</td>
<td>50</td>
</tr>
<tr>
<td>Transfer Credit, Ph.D. Degree</td>
<td>52</td>
</tr>
<tr>
<td>Tuition, Graduate</td>
<td>23</td>
</tr>
<tr>
<td>Tuition Scholarships</td>
<td>48</td>
</tr>
<tr>
<td>Tutoring Services</td>
<td>11</td>
</tr>
<tr>
<td>Unconditional Admission</td>
<td>44</td>
</tr>
<tr>
<td>University Center</td>
<td>14</td>
</tr>
<tr>
<td>Veterans Affairs</td>
<td>25</td>
</tr>
<tr>
<td>Wellness Center</td>
<td>12</td>
</tr>
<tr>
<td>Withdrawal Policy</td>
<td>33</td>
</tr>
<tr>
<td>Writing Center</td>
<td>11</td>
</tr>
<tr>
<td>Index</td>
<td>272</td>
</tr>
</tbody>
</table>
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