Florida Institute of Technology

2004–2005

University Catalog

Choosing the right university Is one of the most imporTant decisions you will ever have to make. Your university experience will do more than provide you with a higher education, it will shape your life in ways that will surprise you. In addition to making friends and memories while at Florida Institute of Technology, you will also lay the foundation for a lifetime of learning and achieving. Your career begins here.

The university you choose must provide the best possible learning and living environment. We believe Florida Tech does this through small class sizes, world-class faculty, and undergraduate research options that may begin as soon as your freshman year.

With these thoughts in mind, I welcome you to the community of scholars at Florida Tech. We take your education personally.

Best regards,

Anthony J. Catanese Ph.D.

For information, or to arrange for a campus visit:

call us toll free at

(800) 888-4348 (Undergraduate Admission)
(800) 944-4348 (Graduate Admissions)

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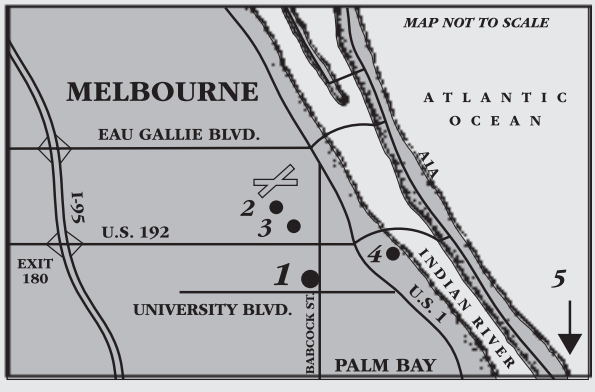

FLORIDA TECH LOCATIONS

1 **Florida Institute of Technology Main Campus**
2 **School of Aeronautics Flight Center (located at Melbourne International Airport)**
3 **Applied Research Laboratory Building**
4 **Ralph S. Evinrude Marine Operations Center**
5 **Vero Beach Marine Laboratory (located at Vero Beach, about 35 miles south of Melbourne)**

Florida Institute of Technology

Mission Statement

Florida Institute of Technology is an independent technological university that provides quality education, furthers knowledge through basic and applied research, and serves the diverse needs of our local, state, national and international constituencies.

In support of this mission, we are committed to:

- An organizational culture that values and encourages intellectual curiosity, a sense of belonging and shared purpose among faculty, students and staff, and pursuit of excellence in all endeavors;
- Recruiting and developing faculty who are internationally recognized as educators, scholars and researchers;
- Recognition as an effective, innovative, technology-focused educational and research institution;
- Recruiting and retaining a high-quality, highly selective and culturally diverse student body;
- Continued improvement in the quality of campus life for members of the university community;
- Providing personal and career growth opportunities for both traditional and nontraditional students and members of the faculty and staff.

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This catalog contains current information regarding curricula, educational plans, offerings and requirements of the colleges and schools, including the Graduate School, and may be altered from time to time to carry out the purposes and objectives of the university. The provisions of this catalog do not constitute a contract between the university and the enrolled student. The university reserves the right to change any provision, offering, requirement or fee at any time.

A student may be required to withdraw (under appropriate procedures) whenever it is deemed to be in the best interest of the student and/or the university. The university may impose probation on any student whose conduct is unsatisfactory. Any admission based on false statements or documents presented by the student is void when the fraud is discovered, and the student is not entitled to credit for work that may have been completed. When a student is dismissed or suspended from the university for cause, there will be no refund of tuition and fees paid. If a dismissed student has paid only a part of the tuition and fees, the balance due the university will be collected.

There will be no refund of tuition, fees or other payments made in the event the operation of the university is suspended as a result of any act of God, strike, riot, disruption or for any other reason beyond the control of the university.

Florida Institute of Technology does not discriminate on the basis of race, color, sex, disability, age, or national or ethnic origin in admission of students, administration of its educational policies, scholarship and loan programs, employment policies, and athletic or other university-sponsored programs or activities.

Welcome to Florida Tech

Academic Calendar

Fall 2004

July 30	Tuition and fees due for Fall Semester 2004
Aug. 25	CLASSES BEGIN (Wednesday)
Aug. 25–27	Financial Aid sign in
Aug. 31	Last day to register or add a class
Sept. 6	Holiday
Sept. 7	Last day to drop a class with full tuition refund and without receiving a grade of W
Sept. 24	Last day to file a Petition to Graduate for Spring Semester 2005 without a late fee
Oct. 14–15	Fall Break
Oct. 22	Last day to withdraw from a course with a final grade of W
Nov. 8	Registration for Spring Semester 2005 begins
Nov. 24–26	Holiday
Dec. 3	Tuition and fees due for Spring Semester 2005
Dec. 11	Last day of classes
Dec. 13–18	FINAL EXAMS
Dec. 18	Fall Commencement Exercises

Spring 2005

Dec. 3	Tuition and fees due for Spring Semester 2005
Jan. 10	CLASSES BEGIN (Monday)
Jan. 10–12	Financial Aid sign in
Jan. 14	Last day to register or add a class
Jan. 21	Last day to file a Petition to Graduate for students who plan to complete their requirements by the end of Summer Term 2005
Jan. 21	Last day to drop a class with full tuition refund and without receiving a grade of W
Jan. 31	Registration for Summer Term 2005 begins
Feb. 7	Re-petition deadline for Spring Semester 2005 (for students who had petitioned for an earlier graduation)
March 4	Last day to withdraw from a course with a final grade of W
March 7–11	Spring Break
March 15	Priority deadline for filing Financial Aid Applications for 2005–2006
March 28	Registration for Fall Semester 2005 begins
April 8	Last day to file a Petition to Graduate for Fall Semester 2005 without a late fee
April 22	Tuition and fees due for Summer Term 2005
April 29	Re-petition deadline for Summer Term 2005 (for students who had petitioned for an earlier graduation)
April 30	Last day of classes
May 2–7	FINAL EXAMS
May 7	Spring Commencement Exercises

Summer/Fall 2005

May 16	SUMMER CLASSES BEGIN (Monday)
May 16–18	Financial Aid sign in
May 20	Last day to register, add a class, or drop a class with full tuition refund and without receiving a grade of W
May 30	Holiday
June 17	Last day to withdraw from a course with a final grade of W (8-week and 11-week classes)
June 24	Last day of classes, first 6-week term
June 27	First day of classes, second 6-week term
July 4	Holiday
July 8	Last day of 8-week classes (final exam on last scheduled class day)
July 29	Last day of 11-week classes (final exam on last scheduled class day)
Aug. 1	Tuition and fees due for Fall Semester 2005
Aug. 5	Last day of classes, second 6-week term
Aug. 24	FALL CLASSES BEGIN (Monday)
Aug. 24–26	Financial Aid sign in

The University

Florida Institute of Technology is an accredited, coeducational, independently controlled and supported university. It is committed to the pursuit of excellence in teaching and research in the sciences, engineering, technology, management and related disciplines, as well as providing the challenges that motivate students to reach their full academic and professional potential. Today, over 4,400 students are enrolled, with more than 3,000 students on the Melbourne campus and the others at Florida Tech's off-campus graduate centers. All of the off-campus students and more than 850 on-campus students are enrolled in graduate programs. Florida Tech offers 140 degree programs in science and engineering, aviation, management, humanities, psychology and communication. Doctoral degrees are offered in 20 disciplines, while more than 60 master's degrees are offered.

Because of the moderate size of the student body and the university's dedicated faculty and staff, a student at Florida Tech is recognized as an individual. Acting as individuals or as members of student organizations, students are encouraged to express their opinions on ways in which academic programs and student life might be made better for all. An active student government and student court plays a meaningful part in matters affecting student life.

Many students enrolled in graduate programs, as well as some undergraduates, take part in sponsored research programs and make significant contributions to project results. Florida Tech houses a number of research institutes and centers that, in collaboration with academic departments, aid in the students' training. These institutes and centers are described more fully in the *Research: Institutes, Centers and Major Laboratories* section of this catalog.

The university is organized into six academic units: the College of Engineering, College of Science and Liberal Arts, School of Aeronautics, School of Management, School of Psychology and School of Extended Graduate Studies.

The **College of Engineering** includes seven departments: chemical engineering, civil engineering, computer sciences, electrical and computer engineering, engineering systems, mechanical and aerospace engineering, and marine and environmental systems. Programs offered in addition to those included in the department names are biological oceanography. chemical oceanography, coastal zone management, computer information systems, engineering management, environmental resource management, environmental science, geological oceanography, marine environmental science, meteorology, ocean engineering, physical oceanography, software engineering and systems engineering.

The **College of Science and Liberal Arts** is composed of the departments of biological sciences, chemistry, mathematical sciences, physics and space sciences, science and mathematics education, and humanities and communication. Bachelor's degrees are offered in all of these areas and in biochemistry, interdisciplinary science and military science. Master's degrees are offered in applied mathematics, biological sciences, chemistry, computer education, environmental education, mathematics education, operations research, physics, technical and professional communication, science education, space sciences and teaching. Advanced degrees include the Specialist in Education and doctoral degrees in applied mathematics, biological sciences, chemistry, mathematics education, operations research, physics, science education and space sciences.

In addition to the degree-granting departments listed above, the college also includes the Division of Languages and Linguistics within the humanities department and the military science department (Army ROTC). The university offers two- and four-year Army ROTC programs to interested, qualified students. Students may qualify for a reserve commission in the U.S. Army through normal completion of both the college basic and advanced cadet programs, or may enter directly into the advanced program after completing their basic program requirements before entering the university.

The **School of Aeronautics** offers bachelor's degrees in aeronautical science, aviation management, aviation meteorology (with flight options available in each program) and aviation computer science, and master's degrees in airport development and management, applied aviation safety and aviation human factors.

The **School of Management** offers both bachelor's and master's degrees in business administration, and bachelor's degrees in accounting, business and environmental studies, and management information systems. An accounting track in the M.B.A. program is offered for individuals who have completed a four-year degree in accounting and require additional credits to be able to qualify for the CPA exam in Florida, or to receive reciprocal licensure in Florida from another state.

School of Management students are prepared to compete in a global, technologically driven business environment by integrating personalized and applied business instruction into a focused, high-quality academic learning experience.

The **School of Psychology** offers bachelor's degrees in psychology and forensic psychology, master's degrees in applied behavior analysis and industrial/organizational psychology, and doctoral degrees in clinical psychology and industrial/organizational psychology.

The **School of Extended Graduate Studies** began in August 1972 as "Off-Campus Programs," when 42 students enrolled in a master's degree program in electrical engineering at the Naval Air Test Center, Patuxent River, Maryland. Today master's degree programs are offered at 10 graduate centers in five states. Curricula and course content are tailored to meet the needs of the students and their employers, while maintaining the highest possible academic quality and integrity. Class times and locations are selected for the convenience of the students. Since 1972, nearly 15,000 Florida Tech master's degrees have been conferred on off-campus candidates.

In all programs, Florida Tech believes in helping well-motivated students to use every opportunity to learn self-reliance in developing their skills and knowledge to the highest individual potential. The academic programs at the university provide a vigorous challenge to those in quest of answers to unsolved questions.

History

Founded in 1958 as Brevard Engineering Institute by Dr. Jerome P. Keuper, Florida Institute of Technology initially offered continuing education opportunities to scientists, engineers and technicians working at what is now NASA's John F. Kennedy Space Center. The new school grew quickly, in many ways paralleling the rapid development of space technology that was taking place at Cape Canaveral. In 1966, the name was changed to Florida Institute of Technology to acknowledge its growing identity as a scientific and technological university, the only such independent institution in the Southeast.

From its inception, Florida Tech has shown its commitment to graduate education. An article in the *New York Times* in 1962 described Brevard Engineering College as "the only space engineering college in the country … Its graduate course offers engineers the opportunity to obtain a master's degree and keep up with the advancement taking place daily at the Cape." Originally, all graduate students attended classes on a part-time basis, but at present approximately one-half of the on-campus graduate students attend class and carry out research full time.

The university moved to its current Melbourne campus in 1961, and construction began immediately on administration and classroom buildings to augment existing buildings that had been used by the former University of Melbourne. From that beginning, growth of the campus has been continual through the years, as shown on the campus map at the end of this catalog.

More than 35,000 degrees have been earned by students at Florida Institute of Technology. As the institution advances and the alumni ranks multiply, the university remains dedicated to developing concerned scientists, engineers and business leaders who will make positive contributions to our society.

Accreditation and Memberships

Florida Institute of Technology is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools (1866 Southern Lane, Decatur, GA 30033-4097; (404) 679-4501) to award the associate of science, bachelor of arts, bachelor of science, master of science, master of business administration, master of public administration, educational specialist, doctor of psychology and doctor of philosophy degrees.

The university is approved by the Office of Education of the U.S. Department of Education.

The university is a member of the Independent Colleges and Universities of Florida, the American Council on Education, the College Entrance Examination Board and the American Society for Engineering Education.

The undergraduate programs accredited by the Engineering Accreditation Commission of ABET are aerospace engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, mechanical engineering and ocean engineering. The undergraduate computer science program is accredited by ABET's Computing Accreditation Commission.

The university is approved by the State of Florida Department of Education for teacher education in secondary science and mathematics at the bachelor's, master's and doctoral degree levels. Selected courses are approved for credit toward recency-of-credit, extension, reissuance or reinstatement of certificates.

The undergraduate program in chemistry is accredited by the Committee on Professional Training of the American Chemical Society. Students may obtain ACS-certified degrees by following a prescribed curriculum.

The aeronautical science, aviation computer science and aviation management programs are accredited by the Council on Aviation Accreditation.

The Doctor of Psychology, Clinical Specialization, is accredited by the American Psychological Association.

Operation and Control

Florida Institute of Technology was granted a charter as a nonprofit corporation by the State of Florida in December 1958. The corporate charter established the school as an independent institution of higher learning with academic programs leading to undergraduate and graduate degrees. The charter ensures that the university will be coeducational in character and that admission will be open to all qualified applicants regardless of race, creed, age, sex, color or disability. Under the corporate charter, control of the university is vested in a self-perpetuating board of trustees. Members of the board are selected based on outstanding ability, integrity and personal interest in the development and preservation of the university.

Financial Support

The university is supported by tuition and fees, research grants and contracts, and assistance from foundations, industry and the local community. Careful attention to sound business policies has placed the institution on a sound financial basis year after year.

Florida Institute of Technology was ruled tax-exempt under Section 501(c)(3) of the Internal Revenue Code (IRC) of the U.S. Treasury Department in January 1960. The university was classified in October 1970 as an organization that is not a private foundation as defined in Section 509(a) of the IRC. Gifts to the university are thus tax deductible.

Campus Environment

Florida Tech's campus is located in Melbourne, a residential community on Florida's Space Coast. The area offers a delightful year-round subtropical climate and inviting ocean beaches. The Kennedy Space Center and Walt Disney World in Orlando are within an hour's drive from Melbourne.

The university's location on Florida's Space Coast gives it a unique place in the academic world. Corporations whose scientists and engineers are making tomorrow's technological breakthroughs for the U.S. space program surround the Kennedy Space Center. The space center's proximity allows easy interaction between space center personnel and the university community. Moreover, the growing number of high-tech, innovative businesses and industries in the Melbourne area help to make Florida's business environment one of the most promising and exciting in the nation, and enables university professors to stay abreast of the latest challenges and developments in the scientific, technical and business worlds. With both the Indian River lagoon and the Atlantic Ocean nearby, students in the oceanography, aquaculture, environmental science and marine biology programs have ready access to the beaches and waters for a variety of field experiments and research projects. Overall, Florida Tech's location is ideal for keeping pace with developments in science, technology and business.

Facilities

The **Homer R. Denius Student Center** houses the SUB Café and Deli, the bookstore and the campus post office. Located on the second floor is the Office of Student Life, which includes student activities, orientation, residence life and the dean of students. The John T. and Martha Hartley Room and offices for Student Government (SG), Campus Activities Board (CAB) and other campus organizations are also on the second floor.

Located on the first floor of the Denius Student Center, the **bookstore** offers new and used textbooks, office supplies, study guides, magazines, postcards and imprinted giftware. Clothing for all seasons, hats, umbrellas and an extensive collection of gift items are also featured. Students may sell their used textbooks year-round with a Florida Tech Student ID card. Order online at www.fit.bkstore.com or use the order-by-phone service. Bookstore hours are Monday through Friday from 8:30 a.m.–5 p.m., with extended hours at the beginning of each semester.

University **residence halls** provide a variety of accommodations including single-sex and coed halls, with both community and private or shared bathrooms. Each residence hall room and apartment is equipped with two Ethernet connections to the university's fiber-optic network. **Southgate Apartments** offer studio, one-, two- and three-bedroom apartment options for upper-division students. Located on the edge of the Botanical Garden, **Columbia Village** offers fully furnished four-bedroom suite-style living with efficiency kitchens. The Columbia Village commons building features a meeting room, laundry facilities, resident assistant office and a resident director's apartment. Priority for all housing is given to undergraduate students.

The **Botanical Garden**, a lush Florida forest of palm, water oak and tropical vegetation, comprises one-fifth of 130 acres of partially wooded, beautifully landscaped campus. Visitors can enjoy leisurely walks on the pathways through this garden. One path, the Dent Smith Trail, is named in honor of the man who founded the Palm Society and contributed significantly to the university's palm collection. More than 200 species of palm, some quite rare, are found on the campus.

The **Charles and Ruth Clemente Center for Sports and Recreation** is a $6.8-million sports complex that opened in fall 2001. The 57,250 sq. ft. facility houses varsity and intramural basketball courts, a racquetball court, a complete fitness center, group fitness room, walking track, volleyball and badminton courts, the Center Court food services area, men's and women's locker rooms, an equipment checkout area and two multipurpose meeting rooms. The 5,000 sq. ft. weight and fitness area is equipped with cardiovascular machines including treadmills, elliptical machines, exercise bikes and stair-climbers, free weights and selectorized weight equipment. Recreation and athletics department offices are also located in the facility. The Clemente Center hires student staff to work in the facility throughout the year.

The 505-seat **W. Lansing Gleason Performing Arts Center** is designed for stage plays, musical productions, scientific displays, lectures, seminars, camps and conferences. It is equipped with a complete control booth for professional stage facilities, lighting and sound. The facility is equipped with both C- and KU-band, and digital satellite downlink services that can be incorporated into productions and viewed on a large screen. Situated in the central portion of the campus, the center is a cultural asset to the university and surrounding community.

The **Jerome P. Keuper Administration Building** houses the offices of the vice president for student affairs, financial aid, international student and scholar services, career services and cooperative education. Also located in this building are the offices of graduate and undergraduate admission.

The 65,000-square-foot **John H. Evans Library** is located adjacent to the Learning Pavilion, which houses the Applied Computing Center, Academic Support Center and a teaching auditorium. The library's Web-based Library Information Network (LINK) is accessible on campus and remotely. The LINK (www.lib.fit.edu) provides an online catalog, electronic journals, citation and full-text databases and electronic gateways to library catalogs and information resources worldwide. Electronic resources include ProQuest, FirstSearch, Ingenta, Engineering Village 2, PsycINFO, WilsonWeb, IEEE/IEE Electronic Library, Aquatic Sciences and Fisheries Abstracts, Aerospace and High Technology Database, SciFinder Scholar, Biological Abstracts and Literature Resource Center. These resources complement the print, government documents and audiovisual collections. A classroom is equipped for multimedia presentations. Library faculty and staff support faculty and students with specialized instruction and ongoing assistance with information access.

Current holdings comprise more than 113,000 books, more than 223,000 government documents, and an extensive collection of technical journals including nearly 6,600 current print and electronic subscriptions. The library participates in the Federal Depository Library Program, which makes federally produced information available to the public free of charge. The library is a member of the American Library Association, the Florida Library Association, the Central Florida Library Cooperative, the Library Association of Brevard, the Online Computer Library Center (OCLC) and the Southeastern Library Network (SOLINET).

Of particular interest to undergraduate students is the Research Sources and Systems (COM 2012) course, offered by research and instruction librarians. This one-credit course is designed to familiarize the student with a variety of strategies, services and sources, emphasizing traditional and electronic research tools available in the students' major fields. The skills and knowledge gained in this course enable a student to use library resources effectively for lifelong learning.

The seven-story **Crawford Building** provides space for modern laboratories, classrooms and faculty offices for the mathematical sciences, physics and space sciences, and humanities and communication departments. Also in the Crawford Building are the offices of the assistant provost, the vice president for research and information technology, the associate vice president for research, the associate vice president for information technology, and their staffs.

The **Edwin Link Building** accommodates chemistry, environmental sciences, oceanography and ocean engineering.

The **F.W. Olin Engineering Complex** houses all departments of the College of Engineering with the exception of the department of marine and environmental systems, which is housed in the Link Building. This three-story facility includes 26 specialized research and teaching laboratories and a 145-seat multimedia lecture hall.

The **F.W. Olin Life Sciences Building** is the home of the biological sciences programs. This two-story facility contains eight teaching laboratories and 12 research laboratories that were designed with "flex space" for customizing the areas to meet the needs of specific activities.

Construction is underway for the **F.W. Olin Physical Sciences Building**, which will house the office of the dean of the College of Science and Liberal Arts; chemistry, physics and space sciences offices and laboratories; a high-bay research area; an observatory dome; and a rooftop deck area that will accommodate up to 15 additional telescopes.

The **Shephard Building** is the home of the science education department.

George M. Skurla Hall is the home of the School of Aeronautics. It is a modern two-story building that includes faculty offices, classrooms, laboratories in air traffic control, advanced systems and computers, and a 125-seat auditorium. The flight training department is located nearby at the Melbourne International Airport.

Separate academic buildings on campus are dedicated for use by the **School of Management** and **School of Psychology.**

Services

The **Information Technology** department provides services to the campus community in the areas of e-mail accounts, Web services, computing facilities, technology support and network services. In addition, the department is responsible for telephone and copy services on campus. Resources include a variety of multimedia classrooms, the Applied Computing Center, the TEC Center and the Olin Production Center. Information on both services and facilities is available on the Information Technology Web site, http://www.it.fit.edu, or by e-mail request at info@it.fit.edu.

All residence halls and on-campus apartments are wired for network and Internet access. Wireless access to the campus network is limited to select areas of the Florida Tech campus. Students are assigned e-mail accounts upon enrollment in classes.

The **Office of Career Services** personnel assist students in obtaining professional, career-oriented, permanent employment. Assistance in résumé writing, interviewing techniques and career counseling is available. An updated Career Resources Library is also available for student use. Current job listings are posted in prominent areas throughout the campus, in major academic units and on the career services Web site. As part of career services, a résumé referral program is available for all students registered with this office. Relevant workshops are presented throughout the year.

Career services maintains an interview schedule throughout the academic year. Students must be registered with the office for on-campus interviews with recruiters from companies seeking employees with specific academic backgrounds.

Career services annually presents two career fairs that highlight professionals, agencies, corporations and services from throughout the United States.

Summer internships are also listed by the Office of Career Services, and assistance is provided for local, national and international searches of internship listings and information on employers.

Conference and special events services offered through the Auxiliary Service Center are designed to assist all academic units, faculty, staff, students and the general public in hosting meetings, conferences, banquets and special events at the university. For further information, please contact the conference and events office, located on the ground floor of Evans Hall.

The **cooperative education program** at Florida Tech is designed to prepare students for professional careers through productive work experiences in fields related to their academic or career goals. It provides progressive experiences in integrating theory and practice. The co-op goals are to provide curriculum-related employment opportunities for students before their graduation; to provide a program containing structured work experience that will be beneficial to students in terms of both their personal and professional growth; and to assist employers in the recruitment process. Co-op is a partnership among students, educational institutions and employers.

The cooperative education program is open to all majors. Two co-op plans are offered to students. The conventional plan integrates alternating periods of full-time paid work experience with full-time academic study. The parallel plan incorporates part-time paid work experience simultaneously with a part-time academic course load.

Students participating in the university's cooperative education program (CWE 1001, CWE 2001, CWE 3001 and CWE 4001) receive free elective credits that in some cases may be applied toward degree requirements. They are classified as full-time students.

Availability of co-op employment opportunities varies considerably from field to field. For further co-op information, contact the assistant director in the Office of Career Services and Cooperative Education, room 210, Keuper Administration Building, or call extension 8102.

Counseling services of Florida Tech are designed to assist students with educational, vocational, financial, social and personal problems. The services available include:

The **Academic Support Center** (ASC) helps undergraduates with academic difficulties by providing tutoring and counseling directed toward both their studies and campus life as it relates to their studies. The staff responds to students' academic concerns by offering information and referral services.

Counseling and Psychological Services (CAPS) provides services for students and their families. The services include personal and marital counseling, vocational and career counseling, and learning disability and personality assessment, as well as programs for personal development and enrichment. When necessary, referrals to community public services agencies are provided. All services are provided under the direction of a licensed psychologist. Professional standards of practice are maintained and, in all cases, student contacts with the group are strictly confidential. Services provided by the center are free of charge. Located on the corner of Country Club Road and West University Boulevard, Counseling and Psychological Services is open Monday through Friday from 8 a.m. to 5 p.m.

A **faculty adviser** is assigned to each student to assist in selecting the proper courses to achieve academic goals and ensure timely graduation. The faculty adviser also assists with any academic problems the student may have.

The **Holzer Health Center** is operated by OMNI Healthcare, a private medical provider. All full-time and part-time students may use this facility and receive free office visitation and consultation. Students may use their university student health insurance or third-party insurance (in accordance with their health insurance policy provisions) along with personal funds to pay for any additional services provided by OMNI Healthcare. Students are required to present their Florida Tech Student ID cards to be seen at the health center.

The health center provides medical services covering a wide range of health care needs including routine illness, minor injuries, radiology and diagnostic services, and works to protect the student body from the spread of communicable diseases. The health center cannot accept responsibility for prolonged illness or chronic diseases. When necessary, students are referred to other medical specialists and/or hospitals in the Melbourne area.

All students must provide a completed medical history report, certified by the signature of the student's health care provider, including proof of the required immunizations, whether or not they plan to use the health center.

The **international student adviser** provides overall guidance to international students attending the university and will assist in resolving any problems that may arise. The staff of the Office of International Student and Scholar Services can answer questions related to university experiences and adaptation to living in the United States. Florida Tech's International Student Service Organization (ISSO) works with the international student adviser to provide new students with a comprehensive orientation.

The international student adviser is also responsible for reissuing the certificates of eligibility (the I-20 and DS-2019) of an attending student when needed to maintain student visa status, and other immigration forms. The adviser is in contact with embassy and foundation sponsors, and processes forms required by foreign governments regarding student status. All international students must report to this office with their passports and entry documents (I-20 or DS 2019 and I-94 card) upon arrival. Allow at least three weeks prior to any vacation period involving travel outside the United States to request paperwork for reentry.

Florida Tech's **Office of Residence Life** is committed to supporting and enhancing the academic mission of the university. This office works with the Auxiliary Service Center and Office of Facilities Management to ensure clean, comfortable and well-maintained residence halls.

The residence life program includes all of the student life aspects of residential facilities and the formulation and interpretation of all policies and procedures affecting students in residence. It also includes all counseling and student conduct concerns, programming and community development. The emphasis is on providing living and learning experiences from which people can grow. The major role of the Office of Residence Life is to support and enhance the development of the personal as well as academic life of students while they are at Florida Tech.

The **Office of Student Employment** (OSE) assists students in obtaining employment while they are enrolled at the university. Assistance is provided with part-time on- and off-campus employment, résumé critiques, interviewing techniques and job search strategies. Many students find interesting and rewarding jobs that not only help pay their bills, but provide the opportunity to build a base of experience for their future careers. The Office of Student Employment is located on the second floor, Keuper Administration Building, room 210.

The Federal Work Study (FWS) program is a federally funded program providing students with part-time, on-campus employment. Only students who receive financial aid are eligible for this program. Work-study awards are made by the Office of Financial Aid based on need and dependent on available funds, so it is highly recommended that a Free Application for Federal Student Aid (FAFSA) be submitted early. Students receiving FWS employment report to the

Office of Student Employment at the beginning of each academic year. There is a variety of work-study job opportunities.

The FWS Community Service program exists within the Federal Work Study program. It provides off-campus part-time jobs to eligible students in nonprofit community organizations. Available positions vary each semester, and may be major-related or clerical.

The Job Location and Development (JLD) program is a federally funded program to assist currently enrolled students in obtaining off-campus employment. It is a free service to both students and employers. Available jobs in the local community are posted on the JLD job board in the Keuper Administration Building as well as on the OSE Web site at www.fit.edu/ProsStud/employ. Students are urged to visit the Office of Student Employment to learn more about the positions. The only participation requirements are that students fill out data sheets to register with the program before receiving referrals and those students who obtain off-campus positions notify the Office of Student Employment. Some of the positions typically listed include computer programmers, engineering aides, office assistants, food servers, retail clerks, landscapers and child caretakers.

The College Roll program provides on-campus employment for currently enrolled students. Positions are temporary part-time jobs and are not based on student need.

The **Office of Veterans Affairs**, located in the Office of the Registrar, has a coordinator available to assist veterans and their dependents with both university and VA-related matters. In addition to providing information regarding VA educational benefits, tutorial assistance and employment services, the office offers individual counseling and referrals.

The **Auxiliary Service Center** coordinates many campus services including four food operations, catering, student housing business operations, the bookstore, campus vending, ATMs, ID cards, campus scheduling and the Gleason Performing Arts Center.

Evans Dining is located in the Residence Quad, on the second floor of Evans Hall. It is an "all you care to eat" cafeteria that offers a variety of homemade entrees, short-order grill, cook-to-order stir-fry station, deli, hot and cold buffet bar, and dessert and beverage bars. Bag lunches are available if ordered in advance. Evans accepts meal points, FlexCash, Panther Cash, cash and major credit cards.

The **SUB Café and Deli** in the Denius Student Center is a comfortable, casual dining spot in the heart of campus. It features a variety of daily specials, soup and salad bars, full grill service, desserts and fresh-baked cookies, along with a deli sandwich shop. **Pete's Java Den** offers cappuccino, espresso, latte, mocha and many gourmet coffees. The SUB Café accepts FlexCash, Panther Cash, cash and major credit cards.

The **Rathskeller Eatery and Pub** on the ground floor of Evans Hall offers fresh-baked pizza, burgers, deli subs, hand-dipped Edy's ice cream and freshly baked gourmet cookies. The "Rat" offers late night dining with big-screen TV and a game room, pizza delivery, and a mini convenience store. The Eatery and Pub accepts FlexCash, Panther Cash, cash and major credit cards.

Center Court on the first floor of the Clemente Center for Sports and Recreation serves the south side of campus with a variety of healthy food choices. Center Court accepts FlexCash, Panther Cash, cash and major credit cards. Center Court is open Monday-Friday 8 a.m.–8 p.m. and during Panther home games.

Co-curricular Activities

Florida Tech hosts more than 100 student organizations for students to join and hold positions of leadership. Organizations represent the varied interests of Florida Tech's students. These interests include student governance, social programming, cultural education and appreciation, fraternity/sorority membership, political and religious development, dance, music and theater performance, academic and honor organization involvement, science fiction/historical role playing and participation in athletic club team sports.

New campus organizations are formed annually based on student interest. All organizations are supported by the Office of Student Activities and a faculty/administrative adviser. Organizations are provided leadership training and recognition throughout the year.

The university provides **varsity athletics and intramural and recreational activities** for students. Florida Tech is a member of the National Collegiate Athletic Association (NCAA) Division II and competes in the Sunshine State Conference. Men's sports include baseball, basketball, crew, cross country, golf, soccer and tennis. Women's sports include basketball, crew, cross country, golf, soccer, softball, tennis and volleyball.

Intramural team sports include flag football, softball, volleyball, cricket, basketball, soccer and inner tube water polo. Individual intramural sports are tennis, running, golf, weight lifting, racquetball and badminton.

The 57,250 sq. ft. Clemente Center for Sports and Recreation offers abundant opportunities for a variety of sports and recreational activities. (See "Facilities" in this section.)

Two swimming pools, soccer fields, baseball and softball diamonds, four regulation tennis courts and two four-wall racquetball courts are located on campus. Nearby are two 18-hole golf courses. Students are welcome to use these facilities and to take advantage of many other recreational opportunities afforded by the warm, sunny climate, the Atlantic Ocean and the natural waterways in Brevard County. Surfing, water skiing, swimming, boating and fishing are popular activities throughout the area.

The All Faiths Center and the United Campus Ministry office are located at the southern end of the campus on Babcock Street (adjacent to the Psychology building). The center is open to all students as a place to pray, meet friends and consult with volunteer campus ministers who serve in an educational consortium. The United Campus Ministry serves as a clearinghouse for all religious activities.

Study Abroad

Several types of study-abroad opportunities are available at Florida Tech, including programs with European partner institutions. One of these programs permits Florida Tech students to take Florida Tech courses—essentially the same courses they would take in Melbourne—at CERAM EAI Tech, located in Sophia Antipolis, a high-tech community on the Côte d'Azur near Nice, France. This institute prepares students from France and other countries for entry into the junior year of nearly all Florida Tech programs by offering them the same curricula they would take during the first two years in Melbourne. As a result, students who start their programs in Melbourne have an opportunity to study in Sophia Antipolis for a semester or full year to take second-year (and certain third-year) Florida Tech courses, in English, while at the same time gaining knowledge and experience of a different culture and preparing for full participation in the global business and technology community of the 21st century.

Study abroad opportunities also exist at other Florida Tech partner schools, including the Norwegian School of Management (NSM/BI) in Oslo, Norway, the Ecole Nationale de l'Aviation Civile (ENAC) in Toulouse, France, the Berner Fachhochschule in Switzerland (UASc Berne) and the International University of Monaco (IUM). English is the language of instruction for all courses at NSM/BI, and for certain master's programs at ENAC. Other study-abroad programs have been designed to enable Florida Tech students to earn European diplomas. In France, programs at both ENAC and the Ecole Internationale des Sciences du Traitement de l'Information (EISTI) in Cergy-Pontoise, near Paris, allow students to earn French engineering diplomas along with Florida Tech bachelor's and master's degrees in several fields of engineering, computer science, computer information systems and aviation. For students who are already competent in French before the first semester overseas, the full program can be completed in seven years or less.

Additional information on these programs and others may be obtained from the Office of International Academic Programs.

Expenses and General Information

Tuition

Tuition and other charges for 2004–2005 will not be finalized until presented to and approved by the university's board of trustees in January 2004, and will be available thereafter through Florida Tech's online catalog at www.fit.edu/registrar/tuition. A hard-copy schedule of tuition and other charges may also be obtained by contacting Florida Institute of Technology, Office of Admission, 150 W. University Blvd., Melbourne, FL 32901-6975; or the Office of Student Accounting at the same address.

Tuition for full-time undergraduate students (12–19 credit hours) is charged on a semester basis. Semester tuition rates apply to the fall and spring semesters only. Summer tuition and tuition for part-time students and all graduate students, except those seeking the Psy.D. degree, is charged on a credit hour basis.

Tuition for students enrolled in the School of Extended Graduate Studies is published in that school's catalog, which includes information about each off-campus site.

For students enrolled in flight courses, flight fees are charged in addition to tuition. Flight training in all ratings is also offered to persons who desire to proceed at an accelerated or slower pace relative to the AVF sequence. Those desiring this training need not be registered in the university program. For information on courses and prices, please contact F.I.T. Aviation L.L.C., 640 S. Harry Sutton Road, Melbourne, Florida 32901.

Housing and Board Information

Residence Halls

Students desiring a specific housing assignment may submit requests to the Auxiliary Service Center. Requests for room assignments are honored on a first-come, first-served, space-available basis. The Auxiliary Service Center makes every attempt to grant requests for assignment to certain rooms and roommates. However, the university does not guarantee assignment to a specific type of accommodation, building, room or roommate. In all cases, students are billed based on the number of occupants registered for the room (double, single, etc.)

Because of the high demand for on-campus housing, the university reserves the right to place three students in any residence hall room. If the university exercises this option during the semester, the room occupants receive a prorated adjustment for the semester based on the number of days that triple occupancy occurred.

Southgate Apartments

Studios, one-, two- and three-bedroom apartments are available in Southgate Apartments, and are reserved for students with 24 or more earned credit hours. Occupancy ranges from one to four students per apartment, depending on the unit size.

Columbia Village

Columbia Village features four-bedroom, fully furnished suites with efficiency kitchens. Four students are assigned to each suite.

Meal Plans

Meal plans are offered by the university to make access to food service convenient and cost-effective, using the Student ID card as the access card. Meal plans are contracted with individual students and the benefits are not transferable. All plans are contracted for the entire academic year.

Meal plans consist of two major components:

Meal points are used for entry into Evans Dining, our "all you care to eat" dining room located in the Residence Quad. One point equals one meal. As the meal points are used, the balance available declines until it reaches zero or is reset.

FlexCash is the declining balance portion of the meal plan, and is used like a debit card. It can be used for any food item at any campus location, including select vending machines and pizza delivery. FlexCash carries forward from fall semester 2004 to spring semester 2005 as long as the student is on a meal plan. Any FlexCash remaining after the end of a spring semester is deleted.

Deposits

A nonrefundable tuition deposit of $300 is required of each new full-time student to signify intent to enroll in a given semester and to ensure that the university reserves space in its classes. The deposit will be applied to the first-semester bill, or may be applied to an updated entrance semester provided the student notifies the appropriate admission office in writing within two years of the initial date of acceptance.

A housing deposit must be on file in the student's account prior to the student receiving a housing assignment and remain on file for as long as the student lives in university housing. The deposit is not covered by any scholarship or financial aid and cannot be waived. It is refundable, minus any outstanding university charges, provided the terms and conditions of the housing agreement are fulfilled.

Students who sign Florida Tech Residence Hall and Meal Plan Agreements are obligated for the entire academic year.

Payment Policy

In determining the amount due each semester, students may subtract any scholarships, loans or grants that are made directly payable to the university. Students may also subtract any payment plan (e.g., corporate reimbursement plan) under which payments are made directly to the university by sponsoring organizations, and for which the university has been notified in writing of the student's eligibility and acceptance.

All expenses, including tuition, fees, room and board, must be paid on or before the last Friday in July for the fall semester, the first Friday in December for the spring semester, and the last Friday in April for the summer term. Payments sent by mail should be mailed at least 10 days in advance of the payment due date to assure receipt by the payment deadline. Payments may also be made online through the Panther Access Web for Students (PAWS) system using either a credit card or electronic check. Additional information regarding the university's payment policy can be found in the *Schedule of Classes* printed each semester. Payments should be addressed to Florida Institute of Technology, Business Services/Student Accounting, 150 W. University Blvd., Melbourne, FL 32901-6975.

Student Accounts

On payment of the initial tuition deposit, an account is established in the accounting office for the student, using the student's name and the student number assigned by the university as the account identification. Parents desiring to remit payments to the university by mail are encouraged to do so provided the payment is mailed in time to reach the university by the due date. All checks should show the student's name and last four digits of the student number on the face of the check to assure proper credit to the student's account.

If more money than required is remitted, any excess may be refunded or may be left on deposit for the next semester. All refunds will be paid to the student unless otherwise advised in writing. Requests for refunds must be submitted in writing, and will be honored starting on the 10th day following the start of each semester. The cost of books should not be included in payments mailed to the university. Books and supplies are available at the college bookstore and can be purchased by cash, check, approved credit card or the Panther Access Card Debit Account. A student may charge bookstore purchases to his or her account with the university, provided it contains sufficient funds to cover such purchases. Students in aviation programs can obtain books at F.I.T. Aviation L.L.C. by check or cash purchases. The university will mail the student an account statement within 30 days following registration. The statement will show itemized charges, payments received and the account balance. A current account statement can also be viewed online using the student's PIN.

Time Payment Plan

Florida Tech administers a time payment plan that allows the annual educational expense to be spread over 10 monthly installments. The plan begins in advance of the academic year and carries no finance charge, but does require a yearly administration fee.

Parents and/or students who prefer to pay for educational expenses in monthly installments may want to consider this plan. To determine the yearly budget, calculate all expenses, minus all credits, such as scholarships, grants and/or loans. Books and/or work study payroll programs should not be included in the yearly budget calculation. The yearly budget is then divided into 10 equal payments, or divided by five equal payments for one semester participation. The time payment plan is not available for summer terms.

To receive the application form and/or additional information, please contact student accounting by e-mail at studentacctg@fit.edu, or by telephone at (321) 674-7428 or toll-free (800) 676-9250.

Veteran Accounts

Veterans who receive allowances directly from the government are responsible for paying their fees and charges on the same basis as other students.

Bank and Check Cashing

To have ready access to funds as needed, students are encouraged by the university to open a checking account in one of the local banks. A new student should bring a cashier's check for deposit in the bank of their choice to avoid a waiting period before funds can be withdrawn. An automated teller machine (ATM) is located in the Denius Student Center.

The student accounting cashier's office will cash personal checks for students in amounts not to exceed $100 at prescribed times during the week. Checks returned for nonsufficient funds (NSF) will result in a fine being charged to the student's account. If a second NSF check is returned, the student will lose check cashing privileges. Students are encouraged to open bank checking and ATM accounts so that they will have continuous access to their funds throughout the academic year.

Panther Access Card ID and Debit Account

The Florida Tech identification card is an integral part of an electronic access system that provides a variety of services to the student. It is required to register for classes, check materials out of Evans Library, conduct business at the student accounting cashier's office, attend many university functions, and serves as a control for the various meal plans. The Panther Access Account is a convenient and cost-effective way to manage expenses while attending Florida Tech. These funds are always available and the card can be used at all food service locations, bookstore, soft drink and snack machines, washers and dryers, copy machines and printers. In addition, the card is used for after-hours access to many academic labs and other locations in campus facilities. Funds may be pre-deposited or added at any time from the SUB Café and Deli, Rathskeller, Center Court or Evans

Dining cashiers, bursar's office, Auxiliary Service Center or the automated cash to card machine located in the library. For additional information, please contact the Auxiliary Service Center.

Payments–Credit Cards

Florida Tech accepts VISA, MasterCard, Discover and American Express credit cards for the payment of amounts due on student accounts. Refunds of credit card payments are credited to the credit card account.

Payments–Part-Time Students

All charges for part-time undergraduate and graduate students are due by the payment due date shown in the catalog and semester schedule of classes. Part-time students may register for and attend classes without payment if

1. the student is sponsored by an employer who will make payments directly to the university, and the employer has furnished a letter to student accounting accepting unconditional liability for all charges not paid by the student, regardless of whether the student completes the course or achieves a minimum grade for the course; or
2. the student has a scholarship, loan or grant covering 100 percent of all costs that will be paid directly to the university by the sponsoring organization, and the sponsoring organization has notified the university in writing of the student's eligibility and acceptance.

The student is responsible for submitting all paperwork on time.

If the student's employer will not furnish a statement of unconditional liability, but does make reimbursement directly to the university, then the student is required to make payment to the university at registration. Any amounts subsequently paid by the employer will be refunded to the student.

Registration

Registration is final only after satisfying all financial obligations. A student who is unable to pay by the due date, and has not made prior financial arrangements with the Office of Account Management, may have his or her registration canceled and the class seats made available to other students. A student who registers on or after the first day of classes is charged a $30 late fee. The academic calendar in the front of this catalog lists registration deadlines.

Delinquent Accounts

Each semester, students must meet all financial obligations due to the university, including tuition, fees, traffic/parking fines, library fines, etc. Tuition, housing, board and other charges are subject to audit at any time throughout the academic career of the student. Students who do not make acceptable financial arrangements to pay after they have been notified of the amount due could have their current registrations canceled.

Students with delinquent accounts are not permitted to enroll in succeeding semesters, are not entitled to transcripts and will not be permitted to graduate until they have met all of their financial obligations to the satisfaction of the university.

Refund Policy

Florida Tech provides for a fair and equitable refund policy that meets all applicable federal guidelines governing refunds for tuition, room, board and applicable fees as published in the Federal Register. The refund policy is published in the *Schedule of Classes* before the start of each term.

Cancellation of Housing and Meal Plan Contracts

All university housing contracts are for the full academic year. Neither buyouts nor substitutions are allowed. Students cannot cancel their housing and meal plan contracts after the deadline dates as outlined on the Housing and Meal Plan Contract.

First-time freshmen and new transfer students who withdraw prior to the start of the fall semester must notify the Auxiliary Service Center in writing, no later than July 15, if they want to have their housing deposits refunded. Students not attending or returning spring semester must notify the Auxiliary Service Center in writing, no later than December 1, if they want to receive a refund.

Upper-division students who want to change the meal plan portion of their contracts must submit a written request to the Auxiliary Service Center by 5 p.m. on the Friday ending the first official week of each semester.

Changing meal plans after the cutoff dates is not permitted except for nonenrollment, official withdrawal, graduation or dismissal from school for the remainder of the academic year. However, a student may opt to increase a meal plan or add FlexCash at any time.

Student Accident and Health Insurance

For academic year 2004–2005, Florida Tech's student health insurance coverage begins August 25, 2004, and ends August 25, 2005.

Domestic Students

Domestic students who are enrolled for six or more credit hours may enroll in the university-sponsored student health insurance plan or waive this charge by showing proof of coverage under a parent's/guardian's or third-party accident and health insurance program from an employer or sponsor, etc. The waiver requires completing the waiver portion of the Student Health Insurance Enrollment and Waiver form and providing proof of coverage (photocopy of both the front and back of their current insurance identification card or a copy of the endorsement page of their current plan). This form, together with proof of insurance, must be submitted to the Auxiliary Service Center no later than 5 p.m. on the Friday ending the second official week of the semester.

The health insurance requirement is waived for students who complete waiver forms and provide proof of insurance. The waiver is in effect while the student maintains continuous enrollment at Florida Tech. In case of a change in personal insurance coverage, however, the Auxiliary Service Center must be notified immediately, and it will be necessary to either provide new proof of insurance or enroll in the Florida Tech insurance plan.

In all cases, full-time students (See "Academic Information" for definition.) who fail to submit the required documentation by the dates indicated are automatically billed and enrolled for student health insurance and are obligated for the entire academic year or any portion remaining at the time of registration.

Students seeking to enroll after the open enrollment period must provide documentation of involuntary termination of previous health insurance coverage.

International Students

U.S. government guidelines require health insurance coverage for both full-time and part-time international students, including coverage for all dependents residing with them in the United States.

International students are automatically charged for Florida Tech's student health insurance unless they are officially sponsored by their home government or agency that guarantees student health insurance coverage as part of their contract with Florida Tech. Students in this category should contact the Office of International Student and Scholar Services to obtain a waiver of this insurance requirement. It is mandatory for all other international students to be covered by Florida Tech's health insurance plan.

Enrolling for Dependent Coverage

Full-time domestic and all international students who are married, or single parents who have one or more children living with them, may purchase health insurance for these dependents by completing the appropriate form in the Auxiliary Service Center and paying for the additional insurance at the student accounting office in the controller's office. Dependents will be seen by a local primary care physician, not at the Holzer Health Center.

The student health insurance fee will be refunded and coverage will be canceled if the student pays for coverage and subsequently does not enroll or withdraws from the university within the first two weeks of classes.

Campus Standards, Behavior and University Discipline

A comprehensive system of rules, regulations, and campus code of conduct is published each year by the Office of the Dean of Students. Students are expected to familiarize themselves with these policies and to adhere to them.

Students who violate the university code of conduct, the student housing rules and regulations or any other published university regulation are subject to disciplinary action by the university.

Students who are found to be responsible for serious violations of university policy are subject to dismissal.

Disciplinary matters are the responsibility of the dean of students.

Veterans Benefits

Veterans benefits are administered by the Office of Veterans Affairs, located in the Office of the Registrar. Veterans and their dependents eligible to receive VA educational benefits should contact this office after completing admission requirements. Benefits must be renewed each semester during the registration period with this office. Graduate students must submit a graduate program plan to this office before the completion of 12 credit hours. Any change to the graduate program plan must be immediately reported to this office. Failure to do so may result in a temporary interruption of VA benefits. Enrollment certification will not be submitted to the U.S. Department of Veterans Affairs (DVA) beyond 12 hours without an approved program plan.

For the purpose of certification of students receiving VA benefits, the following credit hour standards are used:

STATUS	UNDERGRADUATE	GRADUATE
Full time	12	9
3/4 time	9–11	6–8
1/2 time	6–8	5
More than 1/4 time, less then 1/2 time	4–5	3–4
1/4 time or less	1–3	1–2

Students receiving VA benefits are required to make satisfactory progress in their degree programs. Undergraduate students receiving VA benefits are expected to maintain a cumulative grade point average of 2.0 or higher. The first term the cumulative grade point average falls below 2.0, the student is placed in a warning status; a second term places the student in probationary status. A third term below 2.0 results in termination of veterans education benefits. Failure of a graduate student to maintain the minimum cumulative grade point average specified below will also result in termination of VA benefits.

SEMESTER HOURS COMPLETED	MINIMUM CUMULATIVE GPA
9–17	2.50
18–23	2.70
24–32	2.90
33 or more	3.00

After termination, an appeal may be made to the DVA for resumption of benefits. Based in part on the university's recommendation, the DVA will determine whether or not to resume the payment of education benefits to the student.

Academic Information

Registration

Students must be properly registered and have their tuition and fees validated for all courses they are attending. No student shall be permitted to attend a class without processing a registration form, regardless of whether that class is being taken for credit, audit or continuing education units (CEUs).

Registration by Web

The Panther Access Web for Students (PAWS) system enables enrolled students at Florida Tech to use the Internet to register for classes, make schedule changes, and access and print their academic and personal information. Students may view and print course descriptions, semester class schedule, address and telephone information, all grades to date and financial account summary by term, in addition to making payments by credit card or electronic check. The PAWS Welcome Page may be accessed from the Florida Tech home page at www.fit.edu or directly at https://paws.adm.fit.edu/homepage.htm. Obtaining access to student-specific information on PAWS requires a student ID number and six-digit personal identification number (PIN) that is assigned by the Office of the Registrar.

Definition of Full Time/Part Time

An undergraduate student is considered full time if he or she is enrolled for 12 or more credits; one-half time for six to 11 credits; less than one-half time for one to five credits. A graduate student is considered full time when enrolled for nine or more credits, half time with five to eight credits and less than half time with one to four credits.

Faculty Adviser System

Each student is assigned a faculty adviser in his or her major academic unit at the beginning of the first semester of attendance. The adviser monitors the student's academic progress toward a degree. A conference is held with each student prior to registration to ensure that courses are scheduled in proper succession, that all relevant academic policies are adhered to and that the schedule best serves the academic needs of the student. Once arranged, scheduled courses cannot be changed without the adviser's written permission, except for changes between sections of the same course before the end of the first week of class. The faculty adviser is available throughout the academic year for consultation by appointment, and students are strongly encouraged to seek the counsel of their faculty advisers in other matters beyond registration and schedule changes.

Transcripts

All courses taken at Florida Tech are indicated in chronological order on the student's academic transcript. A request for a transcript must be made in writing to the Office of the Registrar, Records Unit, along with the appropriate fee enclosed.

Course Numbers Defined

A Florida Tech course number consists of three letters followed by a four-digit number. Numbers beginning with 1, 2, 3 and 4 indicate undergraduate courses, and those beginning with 5 and 6 indicate graduate courses. Graduate students may take 3000- and 4000-level courses, subject to limitations and restrictions delineated in the *Graduate Policy Manual*. 5000-level courses are intended for master's and doctoral students. Courses with numbers beginning with 6 may be taken only by students enrolled in graduate degree programs.

Credit Hours Defined

The credit-hour value of each course normally represents the number of hours in lecture per week during a full-length semester. Because there are exceptions to this general rule, particularly for laboratory periods, the *Course Descriptions* section of this catalog should be consulted for the credit value of specific courses.

Course Cancellation/Schedule Changes

The university reserves the right to cancel classes for which there is insufficient enrollment, to close a class when the enrollment limit in that class is reached and to make schedule changes as necessary, including changes in time, days, credit or instructor. The university does take the needs of students into account and schedule changes are made only when unavoidable.

Directed Study

Directed study is a means of allowing a student to register for a course during a semester when it is not included in the *Schedule of Classes*. To enroll in a directed-study course, a Request for Directed Study Course form should be initiated and approved according to form instructions. Approval is at the discretion of the academic unit head or program chair responsible for the course, and normally requires evidence of a compelling need by the student. The student should submit the approved form to the Registration Center during normal registration hours. The tuition rate for a directed-study course is the standard undergraduate or graduate rate, plus an additional directed-study fee.

Audit

A student may audit a course with the permission of his or her adviser and payment of an audit fee. An auditor does not receive a grade; an AU is recorded on the transcript in place of the grade if the auditor has, in general, maintained a satisfactory course attendance (usually 75 percent class attendance) and completed the appropriate assignments. If the student does not meet requirements, a final grade of F may be awarded. No changes in registration from credit to audit or from audit to credit will be permitted after the second week of classes.

Grade Point Average (GPA)

A student's academic standing is expressed by the cumulative grade point average, determined by dividing the total number of grade points earned at Florida Tech by the total number of credit hours attempted. The number of grade points for each course is the product of the credit hours for the course and 4 for A, 3 for B, 2 for C, 1 for D, or 0 for F. Plus and minus grades (e.g., B+) are not used at Florida Tech. The GPA is truncated at three digits. In the case of multiple degrees earned as a graduate student, the transcript reports both an overall GPA for all courses taken and program GPAs based on courses that apply to each degree.

Undergraduate and graduate GPAs are never combined. An undergraduate student who takes a graduate course and wishes it to be included on his or her undergraduate transcript must submit a written request to the Office of the Registrar. Once the graduate course has been included on the undergraduate transcript it cannot be used toward fulfillment of the requirements of any graduate degree.

Notification of Grades

At the end of each semester, the Office of the Registrar notifies enrolled students of grades earned by posting them to students' Web records (PAWS). These grades become a part of the official student permanent record and are not subject to change, except on authorization from the instructor, academic unit head and respective dean.

During the eighth week of classes, students not making satisfactory progress in 1000-level courses are notified of their status by mail.

Petition to Graduate

A student planning to receive any degree must file a Petition to Graduate no later than the date shown in the *Academic Calendar* of this catalog. Students filing petitions after the due date are subject to a late fee and may not be able to graduate as planned because of insufficient time to verify completion of requirements. Petitions may be obtained from the Office of the Registrar or from the respective academic unit. A petition to graduate must be accompanied by a degree plan signed by the academic unit.

Drop/Withdrawal Policy

To add or drop a course, or withdraw from the university, a student must complete a Change in Registration/Status form. Students withdrawing from the university are asked to complete a withdrawal survey in the Registration Center.

Failure to attend classes or verbal notification to instructors does not constitute an official drop or withdrawal. Students who drop or withdraw without filing the proper form will receive a failing grade of F. When a student drops a course during the first two weeks of class (except in a summer term) the course will not appear on the permanent academic record. After this date, a W will appear on the permanent record for each dropped course. The W is not used in the computation of the semester and cumulative grade point average. The last day to drop a course without receiving a failing grade is published in the *Academic Calendar*.

Readmission Policy

A student who has been away from the university for four or more consecutive semesters (excluding summer terms) or who has attended another institution during an absence from the university must apply for readmission. If readmission is approved, the degree requirements in place at the time of readmission, or later with academic approval, must be met. A student is not considered absent from the university during a period of study at another institution if a Request to Study at Another Institution form was submitted and approved before enrollment for the other institution's courses. A student who has been away from the campus for less than four semesters and who has not attended any other college or university may register for class without filing an application for readmission.

Appeal procedures for students who have been academically dismissed and seek reinstatement are described under "Probation and Dismissal" in the *Undergraduate Information and Regulations* and *Graduate Information and Regulations* sections of this catalog.

Incomplete Work

An I is given when a course cannot be completed because of circumstances beyond the student's control. The I indicates the course work is qualitatively satisfactory and there is a reasonable expectancy that completion of the remaining work would result in a passing grade. The instructor must provide a statement of the work to be completed to the head of the academic unit. The student must complete the work at the earliest possible time but before the beginning of the seventh week of the following semester, unless an earlier deadline is established at the time the I is recorded and the student is notified of this fact. A waiver of the six-week limitation requires written permission of the cognizant dean. The I will automatically become an F in the seventh week unless an approved waiver has been filed with the Office of the Registrar.

Continuing Education

Continuing Education Units

A continuing education student is defined as one who is not seeking a degree from Florida Institute of Technology. Continuing education students will customarily enroll for courses on the basis of receiving continuing education units (CEUs) rather than graduate or undergraduate credit. The CEU is a nationally recognized unit that indicates successful participation in a qualified program of continuing education. It is defined as 10 contact hours of participation in an organized educational experience under responsible sponsorship, capable direction and qualified instruction.

Students enrolled for CEUs in courses that are being offered for academic credit are required to do all homework, outside reading assignments, term papers or special assignments and to attend at least 90 percent of the class sessions, but they are not required to take midterm or final examinations.

In some situations, the continuing education student may want or need to receive credit rather than CEUs, and this alternative is allowable. Students enrolled for credit, whether degree-seeking or not, must take all examinations in addition to completing all course assignments. Students may switch from CEU to credit or vice versa, any time before the end of the first week of classes.

Enrollment Restrictions

A continuing education student may not enroll in any course, either for credit or for CEUs, without the written approval of the head of the academic unit offering the course. This approval will be based on a review of the student's previous preparation and qualifications and an assessment that the student is capable of completing all course assignments (homework, reading, term papers, etc.) and may take into consideration the effect of enrollment of continuing education students on the course and/or academic program. Such approval will be sought and given on a course-by-course basis, and may be withheld at the academic unit head's discretion.

Admission to Degree Programs

A continuing education student may seek admission to a degree program through the normal admission process. If a continuing education student subsequently decides to pursue either an undergraduate or graduate degree at Florida Tech and is accepted into that degree program, a maximum of 12 semester credit hours earned as a CE student may be applied toward the degree, provided the course work is academically appropriate.

English as a Second Language

To enhance the academic performance of students whose native language is not English, courses in English as a Second Language are offered through the Division of Languages and Linguistics. Students with institutional TOEFL scores below 450 on the paper test or 133 on the computer-based test (CBT) will be enrolled in the ELS Language Center on campus. All Florida Tech students must demonstrate English proficiency. A description of the English proficiency required and program offered is given under "Languages and Linguistics" in the *Nondegree Programs* section of this catalog.

Release of Student Information

The Family Educational Rights and Privacy Act of 1974 (FERPA) as Amended establishes a set of regulations governing access to and the release of personal and academic information contained in student education records. FERPA applies to the education records of persons who are or have been in attendance in postsecondary institutions, including students in cooperative or correspondence study programs. FERPA does not apply to records of applicants for admission who have been denied acceptance or, if accepted, do not attend an institution.

Education records are all records that contain information directly related to a student and are maintained by an educational agency or institution, or a party acting for the institution. Exceptions to education records include sole possession records, law enforcement unit records, employment records, health records and alumni records. Rights under FERPA are not given to students enrolled in one component of an institution who seek to be admitted in another component of the institution.

Under FERPA, the rights accorded to parents transfer to students who have reached the age of 18 or who attend a postsecondary institution. These rights are:

1. The right to inspect and review their education records within 45 days of the day the university receives a request for access. Students should submit to the registrar, dean, head of the academic unit or other appropriate official, written requests that identify the record(s) they wish to inspect. The university official will make arrangements for access and notify the student of the time and place where the records may be inspected. If the records are not maintained by the university official to whom the request was submitted, that official shall advise the student of the correct official to whom the request should be made.

2. The right to request amendment of the student's education records the student believes are inaccurate or misleading. A student should write the university official responsible for the record, clearly identify the part of the record they want changed and why it is felt to be inaccurate or misleading.

   FERPA was not intended to provide a process to be used to question substantive judgments that are correctly recorded. The rights of challenge are not intended to allow students to contest, for example, a grade in a course because they felt a higher grade should have been assigned.

   If the university decides not to amend the record as requested by the student, the university will notify the student of the decision and advise the student of his or her right to a hearing regarding the request for amendment. Additional information regarding the hearing procedures will be provided to the student when notified of the right to a hearing.

3. The right to consent to disclosures of personally identifiable information contained in the student's educational records, except to the extent that FERPA authorizes disclosure without consent. One exception that permits disclosure without consent is disclosure to school officials with legitimate educational interests. A school official is a person employed by the university in an administrative, supervisory, academic or research, or support staff position (including law enforcement unit personnel and health staff); a person or company with whom the university has contracted (such as an attorney, auditor or collection agent); to officials of another school, upon request, in which a student seeks or intends to enroll; a person serving on the board of trustees; or a student serving on an official committee, such as a disciplinary or grievance committee, or assisting a school official in performing his or her tasks. A school official has a legitimate educational interest if the official needs to review an education record in order to fulfill his or her professional responsibility.

   Disclosure is defined as permitting access to or the release, transfer or other communication of the educational records of a student or the personally identifiable information contained therein to any party orally, in writing, by electronic means or by any other means. Disclosure of confidential information to a school official having a legitimate educational interest does not constitute authorization to share that information with a third party without the student's written permission.

   FERPA allows release of the following directory information to the public without student consent: student's name, address, telephone number, date and place of birth, major field(s) of study, e-mail address, participation in officially recognized activities and sports, weight and height of athletic team members, dates of attendance, degrees and awards/honors received and the most recent educational institution attended other than Florida Tech.

   Students may prevent the release of directory information by completing a Request to Prevent Disclosure of Directory Information form available in the Office of the Registrar. By law, however, a student cannot prevent the release of directory information to the U.S. military for recruiting purposes.

   Student consent is required for the release of personally identifiable information such as semester grades, academic record, current academic standing, class schedules, and social security/student number. Student consent is not legally required for disclosure of this information, and reports of alcohol or drug policy violations by students under the age of 21, to certain government agencies/officials, sponsoring agencies, parents/guardians of

dependent students and to selected university personnel determined to have a legitimate educational interest in such records.

Students may consent to release personally identifiable information to others by completing the Authorization for Release of Student Information form available in the registrar's office.

Information about the provisions of the Family Educational Rights and Privacy Act of 1974 as Amended, and the full text of the law, may be obtained from the registrar's office.

4. The right to file a complaint with the U.S. Department of Education concerning alleged failures by Florida Tech to comply with the requirements of FERPA. The name and address of the office that administers FERPA is

   Family Compliance Office
   U.S. Department of Education
   400 Maryland Ave., SW
   Washington, DC 20202-4605

The Solomon Amendment established guidelines for the release of directory information to the United States military for recruiting purposes. This Congressional act allows release of the following directory information without student consent to military recruiters for present and previously enrolled students at least 17 years of age: student name, address, date and place of birth, telephone number, level of education, major field(s) of study, degrees received and the educational institution in which the student was most recently enrolled.

Student Right to Know

Florida Institute of Technology is in compliance with both the Student Right to Know Act of 1990 and the Campus Awareness and Campus Security Act of 1990.

Data in compliance with the Student Right to Know Act can be found in the university's *Student Handbook*. The Office of Campus Security keeps statistics on compliance with the Campus Awareness and Campus Security Act. These statistics can be found on the university Web site, and are published and distributed to the university community on an annual basis. They are also available upon request to other interested parties.

Undergraduate Information and Regulations

New Student Information

Admission

Requirements for Freshman Admission

The admission office carefully reviews all candidates for admission, using several criteria to evaluate a student's ability to complete several years of rigorous study. Applications are reviewed with reference to specific degree programs or for admission to first-year programs in engineering, science and general studies. The criteria considered include, but are not limited to, the following:

- High school curriculum
- Performance in high school course work
- Class standing (rank in class)
- SAT I or ACT results
- Teacher recommendations
- Experiential essay
- Participation in special classes, clubs or teams that involve research projects/opportunities and advanced problem-solving techniques

Although an admission interview is not required, campus visits and interviews with admission counselors are highly recommended.

Admission Guidelines

Applicants must demonstrate readiness to succeed in a challenging curriculum. The high school transcript is the most important element of the application. While no minimum grade point average, class rank or standardized test score is specified, these measures must indicate a readiness for college studies in a chosen academic program. Similarly, the courses taken in high school should be commensurate with the degree program to be followed. Science and engineering applicants, in particular, should take the most rigorous and advanced science and mathematics courses that their high schools offer. For all applicants, the nature and estimated difficulty of the courses selected in high school, as well as the grade point average, will be an important factor in the selection process. An applicant who is a U.S. citizen must have earned a high school diploma or high school equivalency diploma by the date of first enrollment.

International applicants are encouraged to apply, and will be evaluated on the basis of the same criteria as all other students except that SAT or ACT scores are not required.

English language proficiency is not required for admission, but enrollment in academic courses will be limited for all whose native language is not English until proficiency can be demonstrated. The ways in which English proficiency may be established, either in advance of enrollment or after arrival at Florida Tech, are described under "Languages and Linguistics" in the *Nondegee Programs* section of this catalog, along with references to the Florida Tech courses available to help establish proficiency.

A **home schooled applicant** must submit a transcript of academic work including an assessment of the level attained in mathematics and the sciences, and the texts that were used; a self-descriptive, one-page essay that includes academic, community and athletic accomplishments, career goals and work experience; and SAT I or ACT scores. Although SAT II scores are not required, it is strongly suggested that SAT II results in Mathematics Level II and English Composition be submitted.

An early admission applicant must have completed those high school courses that are indicators of success for the chosen degree program, and must provide a letter from the high school specifying the requirements that must be completed for the high school diploma to be earned. The admission decision will be based on the same criteria as listed above for all other students.

Transfer applicants must provide official transcripts from all colleges and universities previously attended. An applicant who has earned less than 30 semester hours of credit must submit a high school transcript and SAT I or ACT scores.

Special High School or Community College Dual Enrollment

Upon application, Florida Tech may grant "special status" to an outstanding junior or senior enrolled in a high school in Brevard County, or an outstanding community college student from Brevard or Indian River Community Colleges. Enrollment is tuition-free allowing one class for community college students and up to a maximum of 12 credit hours for high school students. Registration is on a class-by-class space-available basis. Interested students should contact Florida Tech's Office of Admission for application materials and the policy agreement.

Senior Citizens Program

The senior citizens program allows individuals age 65 and over to enroll in courses for credit or audit without charge. Participation in this program is restricted to individuals who are seriously committed to learning.

A prospective student wishing to enroll under the senior citizens program must apply for admission as a nondegree-seeking student and be accepted. The application must be accompanied by records of all prior postsecondary course

work. Copies of transcripts are acceptable in lieu of official transcripts. If no previous postsecondary course work was completed, proof of high school graduation is required. These records may be supplemented by a brief statement of "Qualifications through Life Experience" at the discretion of the applicant. A statement of educational goals and a determination by the appropriate admission office (undergraduate or graduate) that the applicant's educational and life experience history supports a reasonable expectation of successful accomplishment of those goals are necessary.

Enrollment is permitted on a space-available basis only, following the last day of class in the preceding semester or summer term.

Credit by Examination

Placement Examinations

Placement examinations are administered by the Academic Support Center to new freshmen during the orientation period each semester. Academic credit can be earned on the basis of these tests if the result is placement into a more advanced course than an entry level course in the same field, as designated in the student's published program.

There are three mathematics examinations given for specific majors. The Calculus Readiness Test is required of all students whose major requires Precalculus (MTH 1000) or Calculus 1 (MTH 1001). The College Algebra Readiness Test is required of all students whose major requires College Algebra (MTH 1701). These examinations determine readiness for the mathematics courses required in the student's degree program, and can result in the award of advanced standing credit for MTH 1000 or MTH 1701 in programs that require these courses. A low score necessitates the student taking one or more preparatory courses before enrolling in the first mathematics courses listed as part of the program. A very high score can result in an invitation for further testing to determine if additional credit is warranted.

The communication examination is required for new freshmen, and for all new transfer students except those who have received transfer credit for Composition and Rhetoric (COM 1101).

Many students entering Florida Tech are sufficiently proficient to qualify for advanced placement above the entrance level in chemistry, physics, computer programming and other subjects. A qualified student should contact the academic program, faculty adviser or the Office of Academic Support Services to discuss advanced placement tests in these areas.

Equivalency Examinations

These examinations are administered by academic departments to allow an undergraduate student to demonstrate proficiency in courses offered at the university. They are used with new students to evaluate advanced standing and to reconcile issues involving transfer credits.

Specific limitations apply to equivalency examinations:

1. Students may not take an Equivalency Examination for any course
   a. for which they have been evaluated by a prior placement or equivalency examination;
   b. that is a prerequisite or a deficiency for a course for which they have received credit;*
   c. in which they have received a grade, including a W (withdrawal) or AU (audit);
   d. in which they are currently enrolled beyond the first week of classes; or
   e. that is a prerequisite for a course in which they are enrolled after the first week of classes for that course.*
2. Students may not take an equivalency examination for any course during the semester in which they have petitioned to graduate.
3. Equivalency examinations are not available for some courses. A list of excluded courses, approved by the vice president for academic affairs, is available in each academic unit office. All humanities elective courses are excluded.
4. Equivalency examinations are not available for graduate-level courses, even if the purpose would be to apply the credit toward a bachelor's degree, nor are equivalency credits earned for an undergraduate course applicable toward a graduate degree.

**An exception will be made for a transfer student during the first semester at Florida Tech following the semester in which the student has been officially notified of transfer-credit evaluation.*

Advanced Placement Program (AP)

Credit is awarded for the College Board Advanced Placement Program (AP) examinations on which a student scores 4 or higher, as detailed below:

SUBJECT	SCORE	CREDIT
Science		
Biology	4	BIO 1010 (4)
	5	BIO 1010 (4) and BIO 1020 (4)
Chemistry	4, 5	CHM 1001 (4)
Physics B	4, 5	Freshman Science Elective (6)
Physics C-Mech.	4, 5	PHY 1001 (4)
Physics C-E/M	4, 5	PHY 2002 (4)
Mathematics and Computer Science		
Calculus AB	4, 5	MTH 1001 (4)
Calculus BC	4, 5	MTH 1001 (4) and MTH 1002 (4)
Computer Science AB	4	CSE 1001 (4)
	5	CSE 1001 (4) and CSE 1002 (4)
Statistics	4, 5	BUS 2703 (3)
English		
Language and Comp.	4, 5	COM 1101 (3)
Literature and Comp.	4, 5	COM 1102 (3)
Humanities and Social Sciences		
Art History	4, 5	Humanities Elective (3)
Macroeconomics	4, 5	BUS 2303 (3)
Microeconomics	4, 5	BUS 2304 (3)
Psychology	4, 5	PSY 1411 (3)
U.S. Gov't. and Politics	4, 5	Social Science Elective (3)
Comp. Gov't. and Politics	4, 5	Social Science Elective (3)
U.S. History	4, 5	Humanities Elective (3)
European History	4, 5	Humanities Elective (3)
Languages		
French Language	4	LNG 1101 (3)
	5	LNG 1101 (3) and LNG 1102 (3)
French Literature	4, 5	Humanities Elective (3)
German Language	4	LNG 1201 (3)
	5	LNG 1201 (3) and LNG 1202 (3)
Latin/Virgil	4, 5	Languages Elective (3)
Latin Literature	4, 5	Languages Elective (3)
Spanish Language	4	LNG 1301 (3)
	5	LNG 1301 (3) and LNG 1302 (3)
Spanish Literature	4, 5	Humanities Elective (3)

A student receiving a grade of three or better on College Board AP Examinations in most subjects, but not receiving Florida Tech credit under the above provisions, is encouraged to petition to take an equivalency examination, if offered, for further evaluation of possible credit.

College-Level Examination Program (CLEP)

Florida Tech grants academic credit for Subject Examinations only. To receive credit, the minimum score must be above the recommended percentile as published by the American Council on Education. CLEP examinations are not administered on the Florida Tech campus. Contact the Office of the Registrar for further information.

International Examinations

Credit is awarded for participation in an international baccalaureate program based on completion of higher-level exams with grades of four or higher. Credit is also awarded for passing British GCE examinations at the advanced level (A-level) or for passing the French Baccalaureate, based on our review of the subject areas and scores.

Transfer Credit

Transfer credit may be awarded for courses taken at a college or university accredited by a regional accrediting association in the United States, or with equivalent recognition in the case of a college or university elsewhere. Flight credit is transferable subject to FAA rules for transferability between schools.

Transfer credit requires a grade of at least C or equivalent and a determination that the work is equivalent to that given at Florida Tech in course content and hours. If the course equivalency is questionable, credit may be granted by written examination. Credits can be transferred without being applicable toward the student's desired degree. Grades and grade points are not transferable. No credit will be given for courses listed on a transcript without a grade, for courses carrying grades but not credit hours, for vocational/technical courses, correspondence courses or experiential learning. In most cases, credit will not be given for courses completed more than 10 years before Florida Tech enrollment.

All requests for transfer credit, including credit earned by taking College Board Advanced Placement (AP) examinations, "subject area" College Level Examination Program (CLEP) examinations, etc., must be submitted to the Registrar. All official transcripts and documents must be submitted prior to the completion of the first semester of enrollment. Requests for additional transfer credit must be made before the end of the second semester. Requests for advanced standing must be submitted to the appropriate academic unit head no later than 45 days after initial registration.

An unofficial transfer credit evaluation is performed by the Office of Admission upon admission, to be followed by the official transfer credit certification after receipt of the tuition deposit. The official certification of transfer credit is performed by the Office of the Registrar, based on evaluations performed by the academic units responsible for the subject matter areas represented by the transfer courses, except for courses for which there is no corresponding Florida Tech program. In the latter case, the registrar is the sole approving authority. Official transfer credit is reported on the transcript in terms of equivalent Florida Tech course identifications, if any, and otherwise as electives, either with the subject area identified (e.g., physical science elective) or as undesignated transfer credits. The use of any transfer credit, other than credit for a specific Florida Tech course, in meeting degree requirements is subject to the approval of the faculty responsible for the degree program. Transfer students are advised to provide the registrar with college catalog(s) and/or course syllabi and names of textbooks used in courses to help assure a thorough transfer credit evaluation.

Certification of transfer credit is based on official transcripts bearing the correct seals and authorized signatures from all former institutions. A transcript is considered official only when mailed directly to Florida Tech from the issuing institution. The Office of the Registrar coordinates the process, certifies courses without respect to the major and provides notice of the official evaluation. The application of transfer credit to the degree program is completed by the student's academic unit.

See "Credit by Examination" in this section for information on credit awarded on the basis of equivalency examinations, College Board AP examinations, CLEP subject examinations, International Baccalaureate higher-level examinations, British GCE (A-level) examinations and French Baccalaureate examinations.

Transfer Credit from International Universities

A student requesting transfer credit for academic work completed at an international educational institution must request that official transcripts be mailed directly to the Florida Tech admission office directly from all previous institutions attended, showing all courses taken, dates and grades. Personally delivered transcripts are not considered official. Official course descriptions and/or syllabi are also required. In the case of transcripts and course syllabi that are not in English, official English translations are required.

In some cases, additional information about the institution may be required such as accreditation/academic recognition, degrees awarded, academic calendar, grading key and policies, etc.

Florida Tech reserves the right to require the student to request an independent evaluation and/or recommendation regarding the international institution, performed by an agency specified by Florida Tech.

This information must be mailed directly to the Office of the Registrar from the international college/university. Personally delivered transcripts are not considered official.

Articulation Agreements

Articulation agreements exist with a number of schools in the United States and abroad. The majority of these agreements are with two-year colleges and are designed to provide ease of transfer for students who have completed the Associate of Arts degree. Florida Tech has an articulation agreement with all of Florida's Community and Junior Colleges.

For more information on the articulation agreement, contact the articulation officer in the Office of Undergraduate Admission.

Financial Aid and Scholarships

The Office of Student Financial Assistance is available to assist students and their families in identifying sources of aid, completing the application process and providing assistance when needed.

To apply for financial aid, a Free Application for Federal Student Aid (FAFSA) must be submitted annually. The FAFSA is a nationally distributed financial aid form. It is available in high school guidance offices and most financial aid offices, including Florida Tech's Office of Student Financial Assistance. An electronic version of the form is also available on the Internet at www.fafsa.ed.gov/. Continuing students who filed for the previous year will receive a renewal FAFSA by mail in January of each year.

The need analysis takes into account family income and assets, family size, number in college and numerous other factors. It is a systematic way of measuring a family's ability to pay for educational costs and to determine the student's eligibility for financial assistance.

Financial aid is typically awarded as a package that consists of loans, work, scholarships and grants. Award offers can only be made to students who are accepted for admission to the university. Priority is given to students who file a FAFSA with the federal processor before March 15.

Satisfactory Progress Standards for Financial Aid Recipients

The academic records of all students admitted to Florida Tech for the first time will be considered sufficient to allow them to apply for financial aid. To remain eligible to receive financial aid, continuing students must meet the following Satisfactory Progress Standards instituted by the university in accordance with federal law. A review for compliance with these standards will be conducted at the end of each semester.

Grade Point Average (GPA)—An undergraduate student is expected to achieve and maintain a GPA of 2.0 or higher. This GPA is calculated in accordance with the guidelines contained in this catalog.

Hours completed—Undergraduate students are expected to satisfactorily complete 80 percent of their attempted course work. In general, full-time students should complete at least 12 hours per semester. Part-time students (6 to 11 hours) should complete at least 6 hours per semester. Courses with grades of F, I, AU or W are attempted courses, but are not satisfactorily completed for the semester.

Time limit—An undergraduate student enrolled full time is expected to complete a degree program within 12 semesters, or 180 credit hours attempted. A student enrolled part time is expected to complete a degree program within 24 semesters. For transfer students, these limits include equivalent terms of aid taken at other institutions.

Warning, Probation and Suspension

Financial Aid Recipients—The first time students fail to maintain satisfactory progress toward their degree, they will be placed on financial aid warning and informed of the appeal process relative to satisfactory progress standards. A second infraction will suspend the student's eligibility for financial aid until an appeal is filed and approved. Students can file an appeal based on any factor they consider relevant.

Scholarship Recipients—Scholarship recipients are required to maintain full-time enrollment (12 semester hours) and a cumulative GPA of 2.6 at the end of each academic year. Failure to maintain the minimum requirements will result in a permanent loss of the academic scholarship.

Grants and Scholarships

Scholarships

Florida Tech offers a variety of scholarships to qualified new students. Scholarship awards range from $4,000 to $12,500 per year, and are limited to eight semesters or the first bachelor's degree, whichever comes first.

All admitted students are considered for scholarships. Normally, an incoming freshman must have high scores on the Scholastic Aptitude Test (SAT I) or the American College Testing (ACT) assessment test and must have a strong grade point average to be considered. Generally, a transfer student must have a strong grade point average.

Grants

Federal Pell Grants—All eligible undergraduate students are encouraged to apply for this federal program by filing the Free Application for Federal Student Aid (FAFSA). This need-based grant ranged up to $4,000 for 2002–2003. All grants depend on the total amount of funds appropriated by Congress for the program. Information and application materials are available through most school guidance counselors and through the university's Office of Student Financial Assistance.

Federal Supplemental Educational Opportunity Grants—Grants through this federal program are available to a limited number of enrolled undergraduate students who demonstrate financial need. Priority is given to students with the greatest need. Annual awards are approximately $1,200.

Florida Tech Grant Assistance Program—This university-funded grant program provides additional assistance in meeting educational expenses. Students must complete and submit the Free Application for Federal Student Aid (FAFSA) to be considered. Annual awards range from $500 to $7,500.

Florida State Aid—Florida residency and eligibility for Florida state aid programs are based on state law and administrative rules. Students who are eligible to be claimed on a parent's income tax return when the parent lives out of state, and independent students whose domicile in the state of Florida is temporary or merely incidental to enrollment in a Florida institution of higher education, are generally not eligible for Florida state aid.

Florida Student Assistance Grants—All U.S. citizens who have been bona fide Florida residents for at least one year and are enrolled or accepted for enrollment as full-time undergraduate students are eligible to apply for aid through this state program. Grants approximate $1,000 per year based on demonstrated need. The student must file a Free Application for Federal Student Aid (FAFSA) each year.

Florida Resident Access Grant—All full-time undergraduate students who meet the Florida residency requirements as defined by the Florida Department of Education are eligible—regardless of family income—to receive financial assistance from the state. This amount varies from year to

year based on available funds. Applicants must complete an application and submit proof of Florida residency before October 1 each year. Students are not eligible if all of their tuition is paid by other sources. This award was $2,575 for the 2002–2003 academic year.

Florida Academic Scholars Fund—Qualified entering freshmen who have resided in Florida for one year may receive up to $3,200. To be eligible, a student must have earned a 3.5 cumulative grade point average and scored 1280 or above on the SAT I, or 28 or above on the ACT. Applications and further eligibility requirements are available from high school guidance counselors.

Army ROTC Scholarship Program

The U.S. Army offers four-year college scholarships to qualified students. These scholarships pay tuition up to $17,000 per year, textbooks and supplies up to $510 per year, and a tax-free subsistence allowance of up to $2,000 per year. Supplemental scholarships from Florida Tech may also be available. Interested high school students should contact their high school counselors or the nearest Army ROTC office for information about applying for Army ROTC Scholarships. Two- and three-year scholarships are also available for current college freshmen and sophomores. The application deadline is July 15 for the early cycle and November 15 for the regular cycle during the senior year of high school or the preceding summer.

Loans

Federal Perkins Loan Program (formerly National Direct Student Loan Program)—Needy students already enrolled and carrying the normal full-time academic workload are eligible to apply for loans from this federal program. The average award is $1,200/year based on available funding. Repayment of principal and five percent interest typically begins nine months after the completion of study, with minimum payments of $40 per month.

Federal Stafford Student Loan—The Stafford loan program is designed to assist students of all income levels with the cost of their education. Stafford loans are either subsidized or unsubsidized. A subsidized loan is awarded on the basis of financial need. The federal government pays the interest on a subsidized Stafford loan until repayment begins and during authorized deferment periods.

An unsubsidized loan is not awarded on the basis of financial need. Interest begins to accrue from the date of disbursement. Students may choose to pay the interest while in school or have the interest capitalized at the beginning of repayment. Students may receive a subsidized and unsubsidized Stafford loan for the same period.

Dependent undergraduates may borrow up to
- $2,625 as a first-year student
- $3,500 as a second-year student
- $5,500 after two years of study (60 earned credit hours)

Independent undergraduates or dependent students whose parents are unable to get a PLUS Loan (see below) may borrow up to
- $6,625 as a first-year student (at least $4,000 of this amount must be in unsubsidized loans)
- $7,500 as a second-year student (at least $4,000 of this amount must be in unsubsidized loans)
- $10,500 after two years (at least $5,000 of this amount must be in unsubsidized loans)

Federal Parents Loan for Undergraduate Students (PLUS)—Parents may borrow through this federally insured loan program. A parent may borrow up to the cost of attendance (less financial aid) per academic year on behalf of each dependent undergraduate student. Repayment normally begins within 60 days following receipt of the loan check. The interest rate is variable, capped at nine percent. The minimum payment amount is $50 per month; the total loan must be repaid within 10 years.

Four-Year Guarantee

A four-year guarantee is offered to the incoming freshman class. Florida Tech guarantees that a student who meets the following requirements will earn a bachelor's degree in four years:
- Declare a major as an incoming freshman and continue in that major until graduation;*
- Consult the designated academic adviser before registering each semester;
- Follow the curriculum plan presented in the entry-year *University Catalog* by taking and passing each course in the semester indicated; and
- Maintain a GPA of 2.0 or higher.

**Students needing prerequisite course work and those initially enrolled in nondegree-granting programs (General Engineering, General Science or General Studies) do not qualify for this guarantee.*

Academic Information

Grading and Honors

Undergraduate Grading System

GRADE	EQUIVALENT	RANGE	QUALITY POINTS
A	excellent	90–100	4
B	good	80–89	3
C	average	70–79	2
D	poor	60–69	1
F	failure	0–59	0
I	incomplete course work		
AU	audit–no grade		
P	pass, no effect on GPA		
W	official withdrawal		

Distinguished Student Scholars

Following each fall semester, undergraduate students who have cumulative grade point averages of 3.8 or higher and have completed more than 52 credits at Florida Tech are recipients of Distinguished Student Scholar recognition.

Dean's List

Students who have completed 12 or more credit hours at Florida Tech, including six or more in the semester just completed, with a cumulative GPA of at least 3.0 and a GPA in the semester just completed of at least 3.25, are considered

to be "Dean's List" students for that semester. A congratulatory letter from the student's dean confirming this designation will be provided upon request to the dean's office.

Graduation Honors

At graduation, bachelor's degree recipients achieving high academic performance are recognized according to their cumulative grade point averages. In the case of multiple bachelor's degree recipients (multiple diplomas), the honors must be earned separately for each degree received, and are determined by the program GPA based on courses that apply to the specific degree. The honors are determined as follows:

Summa Cum Laude ..... 3.80 to 4.00
Magna Cum Laude ..... 3.50 to 3.79
Cum Laude ..... 3.00 to 3.49

In computing the cumulative GPA for graduation honors, the forgiveness policy does not apply. Academic honors are listed on the student's diploma and transcript.

Graduation Requirements

To receive a bachelor's degree, a cumulative Florida Tech grade point average of 2.0 or higher is required. In the case of a student seeking two or more bachelor degrees (See "Dual Majors and Additional Degrees."), a program GPA of at least 2.0 is required in each program for which a degree is awarded, as well as the overall GPA of at least 2.0 that is required for the award of any bachelor's degree. (See "Grade Point Average" in the *Expenses and General Information* section of the catalog for the definitions of program and overall GPA.) A student is not permitted to graduate unless all financial obligations have been satisfied. All program requirements must be completed no later than 24 hours before commencement exercises. Program requirements completed after this deadline will cause the degree to be awarded at commencement exercises the following semester. When program requirements have been met, the student may request from the Office of the Registrar a letter verifying that all degree requirements have been met and that the degree will be awarded at the next commencement.

Undergraduate Core Requirements

A common purpose of all undergraduate programs at Florida Tech is to impart an understanding of our current technology-centered civilization and its historical background. All students seeking a bachelor's degree are therefore required to complete the following core requirements:

Communication ..... 9 semester hours, including COM 1101, COM 1102
Humanities ..... 9 semester hours, including HUM 2051, HUM 2052*
Mathematics ..... 6 semester hours
Physical and/or Life Sciences ..... 6 semester hours
Social Sciences ..... 3 semester hours

**Science Education majors substitute HUM 3332 for HUM 2052.*

In addition to these 33 semester hours, there is a computer literacy requirement that can be met by earning credit for one of the courses designated as CL in the *Course Descriptions* section of this catalog.

Core requirements for the associate's degree in the School of Aeronautics are the same as for the bachelor's degree, except that in the areas of communication and humanities only the four listed courses (12 semester hours) are included.

Residency Requirements for Graduation

To qualify for a bachelor's degree from the university, no less than 34 semester hours of work must be completed at Florida Tech, and must include the final 12 semester hours before graduation. A request for waiver of the requirement for the final 12 credits to be taken in residence must be submitted, in advance, to the Office of the Provost for consideration. The 34-credit residency requirement cannot be waived.

The university reserves the right to change requirements for graduation when it is decided that such changes are necessary. Students are generally graduated according to the degree requirements of their peer group in effect at the time of their admission, unless attendance has not been continuous.

ROTC Credits Used for Graduation

A Florida Tech student who has been admitted to the ROTC program may elect to use one or more military science courses to partially fulfill requirements for graduation in the program in which the student is enrolled. The number of credit hours that can be substituted for other courses in a degree program depends on the particular program. These limitations are delineated under "Military Science" in the *Nondegree Programs* section of this catalog. All military science grades are included in the student's semester and cumulative grade point averages.

Cooperative Education Credits

Students participating in the university's cooperative education program (CWE 1001, CWE 2001, CWE 3001 and CWE 4001) receive free elective credits and are considered full-time students. The applicability of these credits toward degree requirements is limited, and is dependent on the degree being sought and the nature of the work experience.

Electives

The following definitions of electives pertain to all degree programs at Florida Tech. The student should consult these definitions when selecting appropriate courses to satisfy the electives listed under program requirements. The counsel and consent of the student's adviser is important in the final selection.

Free Elective

Free electives may be any courses taken at Florida Tech, or elsewhere if course-specific transfer credit is awarded by Florida Tech. Non-course-specific transfer credit (credit designated as elective credit) can also be used as free elective credit if approved by the faculty responsible for the student's degree program. Courses can be combined to satisfy the specified free-elective credits (e.g., three one-credit courses can satisfy a three-credit listing in a degree program) or vice versa (a three-credit course for three one-credit listings). No more than a total of four semester hours of free elective credits earned for physical education and/or health education can be applied toward meeting degree requirements.

Flight Training

Flight training is available to any university student and may be used as elective credit in many degree programs with faculty adviser approval. FAA Private Pilot Certificate training requires only two courses totaling five semester hours of credit.

Liberal Arts Elective
A liberal arts elective is any course offered by the Department of Humanities and Communication (HUM, COM, LNG) or the School of Psychology (PSY). Certain BUS and EDS courses may also be considered liberal arts electives as determined by the student's academic unit.

Humanities Elective
Courses concerned with human culture, including literature, history, philosophy, religion, linguistics, professional ethics and foreign languages other than a student's native language, meet the requirements for humanities electives. Courses in art, music and drama, other than performance courses, also meet these requirements. These courses are designated as humanities (HUM) or humanities/social science (HU/SS) electives in the *Course Descriptions* section of this catalog.

A foreign language is considered to be the student's native language if it is the formal or commonly used language of the student's country or community, or if it was the language used as the medium of interaction in all or part of the student's pre-university education.

Humanities elective credits may not be granted by equivalency examinations.

Social Science Elective
Studies of society and of the relationship of the individual to society, including anthropology, psychology, sociology, economics, political science, history, linguistics, social responsibility and foreign languages other than a student's native language, meet the requirements for social science electives. These courses are designated as SS or HU/SS electives in the *Course Descriptions* section of this catalog.

Social science elective credits may not be granted by equivalency examinations.

Restricted Elective
A restricted elective is an elective selected from a specified academic discipline. The academic discipline is included in the specification of the elective, e.g., Restricted Elective (Chemistry) or Restricted Elective (CHM). The level of the elective may be specified by the academic unit.

Technical Elective
A technical elective is a course in any field of science or engineering, subject to department or program approval. Courses classified as mathematics, basic science, applied science, engineering science, engineering design or some combination of these satisfies the requirement. These courses should be at a level appropriate to the level at which they appear in the program.

Engineering Science Elective
Engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward a creative application. These studies provide bridges between mathematics, basic science and engineering practice. Lists of approved engineering science electives are included with the program listings.

Engineering Design Elective
Engineering design is the process of devising a system, component or process to meet desired needs. It is a decision-making process, often iterative, in which the basic sciences, mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing and evaluation. Central to the process are the essential and complementary roles of synthesis and analysis. Each engineering design course includes some of the following features: development of student creativity, use of open-ended problems, formulation of design-problem statements and specifications, consideration of alternative solutions, feasibility considerations, detailed system descriptions and a variety of realistic constraints, such as economic factors, safety, reliability, aesthetics, ethics and social impact. A list of approved engineering design electives is normally available in each engineering department office.

Foreign Languages
Students who have had less than two years of foreign-language study at the secondary level may enroll in elementary language courses at Florida Tech. Students who have had two or more years of foreign-language study at the secondary level and students who transfer one year of foreign-language study to Florida Tech from another college or university must enroll in intermediate courses. Native or multilingual speakers of foreign languages may not enroll in elementary or intermediate courses; they may, however, enroll in advanced-level courses. Final decisions regarding the placement of students in foreign-language courses will be made by the head of the department of humanities and communication.

Academic Regulations
The following paragraphs represent an abbreviated presentation of some of the more commonly encountered regulations affecting undergraduate students at Florida Tech. (See also "Academic Information" in this section.) For other academic policies and regulations, the associate provost should be consulted. Academic policies are subject to change effective with succeeding catalogs.

Attendance
Students registered for any course are expected to attend all lectures and must attend all laboratories, examinations, quizzes and practical exercises, subject to penalties specified by the instructor for that course.

Students who miss class must obtain permission from the course instructor to make up missed work. This permission must be requested at the earliest possible opportunity, and before the absence if possible. The student must arrange with the instructor to make up the missed work. The make-up must be completed within two weeks after the absence. In the case of missed final examinations, the policy on Incompletes (I) applies. In mitigating circumstances, the instructor, with the concurrence of the academic unit head offering the course, may require an alternative to making up the missed work.

If circumstances require a student to report late for a class or to leave before the class is over, prior notification should be given to the instructor if possible. Repeated occurrences may result in the student being temporarily denied admission to the classroom.

The professor of military science of the Army ROTC unit has sole authority to determine attendance regulations in ROTC classes.

Classification

All new students are classified as freshmen unless they have completed sufficient transferable hours at another college or university to qualify for advanced standing at Florida Tech. The university operates on the semester system, and course credits are computed on that basis. For those students who have completed college work elsewhere, classification is based on credit hours accepted at Florida Tech rather than the amount of work presented.

To be classified as a sophomore, a student must have completed at least 30 semester hours; as a junior, at least 56 semester hours; and as a senior, at least 85 semester hours.

Students whose studies at Florida Tech began under the quarter system are classified on the basis of all credits earned under both systems with quarter hours being translated to semester hours according to the ratio three quarter hours to two semester hours.

Course Substitution

Course substitutions or any other deviation from the stated requirements of a degree offered at Florida Tech must have the written approval of the student's academic adviser and the academic unit head.

Dual Majors and Additional Degrees

The dual major is recognized any time a student completes all degree requirements for two of the bachelor's degree programs listed on the inside back cover of this catalog. On completion of the requirements for both programs, the student receives one diploma noting both majors (e.g., "Bachelor of Science in Mathematics and Interdisciplinary Science" or "Bachelor of Science in Biological Sciences/ Ecology and Marine Biology Options.") A student who graduates in one program and completes the requirements for a second major in a subsequent term will be issued a new diploma recognizing both fields on return of the first diploma. In the case of three or more majors, the student must select the two that will appear on the diploma. In all cases, the transcript will list all major fields for which complete degree requirements have been met and for which the student has requested official recognition via a Petition to Graduate.

A student may become a candidate for a second bachelor's degree (two diplomas) when he or she has completed 1) at least 15 credit hours of additional work beyond the requirements of a single degree in the major requiring the higher number of credits and 2) all requirements listed for both degree programs.

Forgiveness Policy

The forgiveness policy is a system by which an undergraduate student may repeat an undergraduate course with only the last grade received for this course (this grade may be an F) used in the cumulative grade point average, and in evaluating the fulfillment of graduation requirements. However, both the last grade and the grade in which the forgiveness policy was applied will be calculated for determining graduation honors. All grades received in any course, including those retaken under the forgiveness policy, are retained and recorded on the transcript. Credits where the forgiveness policy has been applied to a course will be removed from both the term and overall GPAs.

An undergraduate student is allowed to apply forgiveness to undergraduate courses a maximum of five times during his or her Florida Tech career. No forgiveness is allowed for subsequent retakes above the maximum of five; all subsequent grades are averaged into the cumulative grade point average. A student attaining 90 or more credit hours may not apply the forgiveness policy to 1000- and 2000-level courses. The forgiveness policy does not apply to graduate courses, even if taken by an undergraduate student, or to undergraduate courses taken by a graduate student.

A Request to Retake a Course form must be completed for every course retaken under the forgiveness policy. This form is due in the Office of the Registrar no later than Friday of the 12th week of classes to be applied that semester. This form is a binding agreement between the student and Florida Tech. Once applied to a repeated course, forgiveness cannot be reversed.

Not Permitted to Register

When it is determined by the academic dean of the college or school in which a student is enrolled that a student is deliberately trying to circumvent university academic policy, regardless of scholarship, the dean may determine that such a student is not permitted to register.

Study at Other Institutions

A currently enrolled student may take a limited number of courses at other institutions for transfer to a Florida Tech undergraduate degree program. Prior approval is mandatory. The student must complete and submit the required form with all required signatures and a written justification. A copy of the other institution's published course description(s) may be required.

All requirements affecting transfer of credits taken elsewhere for application toward a Florida Tech bachelor's degree, as listed in this section under "New Student Information," apply. After becoming a Florida Tech student, no more than three courses may be taken elsewhere and applied toward a Florida Tech degree. Unless the student was a resident of either Brevard or Indian River County at the time of initial acceptance to Florida Tech, a course may not be taken at another institution in these two counties if the equivalent course is offered at Florida Tech in the same or an overlapping term. A course that includes a significant writing or speaking component must be taught entirely in English to be eligible for transfer. No credit will be awarded for a course taken elsewhere if the student was ineligible to take the equivalent course at Florida Tech for any reason.

The student must arrange for an official transcript to be sent by the other institution to the Florida Tech registrar's office.

Studies-Related Assistance

Student Success Program

The objective of the Student Success Program is to do everything possible to assure that our students are successful in their studies at Florida Tech. A major activity of this program is called FRESH (Freshman Retention by Evaluation and Systematic Help). FRESH assures that new freshmen are placed at the proper level in first-year courses, especially in mathematics and chemistry.

Research conducted by Florida Tech and by other universities categorizes most student problems as academic or social. With its primary focus on academic concerns, the Student Success Program designs activities to promote the students' academic development. Additionally, it helps enhance student appreciation of the ideas and principles that will sustain lifelong growth in judgment, integrity, emotional maturity and an understanding of people. Current areas of activity in addition to FRESH include:

- Counseling students when they need help with their studies or with campus life as it relates to their studies.
- Assuring that students are informed about the services available to them.
- Sponsoring noncredit seminars, courses for credit and other activities that add depth to students' academic experiences and help them to succeed in their studies and in their careers.
- Referring students to other resources that can provide needed help.
- Acting as a liaison between students and academic units.
- Scheduling and publicizing timely academic advising activities. For example, freshman academic advisers meet with new freshman during the sixth week of the new student's first semester to review academic progress and discuss the curriculum.
- Sampling student opinion of both academic and support services offered by the university. Results are transmitted to students and to the university faculty and administration.

Although most of the effort is directed toward the needs of freshmen, a growing portion is aimed at the needs of all students.

Academic Support Center

The Academic Support Center (ASC) is a multipurpose learning facility located in the Evans Library Pavilion. The ASC administers the Student Success Program and offers students free one-on-one tutoring in composition courses, math, computer science, physics, accounting, chemistry, aeronautics and engineering courses. In addition, the ASC offers small group study sessions led by undergraduate honor student tutors.

The ASC also serves as a reserve center for various audiovisual materials that faculty can use to supplement course work. The center contains programs on developmental reading, research paper writing, foreign languages and other topics of value to students.

Change of Major

During their studies, students receive exposure to a number of different academic subjects, and some are attracted to programs different from their initial choices. A change of major is possible if the student submits a written request that is approved by the new academic unit head. After a change of major, courses unrelated to the new program will not be used in computing the student's cumulative grade point average. However, all earned grades and credits remain on the transcript.

Following a change of major, the degree requirements in the new major may be based on either the student's original catalog, or the catalog in effect at the time of the change of major, or on a catalog between those two, subject to the approval of the academic unit head.

Undeclared Major

A new student may be uncertain about the specific academic program he or she wishes to pursue. The undeclared major gives a new student the opportunity to explore the general area of interest more broadly for a limited time before choosing a specific major.

Three freshman-year undeclared major programs are available: General Engineering, General Science and General Studies.

The general engineering and general science programs are described in the *College of Engineering* and *College of Science and Liberal Arts* introductory sections, respectively. The general studies program, described in the *Nondegree Programs* section, is for those who may wish to pursue a major in business administration, communication, humanities or psychology.

Probation and Dismissal

An undergraduate student is placed on academic probation at the end of any semester completed with a cumulative grade point average (GPA) less than 2.0, and while on probation is not be permitted to register for more than 15 credit hours without the approval of the cognizant dean. At the end of the probationary semester, the student's academic performance is reviewed, and if the cumulative GPA has increased to 2.0 or greater, the probationary status is removed. If not, the probationary status is continued if the cumulative GPA exceeds the applicable minimum level defined as follows, where the number of credit hours includes transfer credits, credits by examination and all Florida Tech credits taken, whether passed or not, but does not include grades of W:

27 to 59 credit hours ..... at least 1.50
60 to 89 credit hours ..... at least 1.70
90 or more credit hours ..... at least 1.90

A student is academically dismissed at the end of any probationary semester in which the cumulative GPA does not reach the level defined in the preceding paragraph, with the exception of a student who has been reinstated and is meeting all reinstatement conditions.

Students with fewer than 27 credit hours and cumulative GPAs below 1.50 may be academically dismissed by action of the Academic Standing Committee for unsatisfactory progress toward their degrees.

A student who is registered for summer classes before the start of the term will not be dismissed for failure to meet these standards but will be reviewed again before the beginning of the fall semester. The summer "grace period" is not available to students who are not registered by the Friday immediately following spring semester's final examination week, or to students who fail to meet previous reinstatement conditions.

A student who accumulates four Fs in ESL (English as a Second Language) courses will be academically dismissed.

Dismissal may result from cheating or plagiarism when acted on by the University Disciplinary Committee and approved by a committee consisting of the student's college/school dean, the dean of students and the associate provost.

Notification/Right of Appeal

Notification of academic dismissal from the university will be sent to the student by the university registrar.

An academically dismissed student may be reinstated for educationally sound reasons by special action of the Academic Standing Committee of the college or school in which the student is enrolled. A letter requesting reinstatement should be submitted to the committee through the university registrar. A student who has been away from the university for four or more consecutive semesters and was dismissed after the last term of enrollment must submit a letter of appeal for reinstatement. The letter is sent to the Office of Undergraduate Admission along with the application for readmission.

Students reinstated by the Academic Standing Committee may be subject to special requirements as determined by the committee. Failure to meet the conditions specified at the time of reinstatement will result in a second dismissal, with the student retaining the right to request another reinstatement, although such requests are normally granted only in extraordinary cases.

Disciplinary Dismissal

The university reserves the right to dismiss any student at any time if there is just cause and such action is consistent with the policies outlined in the *Student Handbook*.

Any student dismissed for disciplinary reasons will not be entitled to receive any refunds, will forfeit all fees and deposits and will receive failing grades for all courses scheduled during the semester unless recommended otherwise by the University Disciplinary Committee or designated hearing officer and approved by the dean of students.

Students are expected to be familiar with the "Code of Conduct and University Discipline System" detailed in the *Student Handbook*.

Graduate Information and Regulations

Academic Policies

Academic policies are published in the *Graduate Policy Manual*, which is available for reference and photocopying in Evans Library, in each academic unit office and in the Office of Graduate Programs. It is also available on the Florida Tech Web site (www.fit.edu), under quick links/ graduate programs. All graduate students are advised to review the manual early in their graduate careers and to refer to it if in doubt about any aspect of graduate policy.

Admission

Admission to graduate study is granted to highly qualified applicants. Successful applicants for the master's degree will have received a bachelor's degree from a regionally accredited institution, or its equivalent internationally, in a program that provides suitable preparation in the applicant's chosen field. Admission to doctoral study is granted to a limited number of applicants. Successful applicants to doctoral study will normally have received both a bachelor's and master's degree, but admission only with a bachelor's degree is possible for superior students. The academic record of the applicant must indicate probable success in the desired program. As a general rule, an undergraduate cumulative grade point average (GPA) of at least 3.0, and for doctoral programs, a cumulative graduate GPA of at least 3.2, is required for admission. Individual academic units may have higher minimum standards. Only in unusual cases, in which clear and substantive evidence justifies such action, will students be admitted who do not meet this standard.

For those cases in which the student has acceptable undergraduate achievement but has course deficiencies, the major academic unit will specify those Florida Tech courses that, if taken, will remove the deficiencies.

English Language Proficiency

English language proficiency is required of all students taking courses at Florida Tech. For students, either domestic or international, whose first language is a language other than English, evidence of English proficiency can either be submitted to the university prior to arrival on campus or demonstrated after arrival. English proficiency is not required for admission or for the issuance of immigration documents. However, any student who is not a native speaker of English, and who enters Florida Tech without first establishing proof of English proficiency, is required to take an institutional TOEFL before the start of classes. A score of at least 550 on this test is accepted as proof of English proficiency, and enrollment for classes can then proceed on the same basis as in the case of a native English speaker. Scores between 450 and 550 (CBT 133–213) require enrollment for ESL courses at Florida Tech, as specified by Florida Tech's Division of Languages and Linguistics, with a possibility for concurrent enrollment in a limited number of academic courses depending on the TOEFL score. Students who score below 450 are not permitted to enroll for Florida Tech courses until after having taken a series of lower-level English classes at the ELS center on campus.

See "Languages and Linguistics" in the *Nondegree Programs* section of this catalog for information on acceptable proof of English proficiency and on help with English proficiency provided by Florida Tech to students who are not native English speakers.

Procedures

Applicants for master's degree programs should submit their applications at least four to six weeks before the beginning of the desired entrance semester. Doctoral program applicants (except for applicants to the School of Psychology and the Department of Biological Sciences) and all international applicants should submit their applications according to the following guidelines:

Fall Semester	April 1
Spring Semester	September 1
Summer Semester	February 1
School of Psychology	
Clinical Psy.D.	January 15
All Others	March 15
Department of Biological Sciences	March 1

Application forms may be obtained by writing to the Office of Graduate Admissions or on the graduate admissions home page at www.fit.edu. In addition to the completed application form, applicants should submit the following:

Application Fee—A nonrefundable application fee must accompany any application. The amount required is shown on the application.

Transcripts—An official certified transcript must be sent to the Office of Graduate Admissions by the registrar of each college or university attended.

The admissions table on the following page outlines the additional required application materials described in the paragraphs below. Applicants should note especially the GRE requirements.

Recommendations*—Individuals who can attest to previous academic and professional performance and to potential for success in graduate study should mail letters of recommendation directly to the Office of Graduate Admissions. At least one letter of recommendation, if required, should be from a full-time faculty member, especially if the applicant is applying to a doctoral program; if a master's thesis was carried out, a letter from the thesis adviser is normally required.

Florida Institute of Technology

Summary of Required Admission Materials

This summary is a quick reference for admission into Florida Tech's graduate programs. Please see individual program of study for application and transcript information.

G = GRE General Test
Verbal Reasoning
Analytical Writing
Assessment
Quantitative
Reasoning

S = GRE Subject Test

[1] *Résumés required of students who do not meet standard admission requirements.*

[2] *Application deadline for I/O Psychology and Applied Behavior Analysis programs is March 15. Fall semester enrollment only.*

[3] *Application and related materials deadline is January 15 for the Psy.D. program. Fall semester enrollment only.*

NOTE: GRE scores, although required only in certain programs, are recommended in most others and often can result in a favorable admission decision that might not have been possible otherwise.

	Letters of Recommendation	Résumé	Statement of Objectives	Examination Scores Required
AEROSPACE ENGINEERING, M.S.				G
Ph.D.	3	✔	✔	G
APPLIED MATHEMATICS, M.S.				
Ph.D.	3	✔	✔	
APPLIED BEHAVIOR ANALYSIS, M.S.	3	✔	✔	G
AVIATION, M.S.	3	✔[1]	✔	G
AVIATION HUMAN FACTORS, M.S.	3	✔[1]	✔	G
BIOLOGICAL SCIENCES, M.S.	3	✔	✔	G
Ph.D.	3	✔	✔	G
BUSINESS ADMINISTRATION, M.B.A.				GMAT
CHEMICAL ENGINEERING, M.S.				
Ph.D.	3	✔	✔	G
CHEMISTRY, M.S.				
Ph.D.	3	✔	✔	
CIVIL ENGINEERING, M.S.	2		✔	
Ph.D.	3	✔	✔	
COMPUTER EDUCATION, M.S.		✔	✔	
COMPUTER ENGINEERING, M.S.				
Ph.D.	3	✔	✔	
COMPUTER INFORMATION SYSTEMS, M.S.				G
COMPUTER SCIENCE, M.S.				G
Ph.D.	3	✔	✔	G, S
ELECTRICAL ENGINEERING, M.S.				
Ph.D.	3	✔	✔	
ENGINEERING MANAGEMENT, M.S.	2	✔	✔	G
ENVIRONMENTAL EDUCATION, M.S.	3	✔	✔	
ENVIRONMENTAL RESOURCES MANAGEMENT, M.S.	3	✔	✔	G
ENVIRONMENTAL SCIENCE, M.S.	3	✔	✔	G
Ph.D.	3	✔	✔	G
INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY, M.S.[2]	3	✔	✔	G
Ph.D.[2]	3	✔	✔	G
MATHEMATICS EDUCATION, M.S.		✔	✔	
Ed.S., Ed.D., Ph.D.	3	✔	✔	
MECHANICAL ENGINEERING, M.S.				G
Ph.D.	3	✔	✔	G
METEOROLOGY, M.S.	3	✔	✔	G
OCEAN ENGINEERING, M.S.				
Ph.D.	3	✔	✔	
OCEANOGRAPHY, M.S.	3	✔	✔	G
Ph.D.	3	✔	✔	G
OPERATIONS RESEARCH, M.S.				
Ph.D.	3	✔	✔	
PHYSICS, M.S.	3	✔	✔	
Ph.D.	3	✔	✔	
PSYCHOLOGY, CLINICAL, Psy.D.[3]	3	✔	✔	G, S
SCIENCE EDUCATION, M.S.		✔	✔	
Ed.S., Ed.D., Ph.D.	3	✔	✔	
SOFTWARE ENGINEERING, M.S.				G, S
SPACE SCIENCES, M.S.	3	✔	✔	
Ph.D.	3	✔	✔	
SYSTEMS ENGINEERING, M.S.		✔	✔	
TEACHING, M.A.				
TECHNICAL AND PROFESSIONAL COMMUNICATION, M.S.	2			G

Résumé*—The résumé should detail all past professional and educational experiences, including such information as publications and memberships in professional organizations. Nontraditional educational experiences, teaching and relevant employment should also be discussed.

Statement of Objectives*—This statement of approximately 300 words should include a discussion of intended graduate study, professional career goals and past and proposed activities in the field of study.

Graduate Record Examination (GRE)*—The "Summary of Required Admission Materials" table lists those programs that require the GRE General Test, including those that also require a GRE Subject Test. Official scores not more than five years old are required. The computer-based test (CBT) is now the standard form for the General Test and may be taken year-round at designated sites around the country. International students may still have an opportunity to take the paper-and-pencil test at selected sites. (For a listing of the sites, check the GRE Information and Registration Bulletin available in the Office of Graduate Admissions and on the Web.) The official test results are mailed within four to six weeks of the examination date. The unofficial test results for the CBT are available immediately after the test. The official results of the CBT are mailed within 10–15 days of the examination date.

Graduate Management Admissions Test (GMAT)*—The GMAT is required of most School of Management applicants; for details see the section on admission requirements for the MBA degree program under *School of Management*.

TOEFL Scores—Any student whose native language is not English may be accepted for any degree program but will be subject to limitations on registration for academic courses until certain English language requirements are met; for details see "Languages and Linguistics" in the *Nondegree Programs* section in this catalog.

Assistantship Application—Each assistantship applicant must submit a completed assistantship application, three letters of reference and a statement of objectives. Applicants whose first language is not English must submit a score of at least 600 on the institutional TOEFL or 250 on the computer-based test (CBT), and a score of at least 45 on the Test of Spoken English (TSE) to be considered for a teaching assistantship. A TOEFL score of at least 550, or CBT score of at least 213, is required for a research assistantship.

Reapplication—Admission to most graduate programs is valid for two years from the semester of acceptance, but for the Psy.D. program and all biological sciences graduate programs admission is only valid for the semester of acceptance. Individuals wishing to begin or resume graduate work after a two-year lapse are required to reapply for admission. Individuals who leave Florida Tech and attend another university must reapply for admission and submit grade transcripts regardless of the length of time since last attending Florida Tech. (See "Readmission Policy" in the *Expenses and General Information* section of this catalog.)

Other Forms—The Medical History Report and I-20 request forms should be completed and returned after formal admission to the university has been confirmed.

**See the Summary of Required Application Materials.*

Check-In

New students may come to the Office of Graduate Admissions in the Keuper Administration Building during regular university business hours for check-in instructions. This office is open during all breaks, except during holidays. Please refer to the *Academic Calendar* for reporting dates.

Registration Prior to Admission

Under certain circumstances, applicants can avoid delaying their education by registering for courses, for one semester only, while their applications are being processed, provided they are citizens or permanent residents of the United States.

Students who register prior to admission are not eligible to receive federal student financial aid until they are admitted to the university. Such registration requires a preliminary review of written documentation from the degree-granting institution (not necessarily official) showing previous academic courses taken, grades received and degrees awarded. The review should be carried out by the academic unit head or his or her designee. Permission to register pending formal acceptance requires a decision that there is a high probability of eventual acceptance into the program applied for and that registration prior to acceptance is in the best interest of both the academic unit and the student.

In the event that applicants are denied admission while enrolled in graduate courses, they will be given the option of either withdrawing with full tuition refund or completing the courses underway. If the applicant completes one or more graduate courses prior to being denied admission or completes a course for any other reason, he or she will not be given the option of withdrawing or receiving a tuition refund after completing the course.

Master's Degree Policies

Classification of Students

Assignment to one of the following classifications is made at the time of admission.

Regular Student—A student whose undergraduate grade point average is 3.0 or greater out of a possible 4.0 and who meets all other criteria for admission to a particular program is classified as a regular student.

Provisional Student—A student whose undergraduate grade point average is less than 3.0 out of a possible 4.0 or equivalent, or whose academic unit identifies course deficiencies that are considered excessive, is classified as a provisional student. After completing nine credit hours, a provisional student with a grade point average of 3.0 or greater is reclassified as a regular graduate student. A provisional student whose grade point average is less than 3.0 is placed on academic probation. A grade of D or F in any academic course taken while in provisional status results in dismissal.

Special Student—Special student classifications exist at both the undergraduate and graduate levels and are used for students who, for various reasons, are not enrolled in degree-seeking programs. Specific instances include:

1. a student taking course work for credit to apply at another institution;

2. a student taking courses to fill specific professional or vocational needs; or
3. a prospective graduate student with generally acceptable undergraduate achievements but with subject matter deficiencies (usually as a result of changing fields) that, in the judgment of the academic unit, preclude immediate acceptance into the degree program.

In the last-mentioned case, the student will normally have the option of pursuing an undergraduate degree in the desired discipline or making up the deficiencies while enrolled as a special student. The student will then be considered for admission to the appropriate graduate degree program once sufficient additional work has been done to form an adequate basis for a decision by the academic unit.

The customary classification of special students will be as undergraduate students, regardless of the existence of previous bachelor's degrees. A student may, however, be classified as a special graduate student. In such a case, designation and continuation of graduate student status will be at the discretion of the cognizant academic unit, or the director of graduate programs in the case of students who are not seeking eventual admission to a graduate degree program.

Course Requirements

Course requirements are stated in each master's degree program description. The stated minimum credit hours can include any or all of the following, subject to academic unit approval and specific restrictions stated in the *Graduate Policy Manual*:

1. Up to 12 semester hours of credit transferred from a regionally accredited institution or, in some cases, from a foreign university; or, in the case of a partner institution in a joint-degree or dual-degree program with Florida Tech, up to one-half of the total minimum credit hours.
2. Up to six semester hours of credit for 3000- and 4000-level undergraduate courses taken at Florida Tech. Only 4000-level courses will be considered if the courses are in the student's major field of study.
3. Credit previously used to meet the requirements of another master's degree at Florida Tech may be used to meet up to one-half the credits required for the later degree.
4. Credit in excess of the seven-year statute of limitations if a waiver is in effect, in accordance with the statue of limitations section of this catalog.

Academic credit applied toward the requirements of a bachelor's degree, at Florida Tech or elsewhere, may not be used in any graduate program at Florida Tech, regardless of the level of the course.

Program Plan

Each master's-level graduate student is required to have an approved program plan on file no later than one month prior to the time that nine credit hours of graduate courses have been completed.

Only one program plan can be in effect for a student at any given time.

Because of the importance of the program plan in establishing a new program GPA following a change of major, no request to change majors will be processed unless accompanied by an approved new program plan. This requirement applies whether a degree was earned in the first major or not.

Admission to Degree Candidacy

A master's student becomes a degree candidate by satisfying the following requirements:

1. removal of all course deficiencies specified at the time of admission;
2. completion of at least nine semester hours of graduate courses in good standing, as defined by the academic dismissal regulations of the Office of Graduate Programs; and
3. approval of a program plan by the academic unit head.

Thesis

Master's theses are required in some programs and are optional in most others. The credit hours assigned to the thesis vary according to the program. A student cannot initially register for thesis unless his or her GPA is at least 3.0. Subsequent to the initial registration, the student must continue to register for thesis each academic term, including summer, until the thesis is defended and accepted by the Office of Graduate Programs. An interruption in thesis registration requires written approval in advance and is permissible only for educationally sound reasons and only if the student is making no use of university facilities or personnel.

A grade of S (Satisfactory progress) or U (Unsatisfactory) is assigned at the end of each academic term, with zero credit hours earned. In the first term of registration, timely submission and approval of the thesis proposal is required before a grade of S can be assigned. Based on the written thesis proposal and other indications of the candidate's ability to organize and present research plans and results in writing, the academic unit may require a course in thesis preparation, COM 4000. In addition, the candidate should contact the Office of Graduate Programs early in the thesis preparation process for guidance regarding style and format requirements. A *Thesis Manual and Style Guide* is available at the bookstore.

After at least the required number of thesis credits have been registered for and completed with grades of S, all research has been completed and the written thesis prepared, a thesis defense is scheduled. Scheduling the defense is the primary responsibility of the candidate, who needs to take into account faculty schedules, the need for adequate time for a thorough faculty review of the completed thesis and the requirement that the defense be included in the schedule of graduate examinations that is published each week for examinations taking place the following week. If the thesis defense is successful, a P grade is assigned corresponding to the required number of thesis credit hours. A minimum of five copies of the approved thesis must be accepted by the Office of Graduate Programs before the degree can be awarded.

Design Project

All requirements listed for theses in the preceding section apply equally to design projects.

Final Program Examination

A final program examination is required in all master's programs with the exception of those in the School of Management, and those in the School of Extended Graduate Studies for which there is no on-campus counterpart. For nonthesis students, the examination may be either written or oral, or both, at the discretion of the academic unit. For thesis and design project students, the examination consists primarily of an oral defense of the thesis or design project and takes place during the last term of registration for M.S. Thesis. Questions may be asked that pertain to related subject matter, as well as directly to the thesis itself. Questions requiring a written response may be directed to the candidate in advance of the scheduled oral defense.

An examination candidate must have a grade point average (both program and overall, if different) of 3.0 or higher at the time of the examination to be permitted to schedule any final program examination.

All oral examinations must be included in the weekly schedule of examinations published by the Office of Graduate Programs. Scheduling an oral examination is the primary responsibility of the candidate. For written examinations, application must be made by the student to the academic unit at least one month in advance of the desired examination date. Examination dates will normally be announced each term by academic units requiring written examinations.

A candidate must be enrolled during the term the examination is taken. An exception is made for a nonthesis student if a separate examination fee is paid.

Transfer Credit

If the courses constitute a logical part of the student's master's program, a maximum of 12 semester hours of transfer credit from regionally accredited institutions may be accepted, with the approval of the head of the appropriate academic unit and the director of graduate programs under the following conditions:

1. The courses must have been taken for graduate credit.
2. They must have been graded courses, and grades of at least B or equivalent must have been earned in each course.
3. They must have been taken not more than six years prior to the student's first enrollment at Florida Tech.

No credit is given for courses listed on transcripts without grades, for courses carrying grades but not credit hours, for vocational/technical courses, correspondence courses, experiential learning, or for courses taken at an institution based in the United States that is not accredited by a regional accrediting association.

Transfer credits are not included in the computation of grade point averages.

Graduate Study at Other Institutions

A currently enrolled student may take a limited number of courses at other institutions for transfer to a Florida Tech graduate degree program. The restrictions on graduate transfer credit listed above apply. Prior approval is mandatory. The student must complete and submit the designated form with all required signatures and a written justification. A copy of the other institution's published course description(s) must be attached. The student must arrange for an official transcript to be sent by the other institution to the Florida Tech registrar's office.

Doctoral Degree Requirements

Requirements for the Doctor of Philosophy (Ph.D.) and Doctor of Education (Ed.D.) degrees include the general requirements listed here and specific program-by-program requirements and variations as presented in later sections of this catalog. In addition to the Ph.D. and Ed.D. degrees, the university also offers the Doctor of Psychology (Psy.D.) degree, described in the *School of Psychology* section.

The Ph.D. and Ed.D. degrees are awarded on the basis of clear evidence that the recipient possesses knowledge of a broad field of learning and mastery of a particular area of concentration within that field. The work leading to the degree consists of advanced studies and research that represents a significant contribution to knowledge in the subject area. Each student must complete an approved program of study, pass a comprehensive examination, complete an original research program, and prepare and defend a dissertation on that research.

Credit Hour Requirements—Although the Ph.D. or Ed.D. degree is awarded primarily on the basis of creative accomplishment rather than the accumulation of a specified number of credit hours, minimum standards are enforced regarding the number of credit hours that must be successfully completed by all Ph.D. students. A total of at least 78 semester hours must be completed, including at least 48 semester hours of course work and 24 hours of research and dissertation. The 48 course hours must include at least 24 semester hours of formal classroom courses, and with academic unit approval may include up to six credit hours of undergraduate courses, subject to the limitations delineated in the *Graduate Policy Manual*. At least 18 of the 48 course hours and all of the 24 research and dissertation credit hours must be taken at Florida Tech. At least 15 credit hours of dissertation must be taken after admission to candidacy. Credit earned for courses taken in fulfillment of the requirements for a master's degree, either at Florida Tech or elsewhere, may be used in meeting the 48-semester-hour minimum requirement for course work, subject to the restrictions stated above and provided that the courses are directly applicable to the field of the Ph.D. degree. A student should expect to take a significant amount of course work at a more advanced level, even if master's degrees in more than one field have been earned.

Doctoral Committee—At least 90 days before the comprehensive examination, the student must select a major adviser with the concurrence of the individual selected and the student's academic unit head. The major adviser serves as both research supervisor and chair of the Doctoral Committee and need not be the same person who served as academic adviser while the student was taking courses.

At least 60 days prior to the comprehensive examination, the major adviser nominates a Doctoral Committee for approval by the student's academic unit head and the director of graduate programs. The committee consists of at least four members, including the major adviser. One member must be a full-time graduate faculty member from an academic unit

that is administratively different from the student's and major adviser's. At least three members, including the major adviser, must be approved for doctoral advising.

This committee serves in an advisory capacity throughout the remainder of the doctoral program and is responsible for formally evaluating the candidate's progress by conducting the comprehensive examination, reviewing and approving the dissertation proposal, conducting the dissertation defense and approving the dissertation.

Comprehensive Examination—After the completion of all formal course work (as determined by the academic unit) included in the doctoral program of study, the student is required to take a comprehensive examination administered by the Doctoral Committee established for the student. The examination covers the student's major area of emphasis in depth but may also include other areas considered appropriate by the Doctoral Committee. The examination may be written, oral or both, according to the requirements of each doctoral program. To pass, the student must have the unanimous approval of the committee. A student who does not pass the examination may, at the option of a majority of the committee, be allowed one opportunity to retake the examination after a suitable period of study. The examination must be passed at least one calendar year before the degree is awarded. Scheduling the examination to meet this requirement is the primary responsibility of the candidate.

Dissertation Proposal—Subsequent to successful completion of the comprehensive examination, a dissertation proposal must be submitted to the Doctoral Committee, who will ascertain that the subject of the dissertation is of doctoral quality and that completion of the dissertation is feasible. If the proposal is approved by the committee, a copy will be made a part of the student's permanent record.

Degree Candidacy—After a student has passed the doctoral comprehensive examination and has had the dissertation proposal approved by the Doctoral Committee, the academic unit head will notify the registrar that the student has been admitted to candidacy for the doctoral degree.

Residence—The residence requirement consists of 1) the performance of research under the direct supervision of Florida Tech faculty for at least one calendar year, and 2) enrollment in a Florida Tech graduate program for a minimum of two years from the time of original registration.

A doctoral student who has been admitted to candidacy must normally register each academic term thereafter for six or more credits of dissertation throughout the remainder of his or her program. At the discretion of the academic unit, a doctoral student can register for three credits of dissertation where justified. In some cases, registration for fewer credit hours is permitted in the final semester of registration; see the *Graduate Policy Manual* for details. After admission to doctoral candidacy, an interruption in registration is permissible only if the student is not making any use of university facilities or personnel, and requires prior written approval by the academic unit head and the director of graduate programs.

The student's dissertation performance is evaluated in each term of registration, and grades of S (Satisfactory) or U (Unsatisfactory) are assigned. These grades do not affect the student's grade point average. S grades corresponding to the required number of dissertation hours are replaced by grades of P (Pass) upon successful completion of the dissertation.

Dissertation Preparation and Defense—The dissertation must demonstrate critical judgment, intellectual synthesis, creativity and skills in written communication. The general format must follow the guidelines established by the academic unit and the Office of Graduate Programs. Copies of the dissertation must be submitted to the Doctoral Committee at least one month prior to the proposed date of the dissertation defense. The candidate must verify, by contacting each member of the Doctoral Committee, that the dissertation is generally acceptable before actually scheduling the defense. The Office of Graduate Programs must be notified of the defense at least two weeks prior to its scheduled date. The candidate is primarily responsible for scheduling the examination and notifying the graduate programs office.

The dissertation defense is administered by the Doctoral Committee. The candidate is questioned on the subject of the dissertation and any additional topics related to the candidate's ability to organize and conduct research. The dissertation must have the unanimous approval of the committee and must also be approved by the academic unit head. Requirements for the degree are not completed until the dissertation is accepted by the director of graduate programs. A completed Dissertation Microfilming Agreement form and Survey of Earned Doctorates form (both available from the Office of Graduate Programs) and an additional title page and abstract must accompany the required dissertation copies.

Academic Unit Requirements—The requirements specified above comprise the minimum requirements for Ph.D. and Ed.D. degrees at Florida Tech. Academic units may specify additional requirements for their doctoral degrees as defined in this catalog.

Grading System and Requirements

Graduate work is evaluated by letter grades, with only grades of A, B, C and P being credited toward graduate degrees. Grades of D and F are failing grades in graduate courses. Failed courses must be repeated at the earliest opportunity, if they are required courses. An elective course in which a D or F is received must be repeated, unless the academic unit approves an additional course to be taken in its place.

When Pass/Fail (P/F) grading is used, the total credit hours earned increases without having any effect on the grade point average (GPA) if a grade of P is earned, whereas no credit hours are earned and the GPA is adversely affected in the case of a grade of F, just as with any other F. Pass/Fail grading is used for certain courses and for master's theses, design projects and doctoral dissertations.

The program GPA is based on the student's program plan and includes all courses shown on the program plan as applying toward the degree, both graduate numbered and undergraduate numbered. Before submission of the program plan, the GPA will be based on all graduate-numbered courses taken at Florida Tech with the exception of any that may previously have been used to satisfy the requirements of a bachelor's degree.

In cases where the degree-related GPA referred to above does not include all graduate courses taken at Florida Tech, an overall GPA is also calculated and reported. Graduate courses used to compute the overall GPA, but not the program GPA, include courses taken as deficiencies, courses unrelated to the student's degree program, courses taken prior to a change of major and courses taken in satisfaction of the requirements of a previously earned graduate degree. Courses related to the degree program that are taken in excess of degree requirements are normally included in the program plan. It is not possible to delete a course from a program plan once the course has been taken, although an exception is made if the statute of limitations is exceeded at which time it is dropped from the program plan and from both the program and overall GPAs. Courses are not otherwise dropped from the overall GPA except by special action of the Graduate Council following a change of major. If no degree was earned in the first major and the courses are clearly not applicable to the new major, the council can approve deletion from the overall GPA.

Grades of S (Satisfactory) and U (Unsatisfactory) are used as progress grades in thesis, dissertation, design project, research and internship, and as final grades in some zero-credit seminar courses. They are similar to grades of P and F except that they carry no credit, and S grades (when used as progress grades) may be replaced at any later time by credit-carrying grades of P. U grades remain on the transcript permanently, but like grades of S, they do not affect the grade point average.

The basic requirement for receiving any master's degree is a GPA of at least 3.0 on a 4.0 scale where A = 4, B = 3, C = 2, D = 1, F = 0. Both the overall GPA and the applicable program GPA must be 3.0 or greater for a master's degree to be awarded.

For a doctoral student, a 3.2 cumulative program grade point average represents minimal satisfactory academic performance and is required for admission to candidacy and for graduation. In addition, an overall grade point average of at least 3.0 is required, based on all courses taken as a graduate student at Florida Tech.

Statute of Limitations

Master's Degree

A seven-year statute of limitations is in effect on all work applied toward a master's degree at Florida Tech. All course work and thesis research, including thesis/design project acceptance or final program examination, must be completed within a total elapsed time span of not more than seven years.

An academic unit head may approve a waiver of the statute of limitations for up to six semester credit hours of course work taken either at Florida Tech or elsewhere, subject to the following conditions:

1. Any course so approved must have been completed within the previous 10 years, and with a grade of at least B.
2. Only those courses where course content has not changed significantly in the intervening years may be approved.
3. The student must provide evidence of current mastery of the course content.

The academic unit head must notify the registrar in writing of the action.

In the case of a waiver request that does not conform to these requirements, or a request involving more than six semester credit hours, the academic unit head may either deny the request outright or submit it to the academic dean, accompanied by proof of current mastery based on a written examination endorsed by Florida Tech faculty, with a recommendation for a favorable decision.

A waiver is in effect for a period of seven years from the time it is approved.

Courses over the time limit for which the limit has not been waived may be removed, upon written request, from grade point average (GPA) calculations.

Ph.D. and Ed.D. Degrees

The statute of limitations for students pursuing Ph.D. and Ed.D. degrees is five years from the end of the academic semester during which the comprehensive examination is successfully completed. If this period should expire before completion of the degree and if the student wishes to continue enrollment in the program, the comprehensive examination must be readministered by the student's Doctoral Committee. This new examination should reflect developments of importance in the area of study occurring since the first examination, as well as areas of general importance.

Doctor of Psychology (Psy.D.) Degrees

A student who has not completed the requirements for the degree within seven years of initial enrollment will no longer be considered a candidate for the degree. Appeals for reinstatement of candidacy status must be directed to the Graduate Council.

Probation and Dismissal

Master's Students

A master's student must continue to demonstrate academic proficiency in course work and must show reasonable progress toward the 3.0 grade point average (GPA) required for graduation. Failure to have the minimum GPA specified below results in written notification of academic probation, including the conditions of probation. Failure to satisfy the conditions of probation will result in dismissal following the probationary semester.

In the case of separate program and overall grade point averages, the current program average must meet the standard for the number of attempted credit hours shown on the current program plan and the overall average must meet the standard for the total credit hours attempted.

SEMESTER HOURS COMPLETED	MINIMUM GPA
9	2.60
15	2.80
18 or more	3.00

Students who have transferred credits from another institution will be permitted to complete nine credits of graduate courses at Florida Tech before evaluation of the GPA. After completing nine credits at Florida Tech, the student must meet the above standards for total semester hours completed (Florida Tech credits, plus transfer credits) by using Florida Tech's GPA.

A master's student with fewer than nine credit hours of graduate courses, but nine or more credit hours of undergraduate courses taken while enrolled as a graduate student at Florida Tech, must maintain a 3.0 average in these undergraduate courses. Failure to maintain this average will result in probation. Failure to meet probation terms will result in academic dismissal. On completion of nine credit hours of graduate courses, the graduate GPA will take precedence in probation and dismissal evaluations.

In addition, either of the following conditions will result in immediate academic dismissal:

1. Two or more grades of D or F in any courses taken as a graduate student.
2. Judgment by the Graduate Council that the student is not making satisfactory academic progress, or that the academic efforts of other students are hampered by his or her presence.

In all cases of academic probation and dismissal, the student will be so notified by the Office of Graduate Programs. Any academic dismissal can be appealed for educationally sound reasons. A letter of appeal requesting reinstatement must be submitted to the Office of Graduate Programs. The student will be allowed to continue attending classes pending Graduate Council action on the appeal. If the appeal is denied, or if no appeal is submitted within the time period specified in the dismissal letter, the student's registration will be canceled and further class attendance will not be permitted.

Doctoral Students

The basic standard for successful performance at the doctoral level is a minimum 3.2 program grade point average and an overall minimum grade point average of 3.0. The program grade point average for a doctoral student includes all courses shown on the program plan as applying toward the doctoral degree, both graduate numbered and undergraduate numbered. The overall grade point average is based on all course work taken at Florida Tech while enrolled as a graduate student.

A program grade point average less than 3.2 after 15 or more semester hours will result in probation; if the grade point average of 3.2 is not attained after completing the probationary semester, the Graduate Council will consider dismissal of the student. A grade point average below 3.0 at any stage of the doctoral program will result in the student's dismissal.

If a student fails to maintain satisfactory progress in course work and/or research, as determined by the graduate faculty of the student's major academic unit, academic dismissal may be recommended regardless of the GPA. In such cases, concurrence of the Graduate Council is required.

A dismissed student has the right to appeal the dismissal by submitting a letter to the Office of Graduate Programs stating the basis for the appeal. All appeals are considered by the Graduate Council.

Dismissal for Misconduct

Student conduct that violates the legal or ethical standards of the university may result in mandatory withdrawal from all classes and denial of permission to register in future terms for either a definite or indefinite period of time.

Examples of academic misconduct that could result in these actions include cheating, plagiarism, knowingly furnishing false information to the university, or forging, altering or misusing university documents or academic credentials.

Examples of research misconduct include fabrication, falsification, plagiarism, misappropriation of ideas of others or failure to comply with legal requirements governing research.

Financial Assistance

Graduate Assistantships and Scholarships

Graduate assistantships involve a stipend or a tuition-waiver, or both, and are awarded to well-qualified master's and doctoral students. Awards are normally made on a year-to-year basis. However, not all students receive assistantships, and partial assistantships (such as tuition waiver only) may also be offered. International students are eligible for graduate assistantships in some academic units. In addition to specific academic unit requirements, any student whose first language is not English, whether or not the student has graduated from an English speaking, post-secondary institution, must submit a score of at least 600 on the Test of English as a Foreign Language (TOEFL) and a score of at least 45 on the Test of Spoken English (TSE) to be considered for a teaching assistantship. A TOEFL score of at least 550 must be submitted for a research assistantship.

Award of a teaching assistantship requires satisfactory completion of the GSA Instructional Development Seminar, generally offered once each year at the start of the fall semester. There is no fee for enrollment in this one-week seminar, which is open to all graduate students recommended by their academic unit heads, as well as new teaching assistants, who are required to attend.

Teaching assistants are subject to written evaluation by their supervisors. These evaluations are required for reappointment. The assistantship application deadline is February 15 for the fall semester. The application should be directed to the head of the student's academic unit.

The U.S. Army offers college scholarships to qualified students. These scholarships pay tuition up to $16,000 per year, textbooks and supplies up to $510 per year, and a tax-free subsistence allowance of up to $2,000 per year. Two-year

scholarships are available for college seniors considering graduate school or current graduate students. Contact the nearest Army ROTC office for more information.

Federal Assistance

As a general rule, a graduate student must be enrolled half time (at least five credit hours per term) as a regular student in a degree program and must be a U.S. citizen or an eligible noncitizen to qualify for federal and/or state financial aid.

The graduate student must also complete a Free Application for Federal Student Aid (FAFSA). These forms are available in the Office of Student Financial Assistance.

Although applications are accepted throughout the year, we encourage graduate students to file prior to March 20 to ensure timely processing.

Students must reapply each year and maintain satisfactory academic progress as defined by the Office of Student Financial Assistance to continue receiving federal assistance.

The Federal Stafford Student Loan program is available to graduate students who apply for federal assistance and who maintain at least half time (five credit hours) enrollment in graduate-level courses. Stafford loans are either subsidized or unsubsidized. A subsidized loan is awarded on the basis of financial need. The federal government pays the interest on a subsidized Stafford loan until repayment begins and during authorized deferment periods. A student may borrow up to $18,500 in Stafford loans each year. At least $10,000 of this amount must be in an unsubsidized Stafford loan. Cumulatively, a graduate student may borrow up to $138,500 in Stafford loans with no more than $65,000 in subsidized Stafford loans. The graduate debt limits include any Stafford loans received for undergraduate study.

Satisfactory Progress Standards for State and Federal Aid Recipients

The academic records of all students admitted to Florida Tech for the first time shall be considered sufficient to allow them to apply for financial aid. To remain eligible to receive financial aid, continuing students must meet the following Satisfactory Progress Standards instituted by Florida Tech in accordance with federal law. A review for compliance with these standards will be conducted at the end of each semester.

1. Students are expected to achieve and maintain a grade point average (GPA) of 3.0 or higher. This GPA is calculated in accordance with the guidelines contained in this catalog.
2. Hours completed–Graduate students are expected to satisfactorily complete 80 percent of their attempted course work. In general, full-time students should complete at least nine hours per semester, and part-time students at least five hours per semester. Courses with grades of F, I, AU or W are attempted courses, but are not satisfactorily completed for the semester.
3. A master's degree program is expected to be completed within six semesters, or 54 credit hours attempted. Cases will be reviewed on an individual basis when additional time is needed.

College of Engineering

Dean J. Ronald Bailey, Ph.D., P.E.

Bachelor of Science

Aerospace Engineering
Chemical Engineering
Civil Engineering
Computer Engineering
Computer Sciences
  Computer Science
  Information Systems
Electrical Engineering
Environmental Sciences
  Environmental Science
  Meteorology
Mechanical Engineering
Ocean Engineering
Oceanography
Software Engineering

Master of Science

Aerospace Engineering
Chemical Engineering
Civil Engineering
Computer Engineering
Computer Information Systems
Computer Science
Electrical Engineering
Engineering Management
Environmental Sciences
  Environmental Resource Management
  Environmental Science
  Meteorology
Mechanical Engineering
Ocean Engineering
Oceanography
  Biological
  Chemical
  Coastal Zone Management
  Geological
  Physical
Software Engineering
Systems Engineering

Doctor of Philosophy

Aerospace Engineering
Chemical Engineering
Civil Engineering
Computer Engineering
Computer Science
Electrical Engineering
Environmental Science
Mechanical Engineering
Ocean Engineering
Oceanography

Associate Dean, Academics
Edward H. Kalajian, Ph.D., P.E.

Associate Dean, Research
Fredric M. Ham, Ph.D.

Associate Dean
Kenneth A. Ports, Ph.D.

Director of Laboratories
Daniel R. Simpson, B.S.

Organization

The College of Engineering comprises seven departments that administer the engineering and applied science programs listed on this page. The departments are chemical engineering, civil engineering, computer sciences, electrical and computer engineering, engineering systems, marine and environmental systems, and mechanical and aerospace engineering. Engineering management is a graduate program within the Department of Engineering Systems.

The College of Engineering supports several research centers and laboratories, including the Center for Information Assurance, Research Center for Waste Utilization, Center for Remote Sensing, Wireless Center of Excellence, and Wind and Hurricane Impact Research Laboratory. These centers and laboratories serve to encourage collaborative research activities involving faculty and students from different programs within the college and across colleges.

Mission Statement

The mission of the College of Engineering at Florida Institute of Technology is to pursue knowledge, truth and excellence in a student-centered academic community characterized by shared values, unity of purpose, diversity of opinion, mutual respect and social responsibility. The college is committed to discovering new knowledge through research, and to enhancing Florida Tech's position as an independent educational institution with bachelor's, master's and doctoral degree programs.

Admission

As a Freshman

All entering students are strongly advised to complete at least one year each of chemistry and physics, two years of algebra, one year of geometry and one-half year each of trigonometry and analytic geometry before enrolling. In addition, at least one year of high school biology is recommended for students planning to major in environmental sciences or oceanography. Familiarity with computers and computer programming is advisable for students in all fields.

Admission decisions are based primarily on grades received in the courses listed above plus English, high school rank in class, grade point average and SAT or ACT scores.

A test administered to entering freshmen during the week preceding the start of classes is designed to identify deficiencies in mathematics. Special courses are available for students to strengthen their skills before entering their chosen field of study. Tests are also administered at this time to allow advanced placement in chemistry, computer science and mathematics. Students who did not take high school physics are allowed to take PHY 1001, but should be prepared to do extra work to keep up with the course material.

Written and spoken communications are extremely important. Problems with reading comprehension or speed make it difficult for students to successfully complete reading assignments and tests. Ability to state complex ideas and technical results clearly, in correct written English, can greatly reduce the difficulty of laboratory courses requiring written reports. Every effort should be made to correct any weaknesses in these areas before arrival at the university or during the freshman year.

As a Transfer Student

Admission decisions for transfer students are made on the basis of a combination of the requirements used for new freshmen, postsecondary grade point averages and specific course grades applicable to the major. Where courses equivalent to at least the first year of the university major have been completed, the level of accomplishment in these courses determines admission.

Students who attend a community college for two years before transferring into the College of Engineering should comply with articulation agreements where they exist and refer to the list of "Recommended Courses to be Transferred." This list is for general guidance only. The detailed curriculum plan for the desired program should be consulted for more specific guidance. If possible, the prospective student should review his/her community college curriculum periodically with an appropriate university faculty member. Some of the courses normally taken during the first two years of a program could be unavailable at some community colleges. As a result, it may take one or more semesters beyond the nominal two years following community college graduation to complete a specific bachelor's degree program.

Most mathematics, physics, applied mechanics, computer programming and English courses at the first- and second-year levels are offered every semester. Every effort is made to make space for new transfer students. A transfer student can usually be registered for a full schedule of courses that are tailored to his or her immediate academic needs. Exceptions, when they occur, are usually the result of the student having completed all course work in some disciplines, such as mathematics and the humanities, without having started course work in other essential areas, such as physics or chemistry.

Courses taken at other fully accredited colleges and universities in the United States or at recognized universities abroad are carefully and thoroughly reviewed for award of transfer credit. Except for a student transferring from a Florida community college or other college with which Florida Tech has an articulation agreement, the student must provide college catalogs containing descriptions of all courses taken. Course outlines or syllabi are also helpful in assuring that all earned transfer credit is received. In the case of courses taken at a foreign university, detailed course outlines are required for transfer credit.

If there is doubt about the equivalency of a course taken elsewhere, the student is required to pass an equivalency examination to receive university credit for the course. In any case, where transfer credit is not awarded for a course passed at another college or university, the student may request an equivalency examination.

Guide for Community College Transfers

Students entering majors other than chemical engineering, computer science, environmental science or oceanography can complete their bachelor's degree programs at Florida Tech within five semesters (68 to 78 credit hours) by transferring the courses indicated in the following list of "Recommended Courses to be Transferred." Students majoring in other fields can also expect to graduate in comparable periods of time by transferring appropriate courses, as indicated by the program descriptions in this catalog. Additional transfer credits, such as electric circuit theory for engineering majors, could reduce the time and credits remaining for graduation. Prior contact with the appropriate academic unit is recommended for students planning to transfer to Florida Tech.

Students transferring from Florida community colleges who meet the conditions established in the Articulation Agreement between Independent Colleges and Universities of Florida and the Florida State Board of Community Colleges can graduate within 67 to 75 credit hours, depending on the field of study.

Recommended Courses to be Transferred

SUBJECT AREA	CREDITS
Calculus	12
Differential Equations	3
General Chemistry*	8
Physics (Calculus-based)*	10
Applied Mechanics (Statics, Dynamics)	6
English Composition	3
History of Civilization	6
Economics	3
Humanities/Social Science Electives	9
TOTAL CREDITS	60

**Including laboratories*

Selection of a Major

A student typically selects a major at the same time the application for admission is submitted. A faculty adviser, affiliated with the major program, is assigned prior to the start of classes. A student who prefers to postpone the selection of a major may initially enroll in the first-year nondegree General Engineering program described below. However, selection of a degree program should occur by the start of the sophomore year.

As long as the requirements for continued enrollment (see *Undergraduate Information and Regulations* section) are met, students are permitted to remain in their selected major. A change of major can be initiated by the student, but is subject to the approval of the new academic department

head. Students can generally change majors between any two closely related degree programs during the sophomore year or even during the early part of the junior year without greatly increasing the time needed to complete all degree requirements.

Course Loads

The normal course load taken by students in the College of Engineering is about 17 credit hours. Students may enroll for lighter loads and are strongly encouraged to do so if difficulty is experienced in keeping up with all course work when a full load is attempted, even though the duration of the program would of necessity be extended from eight semesters to nine or more semesters.

Cooperative Education

Students in the College of Engineering are encouraged to participate in a cooperative education program. The Office of Career Services and Cooperative Education exists to help students participate in a program that alternates periods of work experience in a chosen field with academic semesters spent on campus as a full-time student.

Participants in this program are able to earn some of the funds needed to further their education while gaining valuable, practical experience and a knowledge base that is useful in better defining career goals. The length of time needed to earn a degree is extended by an amount comparable to the number of semesters spent away from the campus. Students in this program should pay special attention to scheduling their courses well in advance to avoid conflicts between off-campus periods and the semesters when required courses are offered.

General Engineering

ASSOCIATE DEAN, ACADEMICS
E.H. Kalajian, Ph.D., P.E.

A student who wishes to postpone the selection of a major may enroll for up to one year as a general engineering student, following the curriculum described below. This curriculum is designed to allow students more time to become familiar with all College of Engineering academic programs. Students are urged to select degree programs as early in the year as possible; those who take the courses listed below and no others for the entire freshman year may have up to 12 credit hours of course work to make up later.

Freshman Year Curriculum

FALL	CREDITS
CHM 1101 General Chemistry 1	4
COM 1101 Composition and Rhetoric	3
EGN 1000 Introduction to Engineering	3
MTH 1001 Calculus 1	4
	14

SPRING	
COM 1102 Writing about Literature	3
CSE 1502 Introduction to Software Development with C++	3
or	
CSE 1503 Introduction to Software Development with FORTRAN	3
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
	15

Students in this program are advised by the associate dean of engineering until a degree program is selected. Once 30 credit hours (not including remedial courses) have been successfully completed, the student is expected to select a degree program. Acceptance into the desired degree program is automatic unless the student has been academically dismissed.

Aerospace Engineering

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING
J.J. Engblom, Ph.D., Head

Bachelor of Science *Master of Science* *Doctor of Philosophy*

Areas of Specialization:
Aerodynamics and Fluid Dynamics
Aerospace Structures and Materials
Combustion and Propulsion

Professor

T. Dwayne McCay, Ph.D., *low density gas dynamics, high speed flows, propulsion systems, laser interaction with materials.*

Associate Professors

David C. Fleming, Ph.D., *structural mechanics, advanced composite materials, crashworthy aerospace vehicle design, finite element analysis, fracture mechanics.*

John M. Russell, Sc.D., P.E., *fluid dynamics, mathematical theory of shear flow instability, constitutive theory, dynamics of vortex tubes and filaments, applied aerodynamics, flight vehicle stability and control, mathematics.*

Paavo Sepri, Ph.D., *fluid mechanics, turbulence, convective heat transfer, boundary layers, aerodynamics, wind tunnel testing, droplet combustion, computational fluid dynamics.*

Chelakara S. Subramanian, Ph.D., P.Eng. (UK), *experimental fluid mechanics, turbulence measurements, LDV, photoluminescence barometry and thermometry, wind tunnel experimentation, wind engineering, structure of complex turbulent flows, turbulence modeling, boundary layer receptivity, energy efficient systems, film cooling.*

The field of aerospace engineering has grown rapidly in recent decades to assume a vital role in modern human endeavors. Ranging from manned lunar excursions, exploration of the solar system and ecological study of Earth, to beneficial commerce on space stations and high-quality products for humans and military concerns, the contributions from the aerospace engineering profession have been profound. Accomplishments in airframe materials, computational fluid dynamics and propulsion system designs have resulted in the circumnavigation of Earth by an airplane without recourse to refueling. Aerospace engineers are currently involved in space station operations and are expected to take part in future moon-base and space station missions, as

well as manned exploration of Mars. The many spin-offs from their involvement in these activities in space will surely benefit humanity here on Earth just as their previous space involvement has.

Bachelor of Science Degree Program

The aerospace engineering undergraduate curriculum at Florida Tech presents the fundamentals underlying modern aerospace engineering and prepares the student for a lifetime of continued learning. During the freshman and sophomore years, emphasis is placed on mathematics and physics, while aerospace engineering is introduced through a sequence of three courses. The sophomore and junior years direct the student toward the engineering sciences, including materials science, thermodynamics and fluid mechanics. During the junior and senior years, the study becomes progressively centered about the specific issues facing practicing aerospace engineers. The student uses the basic tools imparted during the first two years and applies them in studies of aerodynamics, propulsion systems, aerospace structures and design projects. Other courses taken during the last two years expand the student's knowledge in the fields of mechanics of solids, electric circuits, flight stability and control, and mission analysis. Technical electives taken during the junior and senior years allow the student to direct the program toward specific areas of personal interest, such as flight training and human factors engineering, space science, mathematics, computer science or other engineering disciplines.

Laboratory experiences are essential to the education of engineers, and these are provided in chemistry, physics, computers, materials, fluids, structures and experimental aerodynamics. The capstone of the educational process is embodied in the aerospace engineering design project, which synthesizes and focuses elements from the various disciplines into a design activity of current aerospace engineering interest. The faculty of the program serve jointly in the supervision and consultation for these projects.

Students are encouraged to define career objectives early in the program (preferably during the sophomore year), so that, in consultation with faculty advisers, electives can be selected that are best suited to the achievement of specific goals.

Students may also choose to benefit from the experience gained through the cooperative education program.

After graduation, the aerospace engineering student is prepared to pursue a career in either industry or government as a practicing engineer, or to enter graduate study in engineering, applied mechanics or mathematics.

The objective of the aerospace engineering program is to graduate students who are well prepared for an engineering career through their understanding of engineering science fundamentals including mathematics, physical sciences and information technology; are able to design and conduct experiments, collect measurements, and analyze and interpret experimental data; can design components and systems, and have an understanding of manufacturing processes; are able to function on multidisciplinary design teams; can identify, formulate and solve engineering problems and understand the impact of their solutions in a global and societal context; can understand professional and ethical responsibility, communicate effectively and recognize the importance of participating in life-long learning opportunities; have knowledge of contemporary issues relevant to the engineering profession; are successful in securing employment; and for those who choose graduate study, are successful in gaining admittance to and completing graduate or professional programs.

Degree Requirements

Candidates for a Bachelor of Science in Aerospace Engineering must complete the minimum course requirements outlined in the following curriculum.

Freshman Year

FALL		CREDITS
CHM 1101	General Chemistry 1	4
COM 1101	Composition and Rhetoric	3
CSE 150x	Introduction to Software Development *(May be either CSE 1502 or CSE 1503)*	3
MAE 1201	Introduction to Aerospace Engineering	1
MTH 1001	Calculus 1	4
		15
SPRING		
COM 1102	Writing about Literature	3
MAE 1202	Aerospace Practicum	2
MTH 1002	Calculus 2	4
PHY 1001	Physics 1	4
PHY 2091	Physics Lab 1	1
	Social Science Elective	3
		17

Sophomore Year

FALL		CREDITS
HUM 2051	Civilization 1	3
MAE 2081	Applied Mechanics: Statics	3
MAE 2201	Aerospace Fundamentals	2
MTH 2001	Calculus 3	4
PHY 2002	Physics 2	4
PHY 2092	Physics Lab 2	1
		17
SPRING		
CHE 3260	Materials Science and Engineering	3
CHE 3265	Materials Science and Engineering Lab	1
HUM 2052	Civilization 2	3
MAE 2082	Applied Mechanics: Dynamics	3
MAE 3191	Engineering Thermodynamics 1	3
MTH 2201	Differential Equations/Linear Algebra	4
		17

Junior Year

FALL		CREDITS
COM 2223	Scientific and Technical Communication	3
ECE 4991	Electric and Electronic Circuits	3
MAE 3061	Fluid Mechanics 1	3
MAE 3064	Fluid Mechanics Laboratory	1
MAE 3083	Mechanics of Materials	3
MTH 3101	Complex Variables	3
		16
SPRING		
MAE 3062	Fluid Mechanics 2	3
MAE 3241	Aerodynamics and Flight Mechanics	3
MAE 3291	Junior Design	1
MAE 4281	Aerospace Structural Design	3
MAE 4284	Aerospace Structures Design Lab	1
MTH 3201	Boundary Value Problems	3
	Technical Elective*	3
		17

Senior Year

FALL		CREDITS
MAE 3260	Experimental Aerodynamics	3
MAE 4242	Aircraft Stability and Control	3
MAE 4261	Air-breathing Engines	3
MAE 4291	Aerospace Engineering Design 1	3
	Humanities Elective	3
	Technical Elective*	3
		18

SPRING

MAE 4262	Rockets and Mission Analysis	3
MAE 4292	Aerospace Engineering Design 2	3
	Humanities/Social Science Elective	3
	Technical Elective*	3
	Free Elective	3
		15

TOTAL CREDITS REQUIRED 132

**A list of recommended Technical Electives is available from the Aerospace Engineering Program Office. Up to six credits of Technical Electives may be replaced by the following:*

AVF 1001 Flight 1, AVF 1002 Flight 2

AVT 1111 Aeronautics 1, AVT 1112 Aeronautics 2

Master of Science Degree Program

The master of science degree can be earned in one of three major areas: aerodynamics and fluid dynamics, aerospace structures and materials, and combustion and propulsion. Because the purpose of each program is to prepare the student for either a challenging professional career in industry or for further graduate study, the programs do not permit narrow specialization. Emphasis is on required course work in several disciplines in which an advanced-degree engineer in a typical industrial position is expected to have knowledge and problem-solving expertise beyond that normally obtained during an undergraduate engineering education.

The master of science degree can be earned on either a full-time or a part-time basis. Full-time students can complete the program in a minimum of three semesters (four in the case of graduate student assistants). Students beginning their course work during the spring semester will be able to register for full course loads, although the commencement of thesis work will normally be delayed.

Graduate student assistants are required to take the one-week teaching seminar offered in mid-August each year.

Admission Requirements

An applicant should have an undergraduate major in a field related to aerospace engineering. Applicants whose bachelor's degrees are in other fields are normally required to take some undergraduate course work in addition to the program described below, as determined by the department head. Applications are also invited from graduates with undergraduate majors in the physical sciences or mathematics. In these cases, at least one year of undergraduate course work in aerospace engineering is normally required before starting the master of science program. In evaluating an international application, due consideration is given to academic standards in the country where the undergraduate studies have been performed.

Master's applicants should take the Graduate Record Examination (GRE) General Test. Applicants from foreign countries must meet the same requirements as applicants from the United States.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The Master of Science in Aerospace Engineering is offered with both thesis and nonthesis options. Each option requires a minimum of 30 credit hours of course work. Prior to the completion of nine credit hours, the student must submit for approval a master's degree program plan to indicate the path chosen and the specific courses to be taken. For the thesis option, up to six credit hours of thesis work may be included in the 30 credit hours' requirement. The thesis can be primarily analytical, computational or experimental; or it can be some combination of these. In each case, students must demonstrate the ability to read the appropriate engineering literature, to learn independently and to express themselves well technically, both orally and in writing. For the nonthesis option, a student may replace the thesis with additional elective courses and a final comprehensive examination, following approval of a written petition submitted to the department head. Generally, students wishing to pursue an academic career are encouraged to choose the thesis option.

Curriculum

The program of study leading to the master's degree in aerospace engineering is offered in the three listed areas of specialization. The minimum program requirements consist of nine credit hours of core courses, six credit hours of mathematics and 15 credit hours (which may include six credit hours of thesis) of electives.

The nine credit hours of core courses must be chosen in consultation with the student's adviser from one of the lists below.

Aerodynamics and Fluid Dynamics

MAE 5110 Continuum Mechanics
MAE 5120 Aerodynamics of Wings and Bodies
MAE 5130 Viscous Flows
MAE 5140 Experimental Fluid Dynamics
MAE 5150 Computational Fluid Dynamics
MAE 5180 Turbulent Flows

Aerospace Structures and Materials

MAE 5050 Finite Element Fundamentals
MAE 5410 Elasticity
MAE 5430 Design of Aerospace Structures
MAE 5460 Fracture Mechanics and Fatigue of Materials
MAE 5470 Principles of Composite Materials
MAE 5480 Structural Dynamics

Combustion and Propulsion

MAE 5130 Viscous Flows
MAE 5150 Computational Fluid Dynamics
MAE 5310 Combustion Fundamentals
MAE 5320 Internal Combustion Engines
MAE 5350 Gas Turbines
MAE 5360 Hypersonic Air-breathing Engines

Electives are selected from these course offerings and appropriate courses in mathematics, in consultation with the student's adviser and committee. The topics of emphasis for aerospace engineering in the three areas of specialization include aerodynamics, computational fluid dynamics, experimental fluid dynamics, flow instability theory, combustion, aerospace propulsion and power, aerospace structures, composite materials, fracture mechanics and fatigue of materials.

Doctor of Philosophy Degree Program

The doctor of philosophy degree program is offered for students who wish to carry out advanced research in any of the three areas of specialization listed under the master of science program. Other research areas within the field of aerospace engineering, which may be very actively pursued

elsewhere, may not correlate well with current faculty interests and facility capabilities at Florida Tech and, therefore, may not be viable fields for doctoral study at this university.

Admission Requirements

A candidate for the doctoral program in aerospace engineering will normally have completed a master's degree in aerospace or mechanical engineering and have adequate preparation in areas of fundamental science and mathematics. Alternatively, a student enrolled in the master's program may apply to work directly toward the doctoral degree after completing at least 18 credits of graduate course work at Florida Tech with a cumulative grade point average of at least 3.5.

Doctoral applicants should have superior academic records, provide letters of recommendation and take the Graduate Record Examination General Test.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The degree of doctor of philosophy is conferred primarily in recognition of creative accomplishment and the ability to investigate scientific or engineering problems independently, rather than for completion of a definite curriculum. The program consists of advanced studies and research leading to a significant contribution to the knowledge of a particular problem. A student's research may have analytical, computational or experimental components, or some combination of these. Each student is expected to complete an approved program of study beyond that required for a master's degree, pass the comprehensive examination (both written and oral parts), present a dissertation proposal acceptable to the student's committee, complete a program of significant original research, and prepare and defend a dissertation detailing the research work.

The program consists of 90 credit hours of study beyond the bachelor's degree or 60 credit hours beyond the master's degree. Candidates from both the thesis and nonthesis master's programs may be admitted into the doctoral program. However, students from the second category must have demonstrated exceptional potential for advanced study to be admitted. Of the 90 credit hours, 36 shall be for dissertation registration, although six credit hours of successfully completed master's thesis registration will normally be accepted into this category.

The purpose of the comprehensive examination is to cover the student's major field of study and related fields important to the major field. The examination is given when, in the judgment of the student's advisory committee, the student has had sufficient preparation in his/her field of study by completing significant course work in at least three areas of specialization, as well as in mathematics, and by initiating doctoral research. The examination must normally be taken before the end of the student's fourth academic semester after admission into the doctoral program. The written portion of the examination consists of individual parts given by each member of the advisory committee. These written examinations are intended to cover each of the student's areas of specialization and applied mathematics. The written portion of the comprehensive examination is followed by an oral component that provides the advisory committee an opportunity to complete the examinations in each of the student's areas of study. Subsequent to completion of both written and oral components of the comprehensive examination, a dissertation proposal must be submitted to the student's advisory committee for evaluation. Upon determining that the proposed research is of doctoral quality and that completion is feasible, the student is advanced to candidacy for the doctoral degree.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

The doctoral program of study must be approved by the student's advisory committee and the department head. Considerable latitude is allowable in course selection, although appropriate advanced courses are expected to form a part of the student's program. A representative distribution of these courses taken beyond the bachelor's degree should include, as a minimum, five courses in the major area and four, three and three courses (in any combination) in the two related areas and mathematics. These choices provide for the selection of three additional courses as electives. The following illustrates a representative doctoral program of study beyond the bachelor's degree.

Major Area (Specialization)	15
Two Related Areas (Specializations) and Mathematics	30
Electives	9
Dissertation (includes 6 cr. thesis if completed)	36
TOTAL CREDITS REQUIRED	90

Selected course offerings from other engineering and science programs can be taken to fulfill the elective requirements. Each student takes electives from the course listings and from mathematics based on his or her areas of interest and in consultation with his or her committee.

Research Activities and Facilities

The research facilities of the aerospace engineering program include laboratories in energy research, fluid mechanics and aerodynamics, combustion and propulsion, metallurgy and solid mechanics, system dynamics and control, instrumentation and applied laser research, computer-aided design and computational research. Other laboratories around the campus can also be used by aerospace engineering graduate students performing advanced research.

Funded research activities of the aerospace and mechanical engineering faculty have included studies of efficient heat transfer and insulation mechanisms in building environments; combustion in porous media; advanced heating, ventilation and air-conditioning; fuel systems; computations of radiative transport; computational mechanics with emphasis on damage mechanisms in laminated composite structures; crashworthiness of aircraft structures; computation of flows in turbine blade environments; turbulent boundary-layer structure with flexible roughness; experimental studies of pressure- and/or temperature-sensitive paints; material characterization using CW and short-pulse lasers; analysis and computation of natural convection, study of leaks in cryogenic seals; and turbulent transport of moisture

contained in air streams. Other studies have involved convection and diffusion of radon gas in porous media, smart composite structures with embedded sensors and optimization of composites.

Laboratories include the Fluid Dynamics Laboratory and the Aerospace Structures Laboratory. The Fluid Dynamics Laboratory features a low-speed, low-turbulence wind tunnel of open-return type, with a square test section 0.535 m on a side and 1.6 m long. The speed range is from zero to 42 m/s. The mean turbulence level is a few hundredths of 1 percent at the lowest tunnel speeds. The Aerospace Structures Laboratory features a drop-tower for impact testing of structures and materials. This laboratory also has a shaker table for the vibration testing of structures. There are also ovens, vacuum pumps and other paraphernalia needed for the custom preparation of material specimens from advanced composite materials.

Aerospace engineering students also have access to other laboratories in the College of Engineering. Of special interest in this context are the laboratories listed in the mechanical engineering portion of this catalog, because the aerospace engineering program has many laboratory courses in common with the mechanical engineering program.

Chemical Engineering

DEPARTMENT OF CHEMICAL ENGINEERING
P.A. Jennings, Ph.D., Head

Bachelor of Science *Master of Science* *Doctor of Philosophy*

Associate Professors
Paul A. Jennings, Ph.D., *reactor engineering, chemical and biological processes used in waste treatment and recycling.*

Manolis M. Tomadakis, Ph.D., *transport processes (diffusion and conduction) in porous and composite media, materials characterization through computer simulations, plasma-enhanced chemical vapor deposition, pressure-swing adsorption.*

Jonathan E. Whitlow, Ph.D., P.E., *multivariable process control, adaptive control, neural networks, expert systems, supercritical fluids.*

Assistant Professors
James R. Brenner, Ph.D., *hydrogen storage, fuel cells, materials synthesis/structure/function relationships, specialty polymers, separations and catalysts, pharmaceuticals, biosensors.*

Maria E. Pozo deFernandez, Ph.D., *diffusion in polymers, properties of polymer systems, thermodynamics, fluid phase equilibria at high pressures, supercritical fluids, sol-gel.*

Professor Emeritus
Donald R. Mason, Ph.D.

Adjunct Professor
J.H. Maysilles, Ph.D.

Bachelor of Science Degree Program

Chemical engineering is primarily the application of chemical principles to industrial processes and environmental problems to effect a change in the composition and properties of matter to benefit society and the environment. A graduate in chemical engineering has the basic training to solve problems in transport and separation processes, process dynamics and control, energy production, food and petrochemical processing, materials synthesis and processing, and chemical equipment and plant design.

In support of the mission of the university, the objectives of the chemical engineering department are to provide undergraduate and graduate level curricula that offer students the opportunity to obtain the knowledge and skills required to enter the chemical engineering profession; an atmosphere that stimulates intellectual curiosity and encourages creative interaction between students and faculty; opportunities for students and faculty to engage in research and other activities to obtain knowledge and skills beyond those obtained in traditional course work; opportunities for students and faculty to interact with and serve the local community; and continuing educational opportunities for alumni and members of the community beyond the limitations of traditional on-campus course work.

The freshman and sophomore years emphasize basic mathematics, science and communication skills; the junior year, fundamentals of chemical engineering; and the senior year, integration of those fundamentals in capstone design courses. Elective course work also allows students to broaden their knowledge in other technical fields, to deepen their understanding in an area of specialization, or to participate in a technical research project under the direction of an individual faculty member.

Admission Requirements

Students seeking admission should have one year of high school biology, chemistry and physics, in addition to at least three years of mathematics, including algebra, geometry and trigonometry.

Degree Requirements

A Bachelor of Science in Chemical Engineering requires a minimum of 134 credit hours as specified below. Because the subject matter in general chemistry forms a critically important foundation for the advanced chemistry courses as well as all chemical engineering courses, chemical engineering majors must pass both CHM 1101 and CHM 1102 with grades of at least C before taking any 2000-level chemistry or chemical engineering courses.

Students must successfully complete all courses listed for the freshman year before registering for upper-level (3000/4000) courses. Students must successfully complete all courses listed for the sophomore year before registering for CHE 4181.

Freshman Year

FALL	CREDITS
BUS 1301 Basic Economics	3
CHE 1101 Introduction to Chemical Engineering 1	2
CHM 1101 General Chemistry 1	4
COM 1101 Composition and Rhetoric	3
MTH 1001 Calculus 1	4
	16

SPRING

CHE	1102 Introduction to Chemical Engineering 2	1
CHM	1102 General Chemistry 2	4
COM	1102 Writing about Literature	3
MTH	1002 Calculus 2	4
PHY	1001 Physics 1	4
PHY	2091 Physics Laboratory 1	1
		17

Sophomore Year

FALL		CREDITS
CHE	2101 Chemical Process Principles 1	3
CHM	2001 Organic Chemistry 1	3
CHM	2011 Organic Chemistry Laboratory 1	2
MTH	2201 Differential Equations/Linear Algebra	4
PHY	2002 Physics 2	4
PHY	2092 Physics Laboratory 2	1
		17

SPRING

CHE	2102 Chemical Process Principles 2	3
CHE	3260 Materials Science and Engineering	3
CHE	3265 Materials Laboratory	1
CHM	2002 Organic Chemistry 2	3
HUM	2051 Civilization 1	3
MTH	2001 Calculus 3	4
		17

Junior Year

FALL		CREDITS
CHE	3131 Transfer Processes 1	4
CHE	3141 Chemical Process Analysis	2
CHE	3170 Introduction to Environmental Engineering	3
CHM	3001 Physical Chemistry 1	3
CHM	3011 Physical Chemistry Laboratory 1	2
HUM	2052 Civilization 2	3
		17

SPRING

CHE	3110 Chemical Engineering Thermodynamics	3
CHE	3132 Transfer Processes 2	4
CHE	3180 Introduction to Design Projects	1
CHE	4121 Chemical Process Control	4
COM	2223 Scientific and Technical Communication	3
	Restricted Elective (Advanced Chemistry)	3
		18

Senior Year

FALL		CREDITS
CHE	4105 Unit Operations Laboratory	2
CHE	4131 Separation Processes	3
CHE	4151 Chemical Engineering Reactor Design	3
CHE	4181 Chemical Engineering Plant Design 1	3
	Humanities Elective	3
	Technical Elective*	3
		17

SPRING

CHE	4182 Chemical Engineering Plant Design 2	3
	Humanities or Social Science Elective	3
	Technical Electives*	6
	Free Elective	3
		15

TOTAL CREDITS REQUIRED 134

**BUS 3501 (Management Principles) or BUS 3601 (Marketing Principles) may be taken in place of three credits of Technical Elective. CWE 1001 may be taken as the Free Elective; CWE 2001 may be taken in place of three credits of Technical Elective.*

Electives

The Restricted Elective (Advanced Chemistry) should be satisfied by completion of one of the following courses:

BIO 4010 Biochemistry 1
CHM 3002 Physical Chemistry 2
CHM 3301 Analytical Chemistry 1
CHM 4222 Environmental Chemistry
CHM 4550 Polymer Chemistry

A list of other recommended electives is available in the chemical engineering office. The list also identifies electives that provide an emphasis in each of the following fields. Students interested in any of these areas for either graduate study or professional employment are encouraged to contact the chemical engineering office for more information.

Emphasis in Biochemical Engineering

Because chemical engineers are often responsible for the design and operation of equipment used to grow microorganisms and to separate products of microbial growth, many students majoring in chemical engineering choose one or more courses in biology and related disciplines as electives.

Emphasis in Business

Because chemical engineers often take graduate-level course work in business or management at some point in their careers, many students majoring in chemical engineering choose one or more courses in business as electives.

Emphasis in Environmental Engineering

Because chemical engineers are often responsible for design and operation of pollution-control equipment, many students majoring in chemical engineering choose one or more courses in environmental engineering as electives.

Emphasis in Materials Science and Engineering

Because chemical engineers are often responsible for development and production of materials for uses ranging from spacecraft to electronics, many students majoring in chemical engineering choose one or more courses in materials science and engineering as electives.

Chemistry/Chemical Engineering Dual Degree Program

Because the chemical engineering curriculum requires much of the same course work required by the chemistry curriculum, a student may wish to pursue a program that satisfies degree requirements for both majors. This program normally requires one additional year of residency. The bachelor's degree in chemistry may be awarded after completing the first four years. Interested students should contact either the chemistry office or the chemical engineering office for more information.

Five-Year Master's Degree Program

More than one-fourth of all chemical engineering graduates choose to continue their education beyond the bachelor's degree. The five-year program offers students the opportunity to complete a master's degree in one calendar year following completion of requirements for the bachelor's degree. To qualify, a student must possess a grade point average of 3.0 or above following his or her junior year. Additional information concerning this program may be obtained by contacting the department head.

Master of Science Degree Program

The objective of the master of science program is to study the basic principles of chemical engineering in greater depth, including transport phenomena, thermodynamics, reactor design and process control. Electives in other areas to broaden the students' exposure are also required. The program's emphasis is research and the writing of a thesis on a current problem. The results of the thesis must be publishable in a technical journal. Students are advised to see

members of the faculty to determine compatibility of interests before selecting a research area. Program policies are available in the program office.

Admission Requirements

The applicant must have a Bachelor of Science in Chemical Engineering or its equivalent. Applicants with degrees in other fields of engineering, or in science or mathematics, are ordinarily required to take preparatory undergraduate courses before starting the master of science program. These courses are established by the faculty adviser and the program chair when the student obtains admission to the program.

General admission requirements and the application process are detailed in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The Master of Science in Chemical Engineering requires satisfactory completion of 30 credit hours, including six credit hours of thesis, as shown below. Required courses include the zero-credit Chemical Engineering Seminar that all graduate students are required to register for and attend every semester. The nine elective credits may be satisfied by taking chemical engineering graduate courses, or other courses approved by the graduate adviser. The degree also requires completion of an independent research project, the writing of a thesis and its successful defense.

Curriculum

Each student establishes an appropriate program of study with the guidance of a graduate committee, subject to final approval by the department head, prior to the completion of nine semester hours of graduate study.

CHE	5100 Chemical Engineering Seminar	0
CHE	5101 Transport Phenomena 1	3
CHE	5110 Equilibrium Thermodynamics	3
CHE	5120 Process Control	3
CHE	5150 Chemical Reactor Design	3
CHE	5999 M.S. Thesis in Chemical Engineering	6
	Electives	12

Areas of Specialization

The student may select electives and the thesis topic to provide an emphasis in any of the following areas:

- Environmental Engineering
- Materials Synthesis, Processing and Characterization
- Transport and Separation Processes
- Computer-aided Modeling, Processing and Control

Doctor of Philosophy Degree Program

The doctoral program is primarily for students who wish to develop independent research or problem-solving and critical thinking abilities. Research areas must be related to the faculty's interests.

Admission Requirements

General admission requirements and the application process are covered in the *Graduate Information and Regulations* section of this catalog.

Admission to the doctoral program normally requires the completion of a master's degree in chemical engineering. However, students enrolled in the Florida Tech master's program may apply to be admitted directly to the doctoral program after completing 18 credits with a cumulative grade point average of 3.5 or more, if there is evidence of the ability to pursue problems independently.

Doctoral applicants must demonstrate outstanding scholastic achievements and aptitude, provide letters of recommendation from previous professors, including the M.S. thesis adviser and provide results of a recent GRE test including both the General Test and Subject Test in Engineering.

Degree Requirements

The doctor of philosophy degree is a recognition of one's independent creative ability to research, delineate and solve novel, significant scientific and/or engineering problems. Results of such work must be publishable in refereed journals. Course work is also included in support of these objectives.

Each student is expected to complete an approved program of study, pass both oral and written examinations, propose and complete an original research project, and write and defend a dissertation on the research work.

The Ph.D. in chemical engineering requires a minimum of 48 credits after the completion of a master's degree, including at least 24 credits of course work in chemical engineering (12 after the master's degree) and nine credits in mathematics, and satisfaction of the general doctoral degree requirements presented in the *Graduate Information and Regulations* section of this catalog. The written examination covers chemical engineering and related mathematical, physical and chemical sciences. The oral examination includes the presentation of a research proposition developed independently by the student to demonstrate ability to create and develop a research idea. The written and oral examinations are normally taken before the end of the fourth academic semester, counted from the semester of admission to the doctoral program. The dissertation may be theoretical, computational, experimental or a combination of the three in any of the areas of specialization shown in the section on the master's degree.

Research Activities and Facilities

Current research activities are within the scope of the areas of specialization previously stated.

In environmental engineering, activities have included experimental studies of biochemical reactors, and theoretical and experimental investigations of advanced water treatment processes such as activated carbon absorption. Current research includes experimental studies in ion exchange and membrane separation, as well as theoretical and experimental investigation of separation through pressure-swing adsorption of a gaseous product of phosphogypsum biodegradation.

In materials synthesis, processing and modeling, ongoing activities are in sol-gel processing of ceramic fibers that may be used in ceramic matrix composites, modeling of ceramic matrix composite properties and reaction kinetics and transport processes in the chemical vapor deposition of hydrogenated amorphous silicon for use as a solar cell. Research on transport properties of porous and composite media during chemical vapor infiltration is actively being pursued, as well

as modeling the sputtering-assisted plasma-enhanced chemical vapor deposition of dielectric films in microelectronics manufacturing. Use of supercritical fluids for extraction of citrus oil and other chemical processing applications is being studied. A new method for recognition and purification of chiral isomers, known as molecular imprinting, is being developed for anticipated pharmaceutical applications.

The department has several ongoing projects in the area of hydrogen technology, focusing on storage in metal hydrides and carbon nanostructures, generation of hydrogen via reforming of methanol or gasoline and deactivation of hydrogen fuel cells.

In the area of computer-aided modeling, processing and control research is ongoing in the area of adaptive control for both single loop and multivariable applications. Neural networks are being investigated for use in nonlinear control as well as other areas of model development in which traditional models are constrained. Other topics of research interest include the development of artificial intelligence and expert system software.

Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING
A. Pandit, Ph.D., P.E., Head

Bachelor of Science | *Master of Science* | *Doctor of Philosophy*

Areas of Specialization:
Construction Management
Environmental
Geo-Environmental
Geotechnical
Structures
Water Resources

Professors
Paul J. Cosentino, Ph.D., P.E., *pavement design and evaluation, transportation planning, containment of hazardous wastes, geotechnical engineering with emphasis on in situ testing and slope stability.*

Edward H. Kalajian, Ph.D., P.E., *geotechnical engineering, foundations, stabilization of waste materials.*

Ashok Pandit, Ph.D., P.E., *groundwater hydraulics and hydrology, numerical methods in subsurface modeling, hydraulic design, stormwater management.*

Associate Professors
Howell H. Heck, Ph. D., P.E., *solid waste management, degradable materials, and determining the ultimate fate of chemicals in disposal facilities.*

Jean-Paul Pinelli, Ph.D., P.E., *structural dynamics and earthquake engineering, modeling and optimization of nonlinear mechanical systems, computer-aided design techniques in structural engineering.*

Adjunct Professors
D.W. Fisher, J.D., P.E.; E.J. Kinberg, J.D.

Professors Emeriti
Maurice K. Kurtz Jr., Ph.D.; Jack W. Schwalbe, M.S.

Lecturers
G. Lucci, M.S.; A.D. Rahal, M.S.

Civil engineering extends across many technical specialties, such as construction, environmental, geological, structures, transportation and water resources, that interact with each other. The planning, designing and constructing of facilities and infrastructure systems used in public and private sectors are the responsibility of the civil engineer. Civil engineers work with architects and other engineers designing and constructing buildings, bridges, highways, aerospace facilities, ocean structures, ports and harbors, and utility facilities. Many civil engineers are involved in the solution and prevention of environmental problems and work on water resources management, soil and groundwater cleanup, and solid and hazardous waste management.

Some Florida Tech students select an environmental engineering emphasis to prepare for careers concerned with the treatment and distribution of water and water resources, as well as the management, treatment and reuse of wastewater, and soil remediation, groundwater cleanup and solid waste management.

Employment opportunities in civil engineering can be found in technical, administrative or commercial work with manufacturing, design, construction, transportation or power companies; with city, state or federal agencies; and with architectural and engineering firms.

The mission of the civil engineering department is to provide state-of-the-art education in a caring and nurturing environment, helping students achieve their full potential. The educational objectives are to produce graduates who will find career growth opportunities both during school and after graduation; understand the need for continued professional growth; have a broad understanding of the various civil engineering disciplines; communicate well; and can work effectively in socially and ethnically diverse teams, with high standards of professional integrity and ethical responsibility.

Bachelor of Science Degree Program

The civil engineering curriculum is designed to prepare students for professional careers and graduate school. During the first two years, emphasis is placed on foundation courses in chemistry, mathematics, physics and engineering mechanics, augmented by practice-oriented civil engineering courses. The introductory civil engineering courses include field trips and introduction to various disciplines of civil engineering. The CAD lab course, using the latest CAD software, provides knowledge that is applied in the rest of the curriculum, as do the engineering materials and construction measurement courses.

During the second and third years, emphasis is on courses in the main disciplines of civil engineering—construction, environmental/water resources, geotechnical, structures and transportation—that further develop analytical skills in preparation for design courses in the last two years. The emphasis in the third and fourth years is on design. The curriculum provides flexibility in the form of restricted electives and a technical/business elective that allow further depth in a discipline of choice, or further breadth.

Altogether, students are required to take five civil engineering laboratory courses to understand concepts and to learn, firsthand, what works and what does not. Each student is also required to be part of a multidisciplinary design project team that identifies, formulates and designs a real-world project. In this course, students must assemble information gleaned from previous courses. Students are also required to take courses in professional communication to develop both oral and written communication skills, and humanities and social science electives for a broader knowledge of human culture and the relationship of the individual to society.

Freshman Year

FALL		**CREDITS**
CHM 1101	General Chemistry 1	4
COM 1101	Composition and Rhetoric	3
CVE 1000	Introduction to Civil Engineering	3
CVE 1001	Computer Applications Lab	1
MTH 1001	Calculus 1	4
	Free Elective	1
		16

SPRING		
COM 1102	Writing about Literature	3
CVE 2080	Construction Measurements	3
MTH 1002	Calculus 2	4
PHY 1001	Physics 1	4
PHY 2091	Physics Lab 1	1
	Social Science Elective	3
		18

Sophomore Year

FALL		**CREDITS**
CVE 3012	Engineering Materials	3
CVE 3013	Engineering Materials Lab	1
MAE 2081	Applied Mechanics: Statics	3
MTH 2001	Calculus 3	4
PHY 2002	Physics 2	4
PHY 2092	Physics Lab 2	1
		16

SPRING		
COM 2223	Scientific and Technical Communication	3
HUM 2051	Civilization I	3
MAE 2082	Applied Mechanics: Dynamics	3
MAE 3083	Mechanics of Materials	3
MTH 2201	Differential Equations/Linear Algebra	4
	Free Elective	1
		17

Junior Year

FALL		**CREDITS**
CVE 3015	Structural Analysis and Design	3
CVE 3030	Fluid Mechanics	3
CVE 3033	Hydraulics Lab	1
CVE 3042	Water and Wastewater Systems for Land Development	3
HUM 2052	Civilization 2	3
MTH 2401	Probability and Statistics	3
		16

SPRING		
CVE 3020	Soils and Foundations	3
CVE 3021	Soil Mechanics Lab	1
CVE 3032	Hydraulics and Hydrology	3
CVE 4000	Engineering Economy and Planning	3
CVE 401x	Structures Elective	3
	Business or Technical Elective.	3
		16

Senior Year

FALL		**CREDITS**
CVE 4060	Transportation Engineering	3
CVE 4070	Construction Engineering	3
CVE 4091	Design Project 1	1
CVE xxxx	Restricted Elective (Civil Engineering)	3
ECE 4991	Electric and Electronic Circuits	3
or		
MAE 3191	Engineering Thermodynamics	3
One of the following three courses		3
BUS 4503	Business Ethics	
HUM 2540	Ethics	
HUM 2570	Bioethics	
		16

SPRING		
CVE 4092	Design Project 2	3
CVE xxxx	Restricted Electives (Civil Engineering)	6
COM 3070	Professional Communication for Executives	3
	Humanities Elective	3
	Free Elective	1
		16

TOTAL CREDITS REQUIRED 131

Restricted electives may be selected, with approval, from other upper division courses in civil engineering or related fields.

Environmental Engineering Emphasis

Students selecting the environmental engineering emphasis should select three of the following five courses as their restricted electives: CVE 3050, CVE 4035, CVE 4050, ENS 3101, OCN 3201.

Master of Science Degree Program

The master of science program in civil engineering allows the engineer the opportunity to apply recent technological developments to the solution of current civil engineering problems. The objective of the program is to provide opportunities for the student's development of professional engineering competence and scholarly achievement. Construction management, environmental, geo-environmental, geotechnical, structures and water resources are the areas of major emphasis for graduate study. The program is structured so that the student will attain an academic mastery in one of the areas of study within civil engineering.

The Master of Science in Civil Engineering may be earned on either a full-time or part-time basis. A student may begin graduate studies in any semester except summer. Fewer scheduling problems will occur for those who begin in the fall semester. International students who wish to improve their English proficiency may choose to enroll in English language classes during the summer before beginning their graduate studies. Graduate courses are offered in the evening to allow part-time students to complete the degree requirements.

Admission Requirements

An applicant should have a bachelor's degree in civil engineering. An applicant whose degree is in another field of engineering, or mathematics or the physical sciences, may be accepted but will be required to remedy any deficiencies by satisfactorily completing undergraduate courses in preparation for graduate study in civil engineering. Applicants must submit two letters of recommendation from academic references and a "statement of purpose" addressing reasons for graduate study in civil engineering. General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

Civil engineering offers the master of science program with areas of specialization in construction, environmental, geo-environmental, geotechnical, structures and water resources. The master of science degree is conferred on students who have successfully completed a minimum of 30 credit hours in either a thesis or nonthesis program consisting of required and elective course work. All graduate students on full or part assistantships (either teaching or research) are required to enroll in the thesis program. Students in the thesis program must successfully defend their theses, while students in the nonthesis program are required to pass comprehensive examinations.

Curriculum

Thesis students enroll in 12 hours of required civil engineering courses (any of the following combinations of four specialization courses), six hours of thesis and 12 hours of elective courses. Nonthesis students enroll in 12 hours of required courses and 18 hours of elective courses. Three to six hours of elective courses should be in the areas of mathematics and/or operations research.

Construction Management

CVE 5035 Design Concepts in Urban Hydrology
or
CVE 5060 Highway Design
CVE 5072 Construction Contracts, Law and Specifications
CVE 5073 Construction Cost Engineering
ENM 5200 Project Engineering

Environmental

CVE 5035 Design Concepts in Urban Hydrology
CVE 5050 Design of Remediation Systems
CVE 5052 Solid Waste Management
ENS 5101 Introduction to Air Pollution

Geo-Environmental

CVE 5020 Geotechnical Engineering
CVE 5037 Numerical Groundwater Modeling
CVE 5039 Groundwater Hydrology and Contaminant Transport
CVE 5050 Design of Remediation Systems

Geotechnical

CVE 5020 Geotechnical Engineering
CVE 5025 Foundation Design
CVE 5060 Highway Design
OCE 5526 Advanced Coastal Engineering Structures

Structures

CVE 5014 Advanced Steel Design
CVE 5015 Structural Systems Design
CVE 5019 Design of Timber Structures
CVE 5020 Geotechnical Engineering
or
CVE 5025 Foundation Design

Water Resources

CVE 5035 Design Concepts in Urban Hydrology
CVE 5037 Numerical Groundwater Modeling
CVE 5039 Groundwater Hydrology and Contaminant Transport
ENS 5700 Introduction to Water Resources

Graduate elective courses in civil engineering and in other engineering disciplines are listed in the *Course Descriptions* section of the catalog and should be chosen in concert with the student's adviser. Numerous elective courses for each area of specialization are available, as posted on our Web site at www.fit.edu.

Doctor of Philosophy Degree Program

The doctor of philosophy program in civil engineering is offered for students who wish to conduct advanced research in one of the following two areas of specialization:

- Environmental/Water Resources
- Geotechnical/Structures

Admission Requirements

Admission to doctoral study is granted to a limited number of qualified applicants. The applicant will normally have received a bachelor's or master's degree from an accredited institution in a program that provides suitable preparation for doctoral-level studies in civil engineering. The applicant should have at least a 3.2 out of a possible 4.0 GPA for the most recently completed degree.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The doctor of philosophy degree is awarded in recognition of scientific accomplishment and the ability to investigate engineering problems independently. The program consists of advanced studies to prepare the student for research and completion of a research project that leads to a significant contribution to the knowledge of a particular problem. Each student should pass the preliminary written and/or oral examination, complete an approved program of study, pass the comprehensive written and oral examination, complete a program of significant research, present the results of the research, and prepare and defend a dissertation concerning the research. A minimum of 24 credit hours of course work and 24 credit hours of dissertation beyond a master's degree are required.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

The doctoral program of study must be approved by the student's advisory committee and the program chair. Considerable latitude is allowed in course selection provided at least 12 credits (beyond the master's level) are selected from courses in civil or environmental engineering. The remaining courses are selected, again in collaboration with the advisory committee, according to the interests and research objectives of the student. Academic courses for the selected areas of specialization can be selected from course offerings in various academic units as follows:

Environmental/Water Resources—Courses may be selected from academic programs in civil, chemical, mechanical or ocean engineering, environmental science, oceanography, mathematics, operations research and computer science.

Geotechnical/Structures—Courses may be selected from academic programs in civil, aerospace, mechanical or ocean engineering, environmental science, oceanography, mathematics and computer science.

Research Activities and Facilities

Research activities of the faculty encompass the major areas of civil engineering. Current research projects in structures and materials are in the areas of structural dynamics and wind engineering. Geotechnical research is concentrated in the areas of stabilization of waste materials for beneficial uses, *in situ* testing of soils, fiber-optic sensors in soils and evaluation of pavements. Research investigations in hydrology and water resources are related to development of new models and usage of existing models in the areas of numerical groundwater modeling, and design and performance of stormwater management systems. Model development is sometimes supplemented by field and laboratory experiments. Research activities in the environmental area include water treatment using reverse osmosis and activated carbon, biomass production, degradation of consumer products, landfill and compost simulation and solid wastes management.

Laboratories for research and instructional activities are available in the areas of materials and structures, soil mechanics, solid waste, unit operations and interactive graphics. Other campus laboratories can be used by students conducting graduate research. The materials and structures laboratory is equipped with several universal testing machines for physical testing, and equipment and instrumentation for experimental stress analysis. The soil mechanics laboratory contains commercial equipment for evaluating the engineering properties of soils. The solid-waste analysis laboratory is equipped to analyze solid wastes, to degrade solid wastes under both aerobic and anaerobic conditions, and to process solid wastes by a variety of methods.

Computer Engineering

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
J.C. Wheeler, Ph.D., Head

Bachelor of Science *Master of Science* *Doctor of Philosophy*

Professors

Chang Wen Chen, Ph.D., Henry Professor, *wireless multimedia, mobile communications, image and video coding, image processing and analysis, imaging sensors and sensor networks.*

Barry G. Grossman, Ph.D., *fiber-optic sensor systems and smart structures, fiber-optic communications, optical computing and signal processing, neural network image and signal processing, and acoustooptic and electrooptic devices.*

John Hadjilogiou, Ph.D., P.E., *switching theory, computer organization and architecture, fault diagnosis, reliable design.*

Fredric M. Ham, Ph.D., Harris Professor, *linear and nonlinear control systems, optimal control systems, optimal estimation, digital signal processing, system modeling, large-scale dynamical systems analysis and control, and neural networks.*

Samuel P. Kozaitis, Ph.D., *automated feature extraction, optical pattern recognition, image processing.*

Kenneth A. Ports, Ph.D., *semiconductor and microelectronic technology, radiation effects in semiconductors, nanotechnology.*

Joseph C. Wheeler, Ph.D., *computer-processing algorithms, geophysical data, infrasonic and seismic sensors.*

Associate Professors

Raghvendra Deshmukh, Ph.D., *electronic circuits, digital systems, high-performance computer architecture, microprocessor applications, parallel processing.*

Veton Z. Këpuska, Ph.D., *human-machine interaction and communication, speech recognition, text to speech, speaker identification, biometrics and telematics, digital signal processing, adaptive filtering, pattern recognition, neural networks, language modeling.*

M. Mehdi Shahsavari, Ph.D., *wireless networking, computer networks, telecommunications, development of secure distributed applications over the Internet, intrusion detection, component-based network management.*

Assistant Professors

Georgios C. Anagnostopoulos, Ph.D., *machine learning, pattern recognition, artificial intelligence, data mining, communications.*

Ivica Kostanic, Ph.D., *telecommunications, wireless telecommunications, signal processing, neural networks.*

Professor Emeritus

Rufus H. Cofer, Ph.D.

Adjunct Professors

T. Crandell, Ph.D.; E. Hines, Ph.D.; P.M. Julich, Ph.D.; B.A. Myers, Ph.D.; J.K. Roach, Ph.D.; C. Zahm, Ph.D.

Bachelor of Science Degree Program

The goal of the computer engineering program is to provide the student with a total learning experience. The program is designed to expose the entire spectrum of computer engineering concepts from the basic building blocks of transistors and gates, through the progression of embedded controllers, computer architectures and complex computer system applications. Students develop an extensive knowledge of hardware, along with a strong education in concurrent programming techniques to provide them with a complete understanding of computer systems. In the senior year, they design, build and test "computer systems" as part of their senior design course.

The mission of the electrical and computer engineering department is to provide a top quality, state-of-the-art education to our graduates; to perform interdisciplinary research focusing on the needs of industry and government partners; and to provide technical and professional services to our local, state, national and international constituencies.

The program objective for computer engineering is to produce engineers with significant professional credentials. They will possess a fundamental knowledge and understanding of the mathematics and science applicable to computer engineering and will routinely demonstrate the ability to competently apply their knowledge to produce effective engineering solutions. Our graduates have experience in the use of modern tools for design, synthesis and analysis of contemporary engineering challenges, and can integrate

hardware and software. They exhibit ehical conduct and sensitivity to contemporary social issues. Able to function well on multidisciplinary teams, our graduates communicate effectively and engage in lifelong learning and continuous professional development.

A major component of the computer engineering program at Florida Tech involves hands-on learning. The computer engineering student begins taking computer engineering courses during the freshman year. The freshman-level courses include building and testing an actual computer board for subsequent expansion. Laboratory experience is integrated into most of our classes.

In computer engineering, a strong focus is on the mastery principle. It is assured that computer engineering students not only know the material critical to engineering, but that they can demonstrate mastery of the material, which is the goal of everyone in the program.

The information explosion via the Internet is so important to future conduct of business in the technology industry that the curriculum includes almost daily interaction of the student with the Internet. This includes the collection of information from other universities and the use of the Internet as a teaching aid and guide to the learning experience.

During the freshman and sophomore years, students learn the basics of computer engineering along with college-level mathematics and physics. In addition, courses in computer design with hands-on lab experience are taken both terms of the freshman year. In these courses, students design and build a working computer.

Throughout the sophomore and junior years, students learn basic analytical techniques of the engineer—ways in which the engineer views physical situations and uses mathematical techniques to design basic subsystems. Many of the courses taken by students at this level offer integrated lab experiences. In this way, students can visualize the practical aspects of the various theories they encounter.

During the senior year, students take courses that allow them to use previous knowledge to develop a system approach to engineering design. Through electives, students may explore various topics within computer engineering for which they have developed specific interests.

Degree Requirements

Candidates for the Bachelor of Science in Computer Engineering must complete the minimum course requirements as outlined in the following full-time curriculum. Deviations from the recommended program may be made only with the approval of the student's adviser and concurrence of the department head, in accordance with Accreditation Board for Engineering and Technology (ABET) criteria. Students may complete these requirements on a part-time basis.

Proficiency in certain key areas is of primary importance to success as computer engineers. For this reason, a student who receives a grade of D in any of the following courses is strongly urged to repeat the course to attain a grade of at least C: MTH 1001, MTH 1002, MTH 2001, MTH 2201; PHY 1001, PHY 2002, PHY 2003; ECE 2111, ECE 2112, ECE 3111.

Students are required to have successfully completed a minimum of 90 percent of all the courses listed below under the freshman and sophomore years before they will be allowed to register for upper-level (3000/4000) courses.

Students who have completed 24 credit hours and have not passed COM 1101 will register for this course in the next available semester. Students who have completed 48 credit hours and have not passed COM 1102 will register for this course in the next available semester.

The engineering science elective is limited to courses that help develop an appreciation of other branches of engineering. Courses that are acceptable as humanities/social sciences electives are identified as such in the *Course Descriptions* section of this catalog. Definitions of electives for engineering programs are presented in the *Undergraduate Information and Regulations* section.

Freshman Year

FALL	**CREDITS**
CHM 1101 General Chemistry 1	4
COM 1101 Composition and Rhetoric	3
ECE 1551 Digital Logic	4
MTH 1001 Calculus 1	4
	15

SPRING	
COM 1102 Writing about Literature	3
ECE 1552 Computer Design	4
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics Laboratory 1	1
	16

Sophomore Year

FALL	**CREDITS**
ECE 2111 Circuit Theory 1	4
ECE 2551 Software/Hardware Design	3
HUM 2051 Civilization 1	3
MTH 2201 Differential Equations/Linear Algebra	4
PHY 2002 Physics 2	4
	18

SPRING	
ECE 2112 Circuit Theory 2	4
ECE 2552 Software/Hardware Integration	3
HUM 2052 Civilization 2	3
MTH 2001 Calculus 3	4
PHY 2003 Modern Physics	3
	17

Junior Year

FALL	**CREDITS**
ECE 3111 Electronics	4
ECE 3551 Microcomputer Systems 1	4
ECE 3541 Digital State Machines	3
ECE 3553 Multifarious Systems 1	4
MTH 2401 Probability and Statistics	3
	18

SPRING	
COM 2223 Scientific and Technical Communication	3
CSE 2410 Introduction to Software Engineering	3
ECE 3240 Junior Design	1
ECE 3552 Microcomputer Systems 2	4
ECE 4112 Digital Electronics	3
Engineering Science Elective*	3
	17

Senior Year

FALL	CREDITS
CSE 4001 Operating Systems Concepts	3
ECE 4241 Systems Design 1	3
ECE 4551 Computer Architecture	3
Humanities Elective	3
Restricted Elective (ECE/CSE)	3
Social Science Elective	3
	18

SPRING	
ECE 4242 Systems Design 2	3
ECE 4561 Computer Communications	3
Technical Elective	3
Free Elective	3
	12

TOTAL CREDITS REQUIRED 131

**A list of approved Engineering Science Electives is available from the department.*

Master of Science Degree Program

The computer engineering program is committed to excellence in teaching, innovative and challenging research programs, and development of the finest faculty. A commitment to innovative research stimulates an excellent teaching and research program that allows graduates to use imaginative solutions to engineering problems. The program offers opportunities for graduates to pursue positions in private research, development, manufacturing, government and other areas.

The curriculum is flexible to allow opportunities to design an education program that is suited to individual academic goals. A background is provided in a variety of topics, including computer architecture, signal and image processing, high-performance computing and telecommunications. Effective interaction between related topics is an important aspect of the program. The faculty are engaged in research of significance and regularly collaborate with prominent scientists and engineers from industry and government. The low student-faculty ratio fosters a close relationship between faculty and students.

The opportunities for graduate education and research in computer engineering are wide-ranging. Although areas of specialization are listed under "Curriculum," there is a great deal of overlap in both technical content and faculty interest. As a result, there is considerable interaction among students and faculty across these areas, and a student may pursue studies that combine a variety of topics.

Admission Requirements

The applicant should have a bachelor of science degree from an electrical or computer engineering program accredited by ABET. In evaluating an international application, consideration is given to academic standards of the school attended and the type of undergraduate degree obtained. Applicants whose bachelor's degrees are in other engineering fields, mathematics or the physical sciences may be accepted, but they will be required to remedy any deficiencies by satisfactorily completing a number of undergraduate courses in preparation for graduate study in computer engineering.

Degree Requirements

The Master of Science in Computer Engineering is offered with both thesis and nonthesis options. Each option requires a minimum of 30 credit hours of approved graduate study. Prior to the completion of nine credit hours, the student must submit for approval a master's degree program plan to indicate the option chosen and the specific courses to be taken. Up to six credit hours of thesis work may be included in the 30-credit-hour requirement. The nonthesis option requires that the candidate satisfactorily complete a minimum of 30 credit hours of course work and the master's final program examination.

Curriculum

To earn the master of science degree, the student must complete:

Five courses from the following list	15
ECE 5256 Digital Image Processing	
ECE 5258 Pattern Recognition	
ECE 5534 Computer Networks 1	
ECE 5535 Computer Networks 2	
ECE 5536 Bit-Slice Architecture	
ECE 5551 High-Performance Computing and Communication Concepts	
ECE 5561 Switching Concepts	
ECE 5571 Digital System Design 1	
ECE 5572 Digital System Design 2	
ECE 5577 Diagnosis and Reliable Design of Digital Systems 1	
ECE 5578 Diagnosis and Reliable Design of Digital Systems 2	
ECE 5583 Multiprocessing Systems	
Two approved computer science and/or mathematics graduate courses	6
Approved electives, including up to 6 credits of thesis	9
Seminar or internship in ECE	1

TOTAL CREDITS REQUIRED 31

Areas of specialization include computer architectures, parallel processing, telecommunications, computer vision, design for testability, automatic test generation and development of secure distributed applications over the Internet. Each student plans a program of study in consultation with a member of the faculty whose professional field is related to the student's interest.

Program for Graduates from Other Fields

A student admitted to this program is expected to have a bachelor's degree from a regionally accredited institution or the equivalent, with an undergraduate major in an engineering discipline, mathematics or the physical sciences, and an academic and/or professional record indicating a high probability of success in graduate work. Preparatory courses required to provide a student with the background necessary for successful graduate study in computer engineering are listed below. Depending on the individual's background, other courses (e.g., differential equations and linear algebra) may also be required. Proficiency in these areas may be demonstrated by either successful course completion or by passing an equivalency examination. When possible, a student will be notified of deficiencies at the time of acceptance. In addition to the preparatory work described, all degree requirements listed above for the master of science degree must be fulfilled.

ECE 1552 Computer Design
ECE 2112 Circuit Theory 2
ECE 2551 Software/Hardware Design
ECE 3111 Electronics
ECE 4112 Digital Electronics

Doctor of Philosophy Degree Program

Admission Requirements

Admission to doctoral study is granted to a limited number of applicants who have received master's degrees in computer engineering from accredited institutions or from international institutions that provide suitable preparation for doctoral-level studies.

The doctoral program in computer engineering can be completed with a minimum of 48 credit hours beyond the master's degree; however, typically 48 to 54 credit hours are necessary. A list of elective courses is available on request.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The Doctor of Philosophy in Computer Engineering is conferred primarily in recognition of breadth of creative accomplishment and ability to investigate engineering problems independently, rather than for completion of a definite course of study. The work should consist of advanced studies and research leading to a significant contribution and knowledge of a particular problem.

Each student should pass the preliminary examination, complete an approved program of study beyond that required for a master's degree, pass the comprehensive examination, complete a program of significant original research, and prepare and defend a dissertation concerning the research.

General degree requirements are presented under the *Graduate Information and Regulations* section of this catalog.

COURSE WORK AND THESIS SUMMARY	CREDITS
Doctoral course work minimum beyond the master's degree	24
Doctoral research and dissertation	24
TOTAL MINIMUM BEYOND THE MASTER'S DEGREE	48

To assure that all graduates of the doctoral program possess a body of common knowledge, certain courses in computer engineering and related areas are required. If, in the judgment of the computer engineering graduate faculty, the student has acquired the equivalent knowledge of a particular subject during previous graduate study at another institution, the student is not required to take the course at Florida Tech.

The student's master's and doctoral course work combined should include a minimum of 24 credits in electrical or computer engineering and 15 credits in mathematics, computer science or operations research. The following courses are required:

CSE 5230 Operating Systems 1
ECE 5534 Computer Networks 1
ECE 5535 Computer Networks 2
ECE 5561 Switching Concepts
ECE 5571 Digital System Design 1
ECE 5577 Diagnosis and Reliable Design of Digital Systems 1
ECE 5583 Multiprocessing Systems
MTH 5051 Applied Mathematical Statistics
MTH 5411 Mathematical Statistics 1
SWE 5000 Introduction to Software Engineering

Research Activities and Facilities

Current areas of research activities include parallel and distributed processing, fault tolerant computing, VLSI architectures, analysis of algorithms, image analysis, optical computing, computer vision, image compression, high-performance computing, neural networks, telecommunications, application of fractals, speech and image processing, virtual reality, numerical analysis, rendering/image generation, computer communications, image understanding, object recognition, wavelet processing, floating-point co-processor design, interfacing, modern process architecture, pattern recognition and higher-order statistics. These activities are being carried out in relation to the following general areas of research interest.

High-Performance Computing

This area focuses on optimization of computational speed and size of various computer applications. Among the areas optimized are software-engineered computer communications between computer subsystems and dedicated hardware. Research includes advanced architectures and algorithms that exploit parallelism and communication on many levels for applications in visualization, advanced security, data protection, information processing and scientific computing.

Image Processing

Image processing is usually done on digital computers, but sometimes is performed by special electrooptical devices. Much of the research is directed at basic problems and contributes to the solution of major national problems in vision and image processing. These include automated object detection and perception, segmentation, texture analysis, nonlinear filtering, computer imaging, modeling and other areas of image analysis. Techniques being used include traditional techniques and other techniques that include wavelets, fractals, higher-order statistics and morphology. Application areas include autonomous inspection in manufacturing and other commercial uses. Projects include the analysis and interpolation of infrared or SAR imagery. Image compression is also being used for the efficient transmission and storage of images. In addition, many of the techniques in image processing can be applied to speech processing.

Advanced Computer Architecture

The goal of research in this area is to discover novel approaches to improve the performance of modern computer systems and reduce the complexity faced by application developers. Topics include computer security, reliability, highly parallel hardware-scheduled superscalars and fault tolerant computer systems with highly robust communications capabilities and built-in self-test algorithms.

Computer Networks

The abundance of computational power and communications requires a robust infrastructure, providing security, privacy, intrusion detection, multimedia capabilities and location dependent services. Research topics include component-based distribution network management, intrusion detection, interactive multimedia application over IP, congestion control, IP traffic engineering and network security improvements.

Computer Sciences

Bachelor of Science
Computer Science
Information Systems

Master of Science
Computer Information Systems
Computer Science

Doctor of Philosophy

Professors
Cem Kaner, Ph.D., *software engineering, software testing, computer law.*

Gerald A. Marin, Ph.D., *computer networks, network security.*

J. Richard Newman, Ph.D., *software engineering, computer graphics, information resource management, multimedia distant learning, computer law and ethics.*

Kamel Rekab, Ph.D., *statistical software testing and reliability, statistical computing, network security.*

James A. Whittaker, Ph.D., *software testing, computer and information security, software reliability, software engineering.*

Research Professor
Richard A. Ford, Ph.D., *computer security, malicious code.*

Associate Professors
Phil J. Bernhard, Ph.D., *database systems, software engineering.*

Walter P. Bond Jr., Ph.D., *software architecture and engineering processes, operating systems.*

Philip K. Chan, Ph.D., *scalable adaptive methods, machine learning, data mining, parallel and distributed computing, intelligent systems.*

Debasis Mitra, Ph.D., *artificial intelligence, spatial and temporal reasoning.*

William Shoaff, Ph.D., *computer graphics, analysis of algorithms, mathematical software.*

Ryan Stansifer, Ph.D., *programming languages, compilers, internationalization.*

Scott R. Tilley, Ph.D., *software engineering, evolution and reuse.*

Assistant Professors
William H. Allen, Ph.D., *computer networks, network security.*

Mike M. Andrews, Ph.D., *software debugging techniques, software engineering.*

Celine Lang, D.P.A., *information systems.*

Ronaldo Menezes, Ph.D., *coordination systems, garbage collection, parallel computing, computation models, distributed computing.*

Eraldo Ribeiro, Ph.D., *computer vision, image processing, computer animation.*

Marius Silaghi, Ph.D., *distributed problem solving and negotiation, asynchronous algorithms.*

Professors Emeriti
Frederick B. Buoni, Ph.D.; David R. Clutterham, Ph.D.

Adjunct Professors
A.A. Jorgensen, Ph.D.; V. Kovarik, Ph.D.; M. Mahoney, Ph.D.

Lecturers
L. Bearden, M.S.; H. Ray, M.B.A.

Student Coordinator
Rosalyn Bursey

Computer scientists are deeply involved in activities that are essential in our modern civilization. These activities include basic research, design, development and testing of software and information systems that serve society and its many needs. Computer technology is found in every aspect of today's world. Common uses include word processors, spreadsheets, computer games and entertainment, communications and information systems, transportation, education and training, medicine, criminology, factory automation, space exploration and assistive devices for the disabled. Computers have led to significant quality of life improvements, and yet their potential is still to be fully realized.

Professionals in computer science design and develop computer systems that are, insofar as possible, free of defects and protected from misuse that would harm the health or welfare of society or the environment.

The mission of Florida Tech's computer sciences department is to pursue knowledge, truth and excellence in computer science, information systems and software engineering by nurturing student-centered academic programs characterized by shared values, unity of purpose, diversity of opinion, mutual respect and social responsibility. We are committed to expanding our range of disciplines through a well-funded and renowned research program, and to the continual improvement of the quality of our degree programs.

Bachelor of Science Degree Programs

The objectives of the computer sciences bachelor of science programs are to graduate students who have strong technical backgrounds in computer science, software engineering or information systems; who are good communicators and team members; who are able to develop and use a variety of systems and software applications; and who have positive attitudes toward the computing profession and a desire for lifelong learning.

The computer science curriculum at Florida Tech is a unique and well-rounded program that provides a solid technical background for careers in the computing profession or for graduate studies. Students can choose between either a traditional computer science program or an information systems program. Undergraduate students study the structure of typical computer systems, the techniques and theories supporting software development and specialized areas such as computer graphics, artificial intelligence, networks and information management. After graduation, they are equipped to enter the work force as systems analysts, application programmers or software specialists, and are provided with the background necessary for graduate study.

Because the subject matter of programming, algorithms and data structures forms a critically important foundation for all advanced computer science courses, the minimum grade for satisfying the prerequisite requirements for either program is a grade of C for each of the following courses: CSE 1001, CSE 1002 and CSE 2010.

Degree Requirements

Computer Science

The computer science program provides a traditional, yet innovative, preparation for those who are interested in careers in the computing industry or graduate study. Course work provides a broad theoretical foundation and the opportunity to study specialized topics in artificial intelligence, computer graphics, computer networks, databases, software design and testing, and other electives.

Students who select computer science must complete the following minimum course requirements:

Freshman Year

FALL		CREDITS
COM	1101 Composition and Rhetoric	3
CSE	1001 Fundamentals of Software Development 1	4
CSE	1101 Computing Disciplines and Careers 1	1
CSE	1400 Applied Discrete Mathematics	3
ECE	1551 Digital Logic	4
		15

SPRING		
COM	1102 Writing about Literature	3
CSE	1002 Fundamentals of Software Development 2	4
MTH	1001 Calculus 1	4
HUM	2510 Logic	3
	Restricted Elective (Science)	3
		17

Sophomore Year

FALL		CREDITS
COM	2012 Research Sources and Systems	1
COM	2223 Scientific and Technical Communication	3
CSE	2010 Algorithms and Data Structures	4
MTH	1002 Calculus 2	4
PHY	1001 Physics 1	4
PHY	2091 Physics Lab 1	1
		17

SPRING		
CSE	2050 Programming in a Second Language	3
CSE	2400 Applied Statistics	3
CSE	2410 Introduction to Software Engineering	3
HUM	2051 Civilization 1	3
PHY	2002 Physics 2	4
PHY	2092 Physics Lab 2	1
		17

Junior Year

FALL		CREDITS
CSE	3030 Legal, Ethical and Social Issues in Computing	3
CSE	3101 Machine and Assembly Language	3
CSE	4250 Programming Language Concepts	3
HUM	2052 Civilization 2	3
	Restricted Elective (Mathematics)	3
		15

SPRING		
CSE	4001 Operating Systems Concepts	3
CSE	4083 Formal Languages and Automata Theory*	3
ECE	4551 Computer Architecture	3
	Liberal Arts Elective	3
	Restricted Elective (Science)	3
	Free Elective	3
		18

Senior Year

FALL		CREDITS
CSE	4081 Introduction to Analysis of Algorithms*	3
CSE	4101 Computer Science Projects 1	3
	Restricted Elective (Computer Science)	3
	Social Science Elective	3
	Technical Elective or CWE 2001	3
		15

SPRING		
CSE	4102 Computer Science Projects 2	3
	Humanities Elective	3
	Restricted Electives (Computer Science)	6
	Technical Elective	3
		15

TOTAL CREDITS REQUIRED 129

**One additional 3-credit restricted elective (computer science) may be taken in place of CSE 4081 or CSE 4083.*

Information Systems

The information systems program offers an interdisciplinary approach that bridges information systems, computing, business and communication disciplines to provide a solid foundation for effective management of today's complex systems. The study of information systems emphasizes strategic, managerial, operational and technical aspects of systems using appropriate decision tools, methods and technologies. Verbal and nonverbal communication modes are incorporated into the problem-solving process to promote the use of different information technologies, including multimedia, Web and distributed environments. There are also information systems programs offered by the School of Management. (See *School of Management* section in this catalog.)

Students who select information systems must complete the following minimum course requirements:

Freshman Year

FALL		CREDITS
BUS	2303 Macroeconomics	3
COM	1101 Composition and Rhetoric	3
CSE	1000 Introduction to Information Systems	3
CSE	1400 Applied Discrete Mathematics	3
EDS	1031 Survey of Science 1	3
		15

SPRING		
BUS	2304 Microeconomics	3
COM	1102 Writing about Literature	3
CSE	1001 Fundamentals of Software Development 1	4
EDS	1032 Survey of Science 2	3
MTH	1001 Calculus 1	4
		17

Sophomore Year

FALL		CREDITS
BUS	2211 Introduction to Financial Accounting	3
COM	2224 Business and Professional Writing	3
COM	2501 Introduction to Visual Communication	3
CSE	1002 Fundamentals of Software Development 2	4
MTH	1002 Calculus 2	4
		17

SPRING		
BUS	2212 Introduction to Managerial Accounting	3
CSE	2010 Algorithms and Data Structures	4
CSE	2400 Applied Statistics	3
HUM	2051 Civilization 1	3
	Social Science Elective	3
		16

Junior Year

FALL		CREDITS
BUS	3401 Corporate Finance	3
BUS	3501 Management Principles	3
CSE	2050 Programming in a Second Language	3
CSE	2410 Introduction to Software Engineering	3
HUM	2052 Civilization 2	3
		15

SPRING		
BUS	3503 Human Resource Management	3
BUS	3601 Marketing Principles	3
COM	4026 Publishing and the Internet	3
CSE	4020 Database Systems	3
CSE	4232 Computer Network Programming	3
	Humanities Elective	3
		18

Senior Year

FALL	CREDITS
BUS 3704 Quantitative Methods	3
COM 3070 Professional Communication for Executives	3
CSE 3030 Legal, Ethical and Social Issues in Computing	3
CSE 4220 Systems Analysis and Design	3
Restricted Elective (Computer Science)	3
	15

SPRING	
COM 3440 Public Relations	3
COM 4424 Advanced Business and Professional Communication	3
CSE 4221 Systems Development Workshop	3
CSE 4410 Software Project Management	3
Humanities Elective	3
	15

TOTAL CREDITS REQUIRED 128

Master of Science Degree Programs

Computer Information Systems

The Master of Science in Computer Information Systems is designed for students who seek a terminal degree that prepares them for positions in organizations that design, develop or use computer systems. It is for students who do not have bachelor's degrees in computer science but who wish to obtain advanced training in this field. Students with bachelor's degrees in computer science should apply for admission to the Master of Science in Computer Science degree program.

Admission Requirements

An applicant for the master's program in computer information systems is not required to have a bachelor's degree in computer science, but should have a mathematical background that includes differential and integral calculus, and those subjects included in the following courses:

CSE 5000 Introduction to Programming
CSE 5001 Assembly Language
MTH 2051 Discrete Mathematics

If the applicant's background is deemed deficient in any of these areas, admission may be granted with the stipulation that deficiencies be made up by taking the necessary extra courses. Students may elect to take MTH 5051, Applied Discrete Mathematics, for graduate credit instead of MTH 2051, for which graduate credit is not awarded. Graduate Record Examination scores (General Test only) are required.

Degree Requirements

The Master of Science in Computer Information Systems requires a minimum of 32 credit hours, as follows:

CSE 5100 Data Structures and Algorithms	3
CSE 5230 Operating Systems	3
CSE 5250 Programming Languages	3
CSE 5500 Computer Science Seminar	2*
or	
CSE 5501 Computer Sciences Internship	2*
Electives (at least 12 credits in Computer Science)	18
ECE 5536 Computer Hardware Design	3

**One credit each in CSE 5500, CSE 5501 or two credits in either course. The internship is completed with an information technology firm or industrial organization and is provided for students with no prior experience in a practical information technology setting.*

A student who can verify competence in any required course may substitute an appropriate course with the permission of the student's adviser and department head. All electives that apply to the degree must be similarly approved. The computer science office maintains a list of approved courses from which electives can be selected.

All students must pass a final program examination. The examination is offered each fall and spring semester and may be taken no earlier than the last semester in which the student is registered for courses. The examination may be retaken in accordance with Graduate School policy.

Computer Science

This program offers a student the opportunity to pursue advanced studies in various areas of computer science. The program is designed for students with bachelor's degrees in computer science and provides a solid preparation for those who may pursue a doctorate.

Admission Requirements

Applicants must have taken courses equivalent to the four required courses in the Master of Science in Computer Information Systems (CIS) degree program, in addition to meeting the admission requirements listed for the CIS program.

If the applicant's background is deemed deficient in any of the listed areas, admission may be granted with the stipulation that deficiencies are made up by taking the necessary extra courses. Graduate Record Examination scores (General Test only) are required.

Degree Requirements

The Master of Science in Computer Science requires a minimum of 32 credit hours. Students are encouraged to complete and successfully defend a thesis. Students who decide not to write a thesis must pass a comprehensive examination given in the last semester in which the student is registered for courses.

To ensure students are exposed to a variety of areas in computer science, they must pass one course in each of three categories, as listed below:

Applied Software
CSE 5260 Database Systems
CSE 5280 Computer Graphics
CSE 5290 Artificial Intelligence

Foundations
CSE 5210 Formal Languages and Automata Theory
CSE 5211 Analysis of Algorithms

Software and Systems
CSE 5231 Computer Networks
CSE 5251 Compiler Theory and Design
SWE 5001 Software Engineering 1

Students are exempted from this breadth requirement only if they can show evidence that they have passed courses equivalent to all of those on the category lists. A listed course can be replaced by another appropriate course only with permission of the student's adviser and department head.

The other course requirements are:

MTH 5051 Applied Discrete Mathematics	3
CSE 5500 Computer Science Seminar*	2
or	
CSE 5501 Computer Sciences Internship*	2
CSE 5999 Thesis in Computer Science or Advanced Electives (CSE 5600 or higher)	6
Electives (at least 6 credits must be in Computer Science, numbered CSE 5600 or higher)	12

**One credit each in CSE 5500, CSE 5501 or two credits in either course. The internship is completed with an information technology firm or industrial organization and is provided for students with no prior experience in a practical information technology setting.*

All electives that apply to the program must be approved by the student's adviser. The computer science office maintains an approved set of courses, including courses in other disciplines, from which electives can be selected. At most, six approved elective credits can be from other disciplines.

Doctor of Philosophy Degree Program

The doctoral program is designed to provide the highest level of academic study and research in the disciplines of computer science. The goal is to produce qualified professionals for teaching and research positions in the academic world, as well as equivalent positions in industry and government. The demand for these qualified professionals continues to far exceed the current production and is expected to remain so for the foreseeable future.

The doctoral program in computer science is designed to attract students with the greatest potential for expanding the frontiers of knowledge and transferring this knowledge to others. The program requires a significant breadth of understanding in the fundamentals of computer science, the mastery of several specialized subjects and the creativity to extend the body of knowledge on a particular subject through significant original research.

Admission Requirements

Each potential candidate must meet the general admission requirements and follow the process for applying, which is presented in the *Graduate Information and Regulations* section of this catalog.

To qualify for admission to the doctoral program in computer science, a candidate must demonstrate the potential for success in this program. A student may do so by one of the following means:

1. Successful completion of a bachelor of science degree in computer science from an accredited institution, with a GPA of at least 3.5.
2. Successful completion of a master of science degree in computer science or a related field from another accredited institution, with a GPA of at least 3.3.
3. Successful completion of 15 credits of advanced graduate course work at Florida Tech in the Master of Science in Computer Science program with a cumulative grade point average of at least 3.3.

Also required are three letters from individuals familiar with the student's academic and research ability recommending doctoral study, and scores from the Graduate Record Examination General Test and Subject Test in Computer Science.

Degree Requirements

The degree of doctor of philosophy is conferred in recognition of both breadth of scientific competence in computer science and technical research capabilities, as demonstrated by producing an acceptable dissertation. The required work consists of advanced studies in preparation for specialized research, and preparation and completion of an original research program resulting in a significant contribution to the body of knowledge in the subject investigated. Each student must qualify for admission, complete an approved program of study, pass a comprehensive examination, complete a program of significant original research and prepare and defend a dissertation concerning the research.

Each candidate is expected to publish major portions of the dissertation in refereed conferences and journals, and is strongly encouraged to teach while pursuing the degree. General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

The minimum course work requirement is 56 credits beyond the bachelor's degree, including at least 21 credits in courses numbered CSE 5600 or higher. The minimum research and dissertation requirement is 24 credits beyond the master's degree or 30 credits if the student did not complete a master's thesis; of these, at least 15 credits must be dissertation.

During the first or second term, a doctoral student must prepare a program of study to be approved by the student's faculty adviser and department head. The program of study should be designed to fit the student's professional goals, the department's resources and the breadth of general computer science knowledge expected of all doctoral candidates, and should identify a major concentration.

Each student is required to pass comprehensive examinations that cover breadth and depth within computer science. The breadth examination is administered by computer science faculty and normally must be taken before the end of two years from admission into the doctoral program. This examination includes topics from the foundations of computer science, computer systems, computer software and applied software. After completion of all course work contained in the approved program of study, the student is required to pass a depth examination administered by his or her doctoral committee. Detailed information on the comprehensive examination is available to students in the department office.

After passing the comprehensive examination, the student prepares a dissertation proposal representing the research plan to be followed. The dissertation research is carried out under close supervision of the student's doctoral adviser. After completion of the research project and approval of the adviser, the dissertation is submitted to the doctoral committee for critical evaluation, followed by an oral defense of the dissertation.

Research Activities

The computer sciences faculty are currently conducting research in the following general areas:

Intelligence Systems

- Data mining and knowledge discovery
- Expert systems
- Model-based reasoning
- Parallel and distributed intelligent systems
- Scalable machine learning with multiple models
- Search algorithms
- Spatio-temporal and constraint reasoning

Software and Hardware Systems

- Computer graphics
- Coordination systems
- Distributed database systems
- High-performance computing and systems
- Internationalization
- Parallel processing
- Programming languages

Laboratory Facilities

A wide array of computer hardware and software is provided to support instruction and research. Continual system upgrades and enhancements allow us to offer up-to-date computing resources. Facilities include networks of IBM, Silicon Graphics and Sun workstations, as well as Pentium PC networks. Instructional classrooms are used to support teaching, and research laboratories are available for advanced studies.

Electrical Engineering

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
J.C. Wheeler, Ph.D., Head

Bachelor of Science | *Master of Science* | *Doctor of Philosophy*

Areas of Specialization:
Electromagnetics
Physical Electronics
Systems and Information Processing
Wireless Systems and Technology

Professors

Chang Wen Chen, Ph.D., Henry Professor, *wireless multimedia, mobile communications, image and video coding, image processing and analysis, imaging sensors and sensor networks.*

Barry G. Grossman, Ph.D., *fiber-optic sensor systems and smart structures, fiber-optic communications, optical computing and signal processing, neural network image and signal processing, acoustooptic and electrooptic devices.*

John Hadjilogiou, Ph.D., P.E., *switching theory, computer organization and architecture, fault diagnosis, reliable design.*

Fredric M. Ham, Ph.D., P.E., Harris Professor, *linear and nonlinear control systems, optimal control systems, optimal estimation, digital signal processing, system modeling, bio-medical engineering, neural networks.*

Samuel P. Kozaitis, Ph.D., *automated feature extraction, optical pattern recognition, image processing.*

Walter M. Nunn Jr., Ph.D., P.E., *electromagnetic theory, microwave electronics, antennas, electromagnetic radiation.*

Kenneth A. Ports, Ph.D., *semiconductor and microelectronic technology, radiation effects in semiconductors, nanotechnology.*

Robert Sullivan, Ph.D., *power systems, power electronics.*

Joseph C. Wheeler, Ph.D., *computer-processing algorithms, geophysical data, infrasonic and seismic sensors.*

Associate Professors

Raghvendra Deshmukh, Ph.D., *electronic circuits, digital systems, high-performance computer architecture, microprocessor applications, parallel processing.*

Syed H. Murshid, Ph.D., *photonics, fiber-optic sensors, acoustic and fiber-optic communications, power electronics, instrumentation.*

M. Mehdi Shahsavari, Ph.D., *wireless networking, computer networks, telecommunications, development of secure distributed applications over the Internet, intrusion detection, component-based network management.*

Assistant Professors

Georgios C. Anagnostopoulos, Ph.D., *machine learning, pattern recognition, artificial intelligence, data mining, communications.*

Susan Earles, Ph.D., *semiconductor modeling, processing and fabrication; microelectronics; solid-state device physics.*

Veton Z. Këpuska, Ph.D., *human-machine interaction and communication, speech recognition, text to speech, speaker identification, biometrics and telematics, digital signal processing, adaptive filtering, pattern recognition, neural networks, language modeling.*

Ivica Kostanic, Ph.D., *telecommunications, wireless telecommunications, signal processing, neural networks.*

Professors Emeriti

Charles D. Beach, Ph.D.; Rufus H. Cofer Jr., Ph.D.; Andrew W. Revay Jr., Ph.D.; Thomas J. Sanders, Ph.D.; Lynn E. Weaver, Ph.D.; Harry P. Weber, D.Sc.

Adjunct Professors

F.M. Caimi, Ph.D.; T. Crandell, Ph.D.; E. Hines, Ph.D.; P.M. Julich, Ph.D.; B.A. Myers, Ph.D.; J.K. Roach, Ph.D.; C. Zahm, Ph.D.

Bachelor of Science Degree Program

The goal of the electrical engineering program is to provide the student with a total learning experience. It is designed to expose the entire spectrum of electrical engineering concepts from the basic building blocks of transistors and gates, through communications, control, electromagnetic, computer and photonic systems. Students develop an extensive knowledge of hardware, along with skills in software simulation and analysis. In the senior year, students design, build and test "complete systems" as part of their senior design course.

The mission of the electrical and computer engineering department is to provide a top quality, state-of-the-art education to our graduates; to perform interdisciplinary research focusing on the needs of industry and government partners; and to provide technical and professional services to our local, state, national and international constituencies.

The program objective for electrical engineering is to produce engineers with significant professional credentials. They will possess a fundamental knowledge and understanding of the mathematics and science applicable to electrical engineering, and will routinely demonstrate the ability to competently apply their knowledge to produce effective engineering solutions. Our graduates have experience in the use of modern tools for design, synthesis and analysis of contemporary engineering challenges, and can integrate hardware and software. They exhibit ehical conduct and sensitivity to contemporary social issues. Able to function well on multidisciplinary teams, our graduates communicate effectively and engage in lifelong learning and continuous professional development.

A major component of the electrical engineering program at Florida Tech involves hands-on learning. The electrical engineering student begins taking electrical engineering courses during his/her freshman year. The freshman-level courses include building and testing an actual computer board for subsequent expansion, followed by courses in which students build "add-on" boards for signal acquisition, generation and analysis, as well as the software needed to operate the boards. Laboratory experience and computer-based analysis are integrated into most classes and all laboratories.

In electrical engineering, a strong emphasis is on the mastery principle. It is assured that electrical engineering students not only know the material critical to engineering, but that they can demonstrate mastery of the material, which is the goal of everyone in the program.

The information explosion via the Internet is so important to the future conduct of business in the technology industry that the curriculum includes almost daily interaction of the student with the Internet. This includes the collection of information from other universities and the use of the Internet as a teaching and research aid and guide to the learning experience.

During the freshman and sophomore years, students learn the basics of electrical engineering along with college-level mathematics and physics. In addition, courses in computer design with hands-on lab experiences are taken both terms of the freshman year.

Throughout the sophomore and junior years, students learn the basic analytical techniques of engineering—ways in which the engineer views physical situations and uses mathematical techniques to design basic subsystems. Many of the courses taken by students at this level offer integrated lab experiences. In this way, students can visualize the practical aspects of various electronic theories they encounter.

During the senior year, students take courses that allow them to use previous knowledge to develop a systems approach to engineering design. They gain a deeper knowledge in at least two specializations through combination lecture/laboratory courses, followed by advanced courses in related areas. Through electives, students may explore various topics within electrical engineering for which they have developed specific interests.

Degree Requirements

Candidates for the Bachelor of Science in Electrical Engineering must complete the minimum course requirements as outlined in the following full-time curriculum. Students may complete these requirements on a part-time basis.

Proficiency in certain key areas is of primary importance to success as electrical engineers. For this reason, a student who receives a grade of D in any of the following courses is strongly urged to repeat the course to attain a grade of at least C: MTH 1001, MTH 1002, MTH 2001, MTH 2201; PHY 1001, PHY 2002, PHY 2003; ECE 2111, ECE 2112, ECE 3111, ECE 3222, ECE 3442.

Students are required to have successfully completed a minimum of 90 percent of all the courses listed below under the freshman and sophomore years before being allowed to register for upper-level (3000/4000) courses.

Students who have completed 24 credit hours and have not passed COM 1101 will register for this course in the next available semester. Students who have completed 48 credit hours and have not passed COM 1102 will register for this course in the next available semester.

The engineering science elective is limited to courses that help develop an appreciation of other branches of engineering. Courses that are acceptable as humanities/social science electives are identified as such in the *Course Descriptions* section of this catalog. Definitions of electives for engineering programs are presented in the *Undergraduate Information and Regulations* section of this catalog.

Additional policies and procedures governing degree requirements may be found in the program's student handbook and "Databus."

Freshman Year

FALL	**CREDITS**
CHM 1101 General Chemistry 1	4
COM 1101 Composition and Rhetoric	3
ECE 1551 Digital Logic	4
MTH 1001 Calculus 1	4
	15
SPRING	
COM 1102 Writing about Literature	3
ECE 1552 Computer Design	4
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
	16

Sophomore Year

FALL	**CREDITS**
ECE 2111 Circuit Theory 1	4
ECE 2551 Software/Hardware Design	3
MTH 2201 Differential Equations/Linear Algebra	4
PHY 2002 Physics 2	4
	15
SPRING	
ECE 2112 Circuit Theory 2	4
HUM 2051 Civilization 1	3
MTH 2001 Calculus 3	4
MTH 2401 Probability and Statistics	3
PHY 2003 Modern Physics	3
	17

Junior Year

FALL	**CREDITS**
ECE 3111 Electronics	4
ECE 3222 Signals and Systems	3
ECE 3331 Electron Devices	3
ECE 3442 Electromagnetic Waves	3
HUM 2052 Civilization 2	3
	16
SPRING	
ECE 3240 Junior Design	1
ECE 3551 Microcomputer Systems 1	4
ECE 4221 Communication Systems	3
ECE 4231 Control Systems	3
ECE 4332 Electrooptic Devices and Systems	3
Humanities Elective	3
	17

Senior Year

FALL	**CREDITS**
ECE 4241 Systems Design 1	3
Restricted Elective* (Electrical Engineering)	6
Free Elective	3
Engineering Science Elective**	3
Social Science Elective	3
	18
SPRING	
ECE 4242 Systems Design 2	3
Humanities/Social Science Elective	3
Restricted Elective (COM)	3
Technical Elective	6
	15
TOTAL CREDITS REQUIRED	129

**The electrical engineering restricted electives must be selected from the following:*
ECE 4224 Communications and Control Laboratory
ECE 4311 Microelectronic Fabrication Laboratory
ECE 4330 Integrated Circuit Design and Layout Laboratory
ECE 4442 Microwave Laboratory

***A list of approved Engineering Science Electives is available from the department.*

Master of Science Degree Program

All master of science areas of specialization can be taken on either a full-time or part-time basis. A two-year projection of course offerings is available on request. Course offerings are arranged to permit the master's program to be completed in three semesters for full-time students and in two calendar years for part-time students.

Admission Requirements

The undergraduate backgrounds of applicants for admission to the master's degree programs vary considerably. An applicant from a U.S. school should have a bachelor of science or equivalent degree from an electrical engineering program accredited by ABET. In evaluating an international application, consideration is given to academic standards of the school attended and the content of the courses leading to the degree obtained.

Applicants whose bachelor's degrees are in other engineering fields, mathematics, or the physical sciences may be accepted, but will be required to remedy any deficiencies by satisfactorily completing a number of undergraduate courses in preparation for graduate study in electrical engineering.

Degree Requirements

The Master of Science in Electrical Engineering is offered with four possible fields of specialization and both thesis and nonthesis degree paths. Each specialization requires a minimum of 30 credit hours of approved graduate study; however, within each specialization, course choices vary considerably. Prior to the completion of nine credit hours, a student must submit for approval a master's degree program plan to indicate the specialization and path chosen and the specific courses to be taken. Up to six credit hours of thesis may be included in the 30-credit-hour requirement. A nonthesis candidate must pass a master's final program examination.

Curriculum

Requirements for the master of science specializations are as follows. No more than nine credit hours of electives may be taken outside of the ECE department.

Electromagnetics Specialization

This area of specialization provides a background for research in important applications including radar, satellite communications, and related fields making use of antennas and guided wave communications.

ECE 5418 Field Theory of Guided Waves 1 3
ECE 5419 Field Theory of Guided Waves 2 3
ECE 5425 Antennas 1 3
ECE 5426 Antennas 2 3
Approved electives (may include 6 credits of thesis) 18
Seminar or Internship in ECE 1
TOTAL CREDITS REQUIRED 31

Physical Electronics Specialization

This specialization is the combination of two interrelated sub-options—microelectronics and photonics. Recent advances in electronic systems have been largely due to the development of integrated circuits, lasers, optical computing and signal processing, as well as fiber-optic communication and sensing. The study and research of these advanced devices and systems comprise the direction of this program.

ECE 5301 Semiconductor Device Theory 3
ECE 5350 Optical Electronics 3
Three courses from one of the sub-option lists below 9
Approved electives (may include 6 credits of thesis) 15
Seminar or Internship in ECE 1
TOTAL CREDITS REQUIRED 31

Microelectronics Sub-option Courses

ECE 5310 VLSI Processing
ECE 5311 Microelectronics Fabrication Laboratory
ECE 5333 Analog IC Design
ECE 5335 Advanced IC Design and Simulation
ECE 6301 Advanced Semiconductor Device Theory

Photonics Sub-option Courses

ECE 5351 Fiber-Optic Communication Systems
ECE 5352 Fiber-Optic Sensor Systems
ECE 5353 Optical Computing
ECE 5354 Acoustooptic and Electrooptic Devices
ECE 5355 Electrooptics Laboratory
ECE 5356 Optical Waveguides and Devices
ECE 5418 Field Theory of Guided Waves 1

Systems and Information Processing Specialization

Within this area of specialization, courses may be selected to allow concentrations in areas that include systems, digital signal and image processing, neural networks and controls. Each student plans a program of study in consultation with a member of the faculty whose professional field is related to the student's interest.

ECE 5201 Linear Systems 1 3
ECE 5234 Communication Theory 3
or
ECE 5223 Digital Communications 3
ECE 5245 Digital Signal Processing 1 3
MTH 5425 Theory of Stochastic Signals 3
Mathematics Elective 3
Approved electives (may include 6 credits of thesis) 15
Seminar or Internship in ECE 1
TOTAL CREDITS REQUIRED 31

Wireless Systems and Technology Specialization

Wireless refers to any system or device that relies on electromagnetic-wave propagation to perform one or more of its functions, including such diverse applications as radar, global positioning, location, sensing, etc., as well as the broader class of communications systems such as satellites, point-to-point/multipoint, WLAN, Wireless WAN etc. This specialization provides students with a solid foundation in the broad array of disciplines that are common and fundamental to these disparate applications, while allowing flexibility to delve into specific application areas of interest.

ECE 5111 Radio Frequency Propagation 3
ECE 5201 Linear Systems 1 3
ECE 5234 Communication Theory 3
ECE 5245 Digital Signal Processing 1 3
MTH 5425 Theory of Stochastic Signals 3
Three courses from one of the sub-option lists below 9
Approved electives (may include 6 credits of thesis) 6
Seminar or Internship in ECE 1

Wireless Systems Sub-option Courses

ECE 5112 Introduction to Wireless Systems and Applications
ECE 5113 Wireless Local Area Networks
ECE 5114 Radio Location, Sensing and Measurement
ECE 5221 Personal Communications Systems
ECE 5223 Digital Communications
ECE 5233 Satellite Communications
ECE 5238 Error Control Coding
ECE 5246 Digital Signal Processing 2
ECE 5251 Radar Systems

Microwave Engineering Sub-option Courses

ECE 5115 Modern Wireless System Design
ECE 5418 Field Theory of Guided Waves 1
ECE 5425 Antennas 1
ECE 5426 Antennas 2
ECE 5450 Automated RF Measurements
ECE 5451 Microwave Circuit Design

Program for Graduates from Other Fields

A student admitted to this program is expected to have a bachelor's degree from a regionally accredited institution or the equivalent, with an undergraduate major in an engineering discipline, mathematics or the physical sciences, and an academic and/or professional record indicating a high probability of success in graduate work. Preparatory courses required to provide a student with the background necessary for successful graduate study are listed below for each specialization. Depending on the individual's background, other courses (e.g., differential equations and linear algebra) may also be required. Proficiency in these areas may be demonstrated by either successful course completion or by passing an equivalency examination. When possible, a student will be notified of deficiencies at the time of acceptance. In addition to the preparatory work described, all degree requirements listed above for one of the master of science specializations must be fulfilled.

Electromagnetics Specialization

ECE 2112 Circuit Theory 2
ECE 3111 Electronics
ECE 3222 Signals and Systems
ECE 3331 Electron Devices
ECE 3442 Electromagnetic Waves

Physical Electronics Specialization

ECE 2112 Circuit Theory 2
ECE 3111 Electronics
ECE 3222 Signals and Systems
ECE 3331 Electron Devices
ECE 3442 Electromagnetic Waves (Photonics Option)
ECE 4332 Electrooptic Devices and Systems

Systems and Information Processing Specialization

ECE 1552 Computer Design
ECE 2112 Circuit Theory 2
ECE 3111 Electronics
ECE 3222 Signals and Systems
ECE 4221 Communication Systems
ECE 4231 Control Systems

Wireless Systems and Technology Specialization

ECE 2112 Circuit Theory 2
ECE 3111 Electronics
ECE 3222 Signals and Systems
ECE 3442 Electromagnetic Waves
ECE 4221 Communications Systems
MTH 2401 Probability and Statistics

Doctor of Philosophy Degree Program

Admission Requirements

Admission to doctoral study is granted to a limited number of applicants who have received master's degrees in electrical engineering or related fields from accredited institutions or from international institutions that provide suitable preparation for doctoral-level studies.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The degree of doctor of philosophy is conferred primarily in recognition of breadth of creative accomplishment and ability to investigate scientific or engineering problems independently, rather than for completion of a definite course of study. The work should consist of advanced studies and research leading to a significant contribution in the field of specialization.

The doctoral program in electrical engineering may be completed with a minimum of 48 credit hours beyond the master's degree; however, typically 48 to 54 credit hours are necessary. Each student must pass the preliminary written examination, complete an approved program of study beyond that required for a master's degree, pass the comprehensive written examination, complete a program of significant original research, and prepare and defend a dissertation concerning the research.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

COURSE WORK AND THESIS SUMMARY	CREDITS
Doctoral course work minimum beyond master's degree	24
Doctoral research and dissertation	24
TOTAL MINIMUM BEYOND THE MASTER'S DEGREE	48

To assure that all graduates of the doctoral program possess a body of common knowledge, certain courses in electrical engineering and related areas are required. If, in the judgment of the electrical engineering graduate faculty, a student has acquired the equivalent knowledge of a particular subject during previous graduate study at another institution, the student will not be required to take the course at Florida Tech. The requirements depend on the student's chosen area of concentration, as described below.

Electromagnetics

The student's master's and doctoral course work combined should include the following courses in electrical engineering and physics, as follows:

ECE 5410 Electrodynamics 1
ECE 5411 Electrodynamics 2
ECE 5412 Electrodynamics 3
ECE 5418 Field Theory of Guided Waves 1
ECE 5419 Field Theory of Guided Waves 2
ECE 5425 Antennas 1
ECE 5426 Antennas 2
ECE 5430 Electromagnetic Tensor Green Functions
ECE 5431 Computational Electromagnetics
ECE 5450 Automated RF Measurements
ECE 5451 Microwave Circuit Design
PHY 5030 Quantum Mechanics 1
PHY 5031 Quantum Mechanics 2

Physical Electronics

The student's master's and doctoral course work combined should include a minimum of 21 credits in electrical engineering, nine credits in physics and nine credits in mathematics, including all courses required in the master's suboption corresponding to the desired area of specialization.

Systems and Information Processing

The student's master's and doctoral course work combined should include a minimum of 24 credits in electrical engineering and 12 credits in mathematics, including the courses listed under one of the following areas of specialization:

Control

ECE 5202 Linear Systems 2
ECE 5231 Optimal Systems
ECE 5243 Digital Control Systems
MTH 5425 Theory of Stochastic Signals

Signal Processing
ECE 5245 Digital Signal Processing 1
ECE 5246 Digital Signal Processing 2
ECE 5256 Digital Image Processing
MTH 5425 Theory of Stochastic Signals

Wireless Systems and Technology

The master's and doctoral course work combined should include all courses in the master's degree core curriculum for this specialization, plus nine additional credits in mathematics and all courses listed under one of the following doctoral specialization areas.

Wireless Systems
ECE 5202 Linear Systems 2
ECE 5223 Digital Communications
ECE 5238 Error Control Coding
ECE 5246 Digital Signal Processing 2

Microwave Engineering
ECE 5418 Field Theory of Guided Waves 1
ECE 5425 Antennas 1
ECE 5450 Automated RF Measurements
ECE 5451 Microwave Circuit Design

Research Facilities

The electrical and computer engineering programs conduct research in all of the listed areas of specialization. This research is funded by both government and industrial sources, including DARPA, Rome Laboratory, U.S. Air Force, U.S. Army, NSF, the Semiconductor Research Corporation, Harris Corporation, Grumman, Lockheed, MITRE Corporation and the state of Florida.

The research facilities include more than 7,000 square feet of well-equipped laboratories. Although these facilities are used principally for theoretical and experimental engineering research and development by graduate students and faculty, they are also available to undergraduate students for experimental investigations to supplement theoretical lecture courses. Central computer resources of the university include Harris Night Hawk and VAX 8350. A network of 16 advanced Sun and 15 PC workstations is available to assist research in the following laboratories.

Applied Perception Laboratory

Perception involves all processes leading up to the characterization of objects and processes within the perception field; 70 percent of the human brain is devoted to the task. Research in automated perception includes object detection and perception, segmentation, texture analysis, noise reduction, edge detection, computer imaging, modeling and other areas of image analysis. Techniques used include wavelets, fractals, higher-order statistics and morphology. Image processing is usually done on digital computers but sometimes is performed by special optoelectronic devices. Application areas include autonomous inspection in manufacturing and other commercial uses, the analysis and interpolation of infrared or synthetic aperture radar (SAR) imagery and the extraction of cartographic features from overhead imagery. Technologies studied include imagery chains, enhancement, compression, restoration, feature extraction and pattern recognition.

Information Processing Laboratory

The Information Processing Laboratory (IPL) was established in 1989 to conduct research concerned with problems in the areas of signal processing, neural networks and biomedical engineering. In signal processing, algorithms have been developed for near-real-time detection and classification of nuclear explosions for purposes of monitoring nuclear testing. Other work includes the development of high-speed n-dimensional discrete convolution algorithms based on matrix Kronecker products. In neural networks, new neural architectures and robust learning rules have been developed. Neural networks have been designed to solve engineering problems (e.g., determining concentrations of glucose from near infrared spectra of human blood serum). Biomedical engineering research includes biosensor development for a noninvasive blood glucose monitoring system for diabetics. A signal discriminator has been developed based on partial least-squares for classifying electroencephalograph signals. This system is being developed to provide a means of communication for individuals who have lost their ability to speak. The IPL is equipped with a network of three DEC-Alpha workstations and six PCs, and an optical test-bed for biosensor development.

Integrated Circuit Research and Development

Laboratories are dedicated to the design, layout and testing of a variety of CMOS and bipolar integrated circuit technologies. The design and layout capability consists of a laboratory with twelve Sun workstations running sophisticated software, including SPICE for circuit simulation and MAGIC for circuit layout. In the course environment, students develop circuits for fabrication through the MOSIS service. Integrated circuit tests are performed in a number of laboratories, including the microelectronics facility. Research has been extended to studies of integrating sensors into silicon chips, enhancing the radiation tolerance of silicon technologies, and developing microwave modules using hybrid ceramic techniques.

Laser and Optronics Laboratory

This laboratory is dedicated to research and development efforts in the field of optical electronics. Research is primarily focused in the areas of optical communications and optical sensors, ranging from development of state of the art optical transmission media and techniques to design and development of cryogenic instrumentation for the space program.

Lightwave Research Laboratory

This laboratory is designed to accommodate the needs of faculty and student researchers advancing the state of the art in fiberoptic devices and systems for communication and sensing applications. Research performed includes development of unique fiberoptic devices and techniques that allow communications channels to operate with expanded bit rates, and encryption and sensors to measure multiple parameters in structures and the environment. Instruments include data processing systems for data acquisition and signal processing, optical time domain reflectometers, laser microscopes, fiber amplifiers, Bit Error Rate (BER) test equipment, lasers, transmitters and receivers, optics benches, couplers, splitters, attenuators and other fiberoptic components.

Microelectronics

The microelectronics facility is designed to be a teaching laboratory as well as an advanced research laboratory. Research conducted in the facility includes advanced microelectronic packaging and processes for new metallization and dielectrics. The facility is a 3,800-square-foot structure with all support services needed for modern semiconductor research. There is a 3,000-square-foot cleanroom as well as areas dedicated to integrated circuit testing and equipment maintenance. Equipment in the teaching laboratory includes photolithographic aligners, diffusion furnaces, a thin film evaporator, wet chemistry benches and significant measurement and inspection equipment. The advanced research laboratory features a scanning electron microscope, rapid thermal annealer and dry-etch equipment. Additional equipment will be added as research programs develop. The facility also hosts a microelectronics fabrication course, taught to both graduates and undergraduates, in which students completely fabricate and test state of the art integrated circuits.

Microwave Laboratory

The Microwave Laboratory is equipped with instrumentation for precision electromagnetic measurements up to 20 GHz, including electron-beam and solid-state microwave amplifiers, oscillators and mixers, spectrum analyzers, analog and digital storage scopes, high-frequency and coaxial transmission lines, waveguides and associated electronics.

Network Communications Laboratory (NetLab)

This laboratory serves the needs of the Center for Computing and Communications addressing topics in high-performance computers and communications, server and router load balancing, multimedia over the Internet, Multi-Protocol Label Switching (MPLS) and firewall design issues with emphasis on computer security and the protection of computer-related assets. A component-based, distributed network management framework is being developed that provides reliability, flexibility, scalability, policy-based intrusion detection, automatic patch updates, and efficiency through plug-and-play of management components. Java and CORBA as well as portable C++ are used to provide mobile code capability and location transparency.

Wireless Center of Excellence (WiCE) Laboratory

The WiCE Lab is equipped to support a wide variety of activities including simulation, fabrication (in conjunction with the Microelectronics Laboratory) and measurement of wireless communications and other systems and components. Current software/simulation tools include HFSS, ADS, and MDS and Sun UltraSPARC workstations. Test equipment includes a spectrum analyzer, vector network analyzer, oscilloscopes, microwave amplifiers, oscillators and mixers, signal generators, and associated active and passive RF devices. Experimental facilities include two anechoic chamber rooms, an azimuth positioner, a digital pattern recorder for antenna pattern measurements and a screen room for facilitating "quiet" RF measurements.

DEPARTMENT OF ENGINEERING SYSTEMS
M.A. Shaikh, Ph.D., Head

Engineering Management

Master of Science

Professors
Muzaffar A. Shaikh, Ph.D., *management science, decision modeling, mathematical programming, management information systems, systems engineering, operations research.*

Wade H. Shaw Jr., Ph.D., P.E., *management of technology, simulation, artificial intelligence, modeling, project engineering, information systems, quality.*

Associate Professor
William W. Arrasmith, Ph.D., *systems engineering, signal processing.*

Professor Emeritus
Frederick B. Buoni, Ph.D.

Adjunct Professors
J.A. Angelo, Ph.D.; C.A. D'cruz, D.Eng.; D.W. Fisher, J.D., P.E.

Master of Science Degree Program

The Master of Science in Engineering Management has been developed to meet the professional needs of the engineer who, although working in a technical field, finds it necessary to update his or her skills in engineering, as well as acquire knowledge in the management of engineering. Typically, the technical person finds that as he or she advances in the chosen field, the challenges of management increase as part of the overall responsibilities of the position. Many find that their careers would best be served by a program addressing both areas of their job responsibilities. This interdisciplinary program is designed for those individuals.

Admission Requirements

An applicant for the master's program in engineering management should have a bachelor's degree from an ABET-accredited engineering program. Applicants with bachelor's degrees in physical sciences, computer science and mathematics will also be considered. In evaluating an international application, consideration is given to the academic standards of the school attended and the content of the courses. Letters of recommendation and a statement of educational objectives reflecting the applicant's professional experience and career goals are also encouraged. Applicants should also take the Graduate Record Examination (GRE).

General admission requirements and the process for applying are discussed in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The master of science degree requires a minimum of 36 credit hours. Courses taken to satisfy admission prerequisites cannot be counted toward the degree requirements. Students without adequate undergraduate courses in accounting, statistics, computer applications and economics will be required to make up these deficiencies. Applicants whose bachelor's degrees are not in engineering will also be required to remedy any additional deficiencies by satisfactorily completing a number of undergraduate courses selected to meet the prerequisites for graduate study in their engineering area of specialization.

Curriculum

The program requires six courses from the management area and six courses from the engineering area. At least four courses should be taken from the engineering management (ENM) list and can be applied toward either the management or engineering requirement.

Management

Six courses with a clear focus on management are required. These courses may be from the foundation, core or elective courses offered by the School of Management or from courses with a management emphasis from other academic units in the university. Each student meets with the engineering management program director and faculty with expertise in the field of management to select the six-course management sequence. A student must meet any prerequisites needed for a graduate course in management that may be required by the academic unit that offers the course.

Engineering

An engineering specialization is taken by every student based on his or her need for graduate education in technology. A specialization track can be drawn from any of the programs within the College of Engineering or closely allied disciplines such as mathematics or operations research. Each student meets with the engineering management program chair and faculty familiar with the area of technical emphasis to form a sequence of five courses. A student must meet any prerequisites listed for a graduate engineering course.

A student may complete an internship with an industrial, government or service organization, or elect to prepare and defend a thesis to account for up to six semester hours of the 36 credits required for graduation. In order to meet graduation requirements, a nonthesis student must present a portfolio of competencies and a summary of the career relevance of his or her academic study.

DEPARTMENT OF MARINE AND ENVIRONMENTAL SYSTEMS
G.A. Maul, Ph.D., Head

Environmental Sciences

Bachelor of Science — *Master of Science* — *Doctor of Philosophy*

Options in:
Environmental Science
Meteorology

Environmental Resource Management
Environmental Science
Meteorology

Program Chair
John G. Windsor Jr., Ph.D.

Professors
Thomas V. Belanger, Ph.D., *environmental planning, freshwater ecology, chemistry and biology of natural waters, wastewater treatment, water resources.*

Iver W. Duedall, Ph.D., *environmental chemistry, geochemistry, marine pollution processes, physical chemistry of natural waters, waste management, global environmental issues, hurricanes.*

George A. Maul, Ph.D., *marine meteorology, climate, socioeconomic implications of global change, physical oceanography, remote sensing.*

John H. Trefry, Ph.D., *trace metal geochemistry and pollution, geochemistry of rivers, global chemical cycles.*

John G. Windsor Jr., Ph.D., *environmental chemistry, pollution, trace organic analysis of air, water, soil, sediment and tissue, gas chromatography, mass spectrometry, environmental education.*

Associate Professor
Charles R. Bostater Jr., Ph.D., *environmental modeling, remote sensing, estuarine particle dynamics, water quality instrumentation, environmental optics, environmental geophysical fluid dynamics, physical oceanography.*

Assistant Professors
Elizabeth A. Irlandi, Ph.D., *landscape ecology in aquatic environments, seagrass ecosystems, coastal zone management.*

Kevin B. Johnson, Ph.D., *water column ecology, planktonic grazing and distributions, predator-prey interactions.*

Steven M. Lazarus, Ph.D., *analysis of planetary boundary layer, development and testing of life cycle models, parameterization of thin mid-level stratiform clouds, atmospheric radiation measurement.*

Adjunct Professors
J.A. Angelo, Ph.D.; M.I. Duedall, J.D.; S.A. Edgerton, Ph.D.; C.L. Emrich, Ph.D.; B.E. LaPointe, Ph.D.; F.J. Merceret, Ph.D.; D.T. Resio, Ph.D.; N.P. Smith, Ph.D.; A.C. Steinemann, Ph.D.

Lecturers
D.D. Barile, M.S.; F.R. Leslie, M.S.; C.R. Parks, M.S.; M. Splitt, M.S.

The environmental sciences are those areas of applied science concerned with the relationship between human activities and the supporting environment; they provide the scientific framework for rational environmental decisions.

Bachelor of Science Degree Programs

Environmental sciences offerings at Florida Tech include two programs, both solidly based on course work in chemistry, mathematics and physics, combined with specialized environmental science courses and courses in either biology or meteorology, as well as the humanities. Technical electives during the junior and senior years allow flexibility to meet individual interests while building a strong foundation in the environmental sciences. Theoretical concepts are reinforced by laboratory programs and multimedia field studies.

Environmental Science Option

The undergraduate environmental science option is designed to provide graduates with opportunities to pursue careers and advanced academic studies in the use, control and preservation of environmental resources and the enhancement of the quality of life. Graduates have a strong background in biological, chemical and physical sciences, coupled with basic and applied environmental science field, laboratory and course work to help develop solutions to current and future environmental problems. Needs exist throughout the private sector and in local, state and federal agencies for the talents and expertise developed by graduates of this program.

Candidates for a bachelor's degree in environmental science complete a minimum program of 132 semester hours as outlined below. Elective course options from other programs enable the student to either broaden the scope of coverage

of the curriculum or to develop a concentration of courses in some specific area of interest. For example, the curriculum can be designed to emphasize biological, chemical or remote sensing studies. The curriculum was developed to give students the solid, well-rounded background necessary to meet the needs of the numerous career opportunities available to graduates.

Freshman Year

FALL	CREDITS
ASC 1000 University Experience	1
CHM 1101 Chemistry 1	4
COM 1101 Composition and Rhetoric	3
ENS 1001 The Whole Earth Course	3
MTH 1001 Calculus 1	4
	15
SPRING	
BIO 1020 Biological Discovery 2	4
CHM 1102 Chemistry 2	4
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
	15

Sophomore Year

FALL	CREDITS
CHM 2001 Organic Chemistry 1	3
COM 2223 Scientific and Technical Communication	3
HUM 2051 Civilization 1	3
OCN 1010 Oceanography	3
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
	17
SPRING	
BIO 2010 Microbiology	4
CHM 2002 Organic Chemistry 2	3
OCN 2407 Meteorology	3
PHY 2002 Physics 2	4
Restricted Elective*	3
	17

Junior Year

FALL	CREDITS
CHM 3301 Analytical Chemistry 1	3
ENS 3101 Atmospheric Environments	3
HUM 2052 Civilization 2	3
OCN 3201 Marine and Environmental Chemistry	3
OCN 3211 Marine and Environmental Chemistry Lab	1
Free Elective	3
	16
SPRING	
BIO 2801 Biometry	4
ENS 3105 Atmospheric Pollution Laboratory	1
ENS 3911 Environmental Field Projects Proposal	1
ENS 4010 Geographic Information Systems	3
Humanities Elective	3
Restricted Elective*	3
	15
SUMMER (Senior Status Required)	
ENS 4911 Environmental Field Projects	1
ENS 4912 Environmental Field Projects	2
ENS 4913 Environmental Field Projects	3
	6

Senior Year

FALL	CREDITS
BUS 4426 Environmental and Resource Economics	3
ENS 4600 Radiation and Environmental Protection	3
ENS 4800 Limnology 1	3
Restricted Elective*	3
Social Science Elective	3
	15
SPRING	
BIO 3410 General Ecology	4
ENS 4004 Aquatic Environmental Toxicology	3
ENS 4701 Environmental Regulation and Impact Assessment	3
OCN 4204 Marine and Environmental Pollution	3
Restricted Elective*	3
	16

TOTAL CREDITS REQUIRED 132

**Science (including aviation science), engineering or business courses, subject to the approval of the environmental sciences program chair before registering.*

Meteorology Option

Meteorology is a joint program between the College of Engineering, the College of Science and Liberal Arts and the School of Aeronautics, administered by the environmental sciences program. A related degree program in aviation meteorology is offered by the School of Aeronautics.

Candidates for a bachelor's degree in meteorology complete a minimum of 134 semester hours as outlined below. A student completing at least 24 semester hours including MET 3401, MET 3402, MET 4233, MET 4305, MET 4306, SPS 4030, and six credits from among AVS 3201, ENS 3101, MET 4310 and OCN 3401, is eligible to be certified as a professional meteorologist by the American Meteorological Society and the U.S. Office of Personnel Management, and is thus qualified for entry into positions in NOAA National Weather Service, NASA and the U.S. Armed Forces.

Freshman Year

FALL	CREDITS
CHM 1101 General Chemistry 1	4
COM 1101 Composition and Rhetoric	3
ENS 1001 The Whole Earth Course	3
MTH 1001 Calculus 1	4
Social Science Elective	3
	17
SPRING	
AVS 1201 Aviation Meteorology	3
CHM 1102 General Chemistry 2	4
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics Laboratory 1	1
	16

Sophomore Year

FALL	CREDITS
COM 1102 Writing about Literature	3
CSE 1301 Introduction to Computer Applications	3
or	
CSE 15xx Restricted Elective (Computer Science)	3
MTH 2001 Calculus 3	4
PHY 2002 Physics 2	4
PHY 2092 Physics Laboratory 2	1
	15
SPRING	
COM 2223 Scientific and Technical Communication	3
HUM 2051 Civilization 1	3
MTH 2201 Differential Equations/Linear Algebra	4
OCN 2407 Meteorology	3
PHY 2003 Modern Physics	3
	16

Junior Year

FALL	CREDITS
ENS 3101 Atmospheric Environments	3
MET 3401 Synoptic Meteorology 1	3
MTH 2401 Probability and Statistics	3
OCN 3430 Fundamentals of Geophysical Fluids	3
OCN 3433 Geophysical Fluids Laboratory	1
PHY 3060 Thermodynamics, Kinetic Theory and Statistical Mechanics	4
	17

SPRING

ENS	3105	Atmospheric Pollution Laboratory 1
ENS	3911	Environmental Field Projects Proposal 1
HUM	2052	Civilization 2 3
MET	3402	Synoptic Meteorology 2 3
MTH	3201	Boundary Value Problems 3
SPS	4030	Physics of the Atmosphere 3
		Technical Elective 3
		17

SUMMER

ENS	4912	Environmental Field Projects 2 2
ENS	4913	Environmental Field Projects 3 3
		5

Senior Year

FALL **CREDITS**

ENS	4700	Environmental Hydrology 3
MET	4233	Remote Sensing for Meteorology 3
MET	4305	Atmospheric Dynamics 1 3
OCN	3401	Physical Oceanography 3
OCN	3411	Physical Oceanography Laboratory 1
		Humanities Elective 3
		16

SPRING

AVS	3201	Aviation Meteorology 2 3
MET	4306	Atmospheric Dynamics 2 3
MET	4310	Climatology 3
		Technical Elective 3
		Free Elective 3
		15

TOTAL CREDITS REQUIRED 134

Master of Science Degree Programs

Today's increasingly complex technological society has placed new demands on our understanding of human interaction with the environment. In fact, the need has never been greater for highly skilled scientists capable of developing basic data from which far-reaching decisions can be made regarding the intelligent use and protection of our natural environment. Recognizing these needs, the environmental science master's program provides a thorough background in the biological and chemical fundamentals of natural environmental systems with specific areas of emphasis related to water and air resources, water and wastewater treatment, hazardous and toxic materials including nuclear wastes and basic processes governing the interaction of humans and the natural environment.

Environmental Science

Admission Requirements

Students applying for admission to the environmental science program should have undergraduate majors in the physical or life sciences with strong backgrounds in chemistry and biology. Students with bachelor's degrees in other scientific or engineering fields may need to complete certain preparatory course work before starting the master of science program, and completion of such courses may require additional time. Any such requirements will be determined by the program chair and graduate faculty before admission. The prospective student will be advised of these requirements prior to acceptance. Applicants must submit Graduate Record Exam General Test scores for evaluation, a statement of interests, a résumé and three letters of recommendation.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

A Master of Science in Environmental Science requires the satisfactory completion of 30 semester hours of required and elective credits based on an approved program plan developed in conjunction with the faculty adviser. Included in the total are 15 hours of core environmental courses as listed below and six credits of thesis research under the supervision of a member of the graduate faculty. Students are required to attend the graduate seminar. A student registers for graduate seminar each semester and makes an oral presentation of research results after completing thesis research. A nonthesis option is also available. In lieu of the thesis, the student completes an additional nine credits of course work and must pass a written master's comprehensive examination.

Core Environmental Courses

ENS	5000	Environmental Science Seminar 0
ENS	5010	Environmental Optics and Remote Sensing 3
ENS	5101	Introduction to Air Pollution 3
ENS	5700	Introduction to Water Resources 3
ENS	5800	Limnology 1 3
OCN	5210	Marine and Environmental Chemistry 3

The remaining course work in the master's candidate program is normally developed around one of four areas of specialization. These areas currently include the following:

Environmental Biology—Selected graduate course offerings are available in environmental science, chemical engineering, biology, chemistry, meteorology and oceanography dealing with the environmental monitoring necessary to determine the significance and impact of various types of environmental pollution and perturbations on the integrity and stability of biological systems.

Environmental Chemistry—Selected graduate course offerings are available in environmental chemistry, analytical chemistry, environmental biology, meteorology, chemical oceanography, toxicology, hazardous waste and risk assessment that pertain to the origin, fate, transformation, impact, monitoring and treatment of natural and synthetic chemicals in the environment.

Environmental Optics and Remote Sensing—Selected undergraduate and graduate courses are available in environmental science, oceanography, physics, electrical engineering, computer science and space sciences dealing with remote sensing of the environment (water and land features) and radiative transfer modeling and algorithms. This specialty area pertains to the use of remote-sensing data from ground, ship, aircraft and satellite platforms for environmental applications, change detection and natural resources assessments.

Environmental Systems—Advanced graduate course offerings have been specifically selected to address multimedia environmental impact issues and their interactions. Included are air and water (including wetlands) interactions with such multifaceted threats as solid waste, agricultural chemicals and hazardous wastes from municipal, commercial or industrial sources.

Environmental Resource Management

Environmental resource management has become an area of national and international significance. Resource managers, typically in the public and private developmental sectors, face increasingly complex technical problems that cut across several of the more traditional educational disciplines. In addition to the fundamentals of biological and chemical environmental processes, managers must be knowledgeable in local and global cause and effect relationships of human activities in the development and utilization of environmental resources. Resource managers must also understand the legal and regulatory aspects of resources management. Recognizing these multidisciplinary needs, the master's degree program in environmental resource management is closely associated with the environmental science program at Florida Tech and includes both university course work and an internship with a regulatory agency, NGO or private company that manages environmental resources. Graduates are well prepared to effectively interact with engineers, scientists, managers and politicians.

Admission Requirements

Students applying for admission to the environmental resources management program should have undergraduate majors in science or engineering, or sufficient course work in the physical and life sciences and engineering to readily understand the fundamental biological, chemical and physical relationships important in environmental resource management. In some instances, additional preparatory work in some areas may be required at the beginning of the program. The prospective student is advised of such requirements before final acceptance. Each applicant is strongly encouraged to arrange for a conference regarding program content and qualifications with faculty and the program chair or other faculty member before arriving on campus to begin an academic program.

General admission requirements and application procedures are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The degree requires satisfactory completion of 30 semester hours of required and elective courses. Included in the total are 24 credits of required courses and internship, and six credits of selected elective topics as specified in a master's program plan developed in conjunction with the student's adviser. An internship document is required by the academic unit, and the student makes an oral presentation of the internship assignment to the graduate seminar or a professional society meeting and to the student's internship advisory committee. Thesis or internship registration must be continuous from the initial registration until graduation.

Required Courses

BIO	5030	Conservation Biology	3
ENS	5000	Departmental Seminar (each semester)	0
ENS	5001	Global Environmental Problems and Solutions	3
ENS	5004	Aquatic Environmental Toxicology	3
ENS	5009	Internship	6
ENS	5700	Introduction to Water Resources	3
ENS	5701	Environmental Regulation and Impact Assessment	3
OCN	5210	Marine and Environmental Chemistry	3

Elective Courses

Acceptable electives for both M.S. programs include:

BUS	4425	Environmental and Urban Planning	3
BUS	4426	Environmental and Resource Economics	3
CVE	4000	Engineering Economy and Planning	3
EDS	5430	Issue Investigation and Evaluation	3
ENS	4001	The Earth System	3
ENS	4010	Geographic Information Systems	3
ENS	5010	Environmental Optics and Remote Sensing	3
ENS	5101	Introduction to Air Pollution	3
ENS	5600	Radiation and Environmental Protection	3
OCN	5801	Coastal Systems Planning	3

Meteorology

Atmospheric science is focused on understanding Earth's gaseous envelope, predicting its evolution and mitigating human impacts. The M.S. program at Florida Tech is uniquely interdisciplinary, drawing on expertise from the College of Engineering, the School of Aeronautics and the College of Science and Liberal Arts. As such, the M.S. in meteorology can have special emphasis in areas such as marine meteorology, water resources, atmospheric chemistry, aviation meteorology or remote sensing. Collaborative research is conducted with specialists from the nearby NASA Kennedy Space Center, the USAF 45th Weather Squadron, the NOAA National Weather Service, the Harbor Branch Oceanographic Institution, WHIRL (Wind and Hurricane Impacts Research Laboratory) and local government agencies or corporations.

Admission Requirements

A student applying for admission to the graduate meteorology program should have an undergraduate major in the physical sciences or engineering. Preparatory course work may need to be completed before starting the master of science program, and completion of such courses may require additional time. Any such requirements will be determined by the program chair and graduate faculty before admission. The prospective student will be advised of these requirements before acceptance. Applicants must submit GRE General Test Scores for evaluation.

Degree Requirements

The M.S. degree requires satisfactory completion of 30 semester hours of required and elective courses including thesis, based on an approved plan developed in conjunction with the faculty adviser. A nonthesis option is also available, where in lieu of a thesis the student completes an additional nine credits of course work (for a total of 33 credits) and must pass a written master's comprehensive examination. Students with bachelor's degrees in meteorology normally take the core courses plus electives emphasizing their areas of special interest. Students with bachelor's degrees in fields other than meteorology are required to complete the core and other graduate courses in addition to appropriate courses necessary for certification as a professional meteorologist by the American Meteorological Society (see undergraduate curriculum). Students are required to attend the graduate seminar. A student registers for graduate seminar each semester and makes an oral presentation of research results after completing thesis research.

Required Courses

MET 5001 Principles of Atmospheric Science 3
MET 5233 Atmospheric Remote Sensing 3
MET 5305 Dynamic Meteorology 1 3
MET 5306 Dynamic Meteorology 2 3
ENS 5000 Environmental Sciences Seminar 0

Elective Courses

Acceptable electives for the meteorology program include
AVS 5201 Aviation Meteorology Theory and Practice 3
AVS 5202 Advanced Aviation Meteorology Laboratory 1
ENS 4001 The Earth System 3
ENS 4010 Geographic Information Systems 3
ENS 5001 Global Environmental Problems and Solutions 3
ENS 5101 Introduction to Air Pollution 3
ENS 5105 Atmospheric Pollution Laboratory 1
ENS 5700 Introduction to Water Resources 3
ENS 5800 Limnology 3
MET 4310 Climatology 3
OCE 5570 Marine Hydrodynamics and Wave Theory 3
OCE 5586 Ocean Engineering Data Analysis 3
OCN 5001 Principles of Oceanography 3
OCN 5210 Marine and Environmental Chemistry 3
OCN 5401 Principles of Physical Oceanography 3
OCN 5403 Ocean Wave Theory 3
OCN 5405 Dynamic Oceanography 3
OCN 5407 Marine Meteorology 3
OCN 5409 Geophysical Fluid Dynamics 3
OCN 5704 Oceanic Remote Sensing 3
PHY 5080 Thermodynamics 3
SPS 4030 Physics Of The Atmosphere 3
SPS 5031 Planetary Science 2: Atmospheres 3

Doctor of Philosophy Degree Program

Admission Requirements

An applicant for the doctoral program in environmental science must have a bachelor's or master's degree from an accredited institution in environmental science, biology, chemistry or other appropriate science curriculum. In some cases, certain undergraduate courses must be taken to remediate areas of deficiency before a student can start the doctoral program.

For admission, a student should have a superior academic record and at least three letters of recommendation, including one from the master's degree thesis adviser. Preference will be given to students with high scores on the Graduate Record Examination.

Included with the application should be a short but clear statement of the interest and objectives of the applicant. Although not absolutely required, an on-campus interview is highly recommended.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The doctoral degree is primarily a research degree and is conferred in part in recognition of research accomplishments. Each student must complete an approved program of course work; demonstrate proficiency in a foreign language or a computer language, at the discretion of the doctoral committee; pass the comprehensive examinations; write an acceptable research proposal and petition for admission to candidacy; complete a program of significant original research; prepare and defend a dissertation concerning the research; and present a seminar on the research. Each candidate is expected to publish a major portion of the dissertation in refereed national or international journals. A minimum of 24 credit hours of course work and 24 credit hours of dissertation beyond a master's degree are required.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog and on the Florida Tech Graduate Programs Web site.

Curriculum

A program of study must be approved by the student's adviser and the program chair. A wide degree of latitude is allowed in course selection and research interest within the capabilities of the university and the student's academic background.

Before admission to doctoral candidacy, the student may be required to demonstrate proficiency in a computer language or a reading proficiency of scientific literature in one foreign language. The chosen language should allow access to important literature in the student's area of research. This requirement is imposed at the discretion of the doctoral committee.

After admission to doctoral candidacy, a yearly seminar demonstrating progress must be presented to the graduate faculty.

Research

Faculty and graduate students are actively engaged in a variety of environmental research projects, including effects of agricultural and urban stormwater runoff on river and estuarine water quality, measurement of quantities and quality of groundwater seepage in Florida lakes, dissolved oxygen budgets in aquatic systems, trace metal contamination of natural waters and sediments, acid deposition, lake trophic state classifications, trace organic contamination in coastal systems, decomposition and sedimentation of aquatic macrophytes and use of waste by-products, including ash produced from fossil fuel combustion and municipal incinerators.

Research Facilities

The program offers specialized facilities for instruction and research. The Marine and Environmental Chemistry Laboratory is equipped with standard water and wastewater sampling and analysis equipment. In addition, analytical instruments provided for advanced study include a total organic carbon analyzer, atomic absorption spectrophotometers and scintillation counters. Florida Tech maintains a variety of small and large boats for field work including a 60-foot lagoon- and oceangoing research vessel equipped with laboratory and computer facilities. Analytical capabilities are extended by means of cooperative projects with the departments of biological sciences and chemistry. In addition, an advanced state-of-the-art analytical facility is available to Florida Tech through a cooperative arrangement with the Midwest Research Institute's Palm Bay laboratories. Instrumentation currently available includes GIS, SEM and ICP/MS.

Mechanical Engineering

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING
J.J. Engblom, Ph.D., Head

Bachelor of Science *Master of Science* *Doctor of Philosophy*

Areas of Specialization:
Dynamic Systems, Robotics and Controls
Structures, Solid Mechanics and Materials
Thermal-Fluid Sciences

Professors

J. Ronald Bailey, Ph.D., P.E., F.W. Olin Professor, *machine design, vibrations, dynamics of machinery, acoustics, noise control, statistical process control, computer-aided manufacturing.*

Thomas E. Bowman, Ph.D., *fluid mechanics and thermal sciences, energy conversion, solar energy, appropriate solar technologies, microgravity fluid mechanics.*

John J. Engblom, Ph.D., P.E., *computational and experimental mechanics, finite element and boundary element methods, development/modeling, mechanics of composites, computer-aided design, structural dynamics and stability.*

Research Professor

Mary Helen McCay, Ph.D., P.E., *metallurgy, crystal growth, laser interaction with materials.*

Associate Professors

Pei-feng Hsu, Ph.D., *radiative and multimode heat transfer, premixed combustion in porous ceramics, numerical methods in heat transfer, pulsed laser applications in medical imaging and material property diagnostics, thermal conductivity measurements, heat exchanger design, HVAC systems design.*

Pierre M. Larochelle, Ph.D., P.E., *synthesis and analysis of mechanisms and machines, design and control of robotic manipulators, theoretical kinematics, design of spherical and spatial mechanisms, computer-aided design.*

Kunal Mitra, Ph.D., *thermal fluid sciences with emphasis on laser applications, thermal radiation, microscale heat transfer, material processing, bio heat transfer modeling.*

Yahya I. Sharaf-Eldeen, Ph.D., P.E., *modeling, simulation, and design of dynamic systems, advanced dynamics, vibration, and design of machinery, thermal-fluid sciences, energy/power systems.*

Assistant Professor

Hector Gutierrez, Ph.D., P.E., *mechatronics, nonlinear control, microprocessor control of electromechanical systems, magnetic suspension systems, intelligent control, automation, computer-based instrumentation, computer-aided engineering of control systems.*

Professor Emeritus

Palmer C. Stiles, M.S.

Mechanical engineers are deeply involved in activities that are essential to our modern civilization. These activities include the research, development, design and testing of materials, structures and machines for the generation of power, for transportation and for the production of electricity by the conversion of energy from various sources including chemical, nuclear, solar and geothermal; conception and design of all types of machines that serve humans and their many needs; construction and operation of production machinery for the manufacture of materials and consumer products; and instrumentation, control and regulation of these and other types of manual and automatic mechanical systems.

Bachelor of Science Degree Program

The mechanical engineering undergraduate curriculum at Florida Tech presents the fundamentals underlying modern mechanical engineering and prepares the student for a lifetime of continued learning. During the freshman and sophomore years, the emphasis is placed on mathematics and physics. An introduction to engineering in the freshman year previews the field and gives the students their first experience in engineering design. The sophomore and junior years direct the student toward the engineering sciences, including mechanics of solids, thermodynamics and fluid mechanics. During the junior and senior years, the study becomes progressively centered about the specific issues facing practicing mechanical engineers. The student uses the basic tools imparted during the first two years and applies them in studies of machine systems, instrumentation, automatic controls, thermal systems and design projects. Other courses taken during the last two years expand the student's knowledge in the fields of heat transfer, electronics, vibrations and mathematics. Technical electives taken during the senior year allow the student to direct the program toward specific areas of personal interest.

Laboratory experiences are essential to the education of engineers, and these are provided in chemistry, physics, computer-aided design, materials, fluids and heat transfer. The capstone of the educational process is the senior mechanical engineering design project, which synthesizes and focuses elements from the various disciplines into a design activity of current mechanical engineering interest. The faculty serve jointly in the supervision and consultation for these projects.

After graduation, the mechanical engineering student is prepared to pursue a career either in industry or government as a practicing engineer, or to enter graduate work in engineering, applied mechanics or mathematics. In some cases, mechanical engineering graduates also enter professional schools of medicine, law or business.

Students are encouraged to define career objectives early in the program (preferably during the sophomore year) so that in consultation with faculty advisers, electives can be selected that are best suited to the achievement of specific goals.

The objective of the mechanical engineering program is to graduate students who are well prepared for an engineering career through their understanding of engineering science fundamentals including mathematics, physical sciences and information technology; are able to design and conduct experiments, collect measurements, and analyze and interpret experimental data; can design components and systems, and have an understanding of manufacturing processes; are able to function on multidisciplinary design teams; can identify, formulate and solve engineering problems and understand the impact of their solutions in a global and societal context; can understand professional and ethical responsibility, communicate effectively and recognize the importance of participating in life-long learning opportunities; have knowledge of contemporary issues relevant to the engineering profession; are successful in securing employment; and for those who choose graduate study, are successful in gaining admittance to and completing graduate or professional programs.

Degree Requirements

Candidates for a Bachelor of Science in Mechanical Engineering must complete the minimum course requirements as outlined in the following curriculum.

For definitions of electives for engineering programs, see the *Undergraduate Information and Regulations* section of this catalog.

Freshman Year

FALL		CREDITS
CHM 1101	General Chemistry 1	4
COM 1101	Composition and Rhetoric	3
MAE 1022	Introduction to Mechanical Engineering 1	2
MTH 1001	Calculus 1	4
	Social Science Elective	3
		16
SPRING		
COM 1102	Writing about Literature	3
CSE 150x	Introduction to Software Development	3
MAE 1023	Introduction to Mechanical Engineering 2	1
MTH 1002	Calculus 2	4
PHY 1001	Physics 1	4
PHY 2091	Physics Lab 1	1
		16

Sophomore Year

FALL		CREDITS
CHE 3260	Materials Science and Engineering	3
CHE 3265	Materials Laboratory	1
COM 2223	Scientific and Technical Communication	3
MAE 2081	Applied Mechanics: Statics	3
MTH 2001	Calculus 3	4
PHY 2002	Physics 2	4
		18
SPRING		
MAE 2024	Solids Modeling and 3-D Mechanical Design Principles	3
MAE 2082	Applied Mechanics: Dynamics	3
MAE 3083	Mechanics of Materials	3
MAE 3191	Engineering Thermodynamics 1	3
MTH 2201	Differential Equations/Linear Algebra	4
PHY 2092	Physics Lab 2	1
		17

Junior Year

FALL		CREDITS
HUM 2051	Civilization 1	3
MAE 3024	Computer-Aided Engineering	3
MAE 3061	Fluid Mechanics 1	3
MAE 3064	Fluid Mechanics Laboratory	1
MAE 3192	Engineering Thermodynamics 2	3
MTH 3201	Boundary Value Problems	3
		16
SPRING		
HUM 2052	Civilization 2	3
MAE 3090	Design of Machine Elements	3
MAE 3091	Theory of Machines	3
MAE 4171	Principles of Heat Transfer	3
MAE 4190	Design Methodologies and Practice	1
	Restricted Elective (Engineering)	3
		16

Senior Year

FALL		CREDITS
ECE 4991	Electric and Electronic Circuits	3
MAE 4024	Mechanical Vibrations	3
MAE 4071	Thermal Systems Design	3
MAE 4074	Heat Transfer Laboratory	1
MAE 4193	Mechanical Engineering Design 1	3
	Technical Elective	3
		16
SPRING		
MAE 4014	Control Systems	3
MAE 4175	Heating, Ventilation and Air Conditioning	3
MAE 4194	Mechanical Engineering Design 2	4
	Humanities Elective	3
	Free Elective	3
		16

TOTAL CREDITS REQUIRED 131

Master of Science Degree Program

All master of science options can be earned on either a full-time or a part-time basis. A two-year projection of course offerings is available on request. Course offerings are arranged to permit the master's program to be completed by full-time students in a maximum of two calendar years.

Admission Requirements

The undergraduate backgrounds of applicants for admission to the master's degree (M.S.M.E.) programs vary considerably. For this reason, a variety of master's degree options are available. The applicant should have a bachelor of science or equivalent degree from a mechanical engineering program accredited by ABET. In evaluating an international application, consideration is given to academic standards of the school attended and the content of the courses leading to the degree obtained. Master's applicants are required to take the Graduate Record Examination (General Test).

Applicants whose bachelor's degrees are in other engineering fields, mathematics, or the physical sciences may be accepted, but will be required to remedy any deficiencies by satisfactorily completing a number of undergraduate courses in preparation for graduate study in mechanical engineering.

Degree Requirements

The Master of Science in Mechanical Engineering is offered with both thesis and nonthesis options. Each option requires a minimum of 30 credit hours of approved graduate study; however, within each option, course choices vary considerably. Prior to the completion of nine credit hours, the student must submit for approval a master's degree program plan to indicate the path chosen and the specific courses to be taken. Up to six credit hours of thesis work may be included in the 30 credit hour requirement. The nonthesis option requires that the candidate satisfactorily complete a minimum of 30 credit hours of course work and the master's final program examination.

Curriculum

Regardless of which degree path the student chooses, the degree candidate must choose one of three specialization fields. Listed below are required and elective courses for the master of science specializations.

Structures, Solid Mechanics and Materials Specialization

Three core courses selected in consultation with the student adviser from the list below:		9
MAE 5050	Finite Element Fundamentals	
MAE 5060	Applications in Finite Element Methods	
MAE 5410	Elasticity	
MAE 5420	Advanced Mechanical Design	
MAE 5460	Fracture Mechanics and Fatigue of Materials	
MAE 5470	Principles of Composite Materials	
	Mathematics	6
	Approved electives, which may include 6 credit hours of thesis	15

TOTAL CREDITS REQUIRED 30

Specialization in this area focuses on analytical and computational techniques as they apply in design. Each student plans a program of study in consultation with a member of the faculty whose professional field is related to the student's interests.

Thermal-Fluid Sciences Specialization

Three core courses selected in consultation with the student adviser from the list below: 9
MAE 5130 Viscous Flows
MAE 5210 Conduction Heat Transfer
MAE 5220 Convection Heat Transfer
MAE 5230 Radiation Heat Transfer
Mathematics 6
Approved electives, which may include 6 credit hours of thesis 15
TOTAL CREDITS REQUIRED 30

Specialization in this area focuses on heat transfer, combustion and energy systems. Analytical, computational and experimental techniques are emphasized.

Dynamic Systems, Robotics and Controls Specialization

Three core courses selected in consultation with the student adviser from the list below: 9
MAE 5610 Advanced Dynamics
MAE 5630 Modeling and Simulation of Dynamic Systems
MAE 5650 Robotics
MAE 5660 Robot Control
Mathematics 6
Approved electives, which may include 6 credit hours of thesis 15
TOTAL CREDITS REQUIRED 30

The student's program of study in this area will be tailored to provide the background and training to pursue a career in a desired and related area of interest. Examples of related areas include design and control of dynamic systems, robotics, vibration, automotive engineering, biomedical engineering, energy and power systems, etc.

Doctor of Philosophy Degree Program

The doctor of philosophy degree is offered for students who wish to carry out advanced research in any of the three optional areas of specialization listed under the master of science program. Other research areas may or may not correlate well with current faculty interests and laboratory facilities. In such cases, the mechanical engineering department head should be consulted to determine the feasibility of pursuing advanced research topics that are outside of the three optional areas listed.

Admission Requirements

A candidate for the doctoral program will normally have completed a master's degree in mechanical engineering or a related field and have adequate preparation in areas of science and mathematics fundamental to his or her field of study. In addition, a student enrolled in the master's program may apply to work directly toward the doctoral degree after completing at least 18 credits of graduate course work at Florida Tech with a cumulative grade point average of at least 3.5.

Doctoral applicants should have superior academic records, provide letters of recommendation and take the Graduate Record Examination (GRE) General Test.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The degree of doctor of philosophy is conferred primarily in recognition of creative accomplishment and ability to investigate scientific or engineering problems independently, rather than for completion of a definite course of study. The work should consist of advanced studies and research leading to a significant contribution to the knowledge of a particular problem. A student's research may have analytical, computational or experimental components, or some combination. Each student is expected to complete an approved program of study beyond that required for a master's degree, pass the comprehensive written/oral examination, complete a program of significant original research, and prepare and defend a dissertation concerning the research work.

The purpose of the comprehensive examination is to cover the student's major field of study and related fields important to the major field. The examination is given when, in the judgment of the student's advisory committee, the student has had sufficient preparation in his/her field of study by completing significant course work in at least three areas of specialization and by initiating doctoral research. The examination must normally be taken before the end of the student's fourth academic semester, as counted from admission into the doctoral program. The written portion of the examination consists of individual examinations given by each member of the advisory committee. These written examinations are intended to cover each of the student's areas of specialization. The written portion of the comprehensive examination is followed by an oral component administered by the student's advisory committee. The oral examination provides the advisory committee an opportunity to complete the examinations in each of the student's specialty areas. Subsequent to completion of both written and oral components of the examination, a dissertation proposal must be submitted to the student's advisory committee for evaluation. Upon determining that the proposed research is of doctoral quality and that completion is feasible, the student is advanced to candidacy for the doctoral degree.

COURSE WORK AND THESIS SUMMARY **CREDITS**
Doctoral course work minimum beyond master's degree 24
Doctoral research and dissertation 24
TOTAL MINIMUM BEYOND THE MASTER'S DEGREE 48

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

The student's master's and doctoral course work combined should include a minimum of 24 credits in mechanical engineering and 12 credits in mathematics. The doctoral program of study must be approved by the student's adviser and the department head. The distribution of these courses should include courses in each of the three optional fields of specialization, and as a minimum should have the credit distribution given below:

Major Field (including master's courses) 18
Minor Fields (including master's courses) ..... 9 (each)
Mathematics (including master's courses) 12

Research Activities and Facilities

Mechanical and aerospace engineering shared facilities include laboratories for energy research, fluid mechanics and aerodynamics, combustion and propulsion, metallurgy and solid mechanics, system dynamics and control, instrumentation and applied laser research, computer-aided design and computational research. Other laboratories around the campus can also be used by mechanical engineering graduate students performing advanced research.

Funded research activities of the mechanical and aerospace engineering faculty have recently included studies of efficient heat transfer/insulation mechanisms in building environments, advanced HVAC and fuel cell systems, integration of renewable energy sources into residential and utility applications, computation of radiative transport, computational mechanics with emphasis on damage mechanisms in laminated composite structures, development of experimental techniques for mechanical behavior of advanced materials systems, thermomechanical behavior of microelectronics packages/devices, design/manufacture of smart human hip prostheses, turbulent boundary-layer structure, study of leaks in cryogenic seals, condition monitoring and fault diagnosis in rotating machinery and turbulent transport of moisture contained in air streams. Other studies have involved convection and diffusion of radon gas in porous media, design of a PD controller for robot manipulators, response of occupants in automobile collisions, thermal management of electronic equipment, smart composite structures with embedded sensors and optimization of composites. Research projects have been variously supported through grants from NASA, National Science Foundation, Defense Nuclear Agency, Air Force Office of Scientific Research, Edith Bush Charitable Foundation, Florida Solar Energy Center, Florida Space Grant Consortium, Department of Energy and a number of industrial affiliations.

Please refer to the *Research: Institutes, Centers and Major Laboratories* section of this catalog for further information regarding the Dynamic Systems and Controls Laboratory; the Laser, Optics and Instrumentation Laboratory; and the Robotics and Spatial Systems Laboratory.

DEPARTMENT OF MARINE AND ENVIRONMENTAL SYSTEMS
G.A. Maul, Ph.D., Head

Ocean Engineering

Bachelor of Science *Master of Science* *Doctor of Philosophy*

Areas of Specialization:
Coastal Processes and Engineering
Hydrographic Engineering
Materials and Structures
Naval Architecture and Ocean Systems

Program Chair
Andrew Zborowski, Ph.D.

Professors
Geoffrey W.J. Swain, Ph.D., *materials, corrosion, biofouling, offshore technology, ship operations.*

Andrew Zborowski, Ph.D., *naval architecture, marine hydrodynamics, ship model tank studies, dynamics of marine vehicles, design of high-speed small craft.*

Associate Professor
Lee E. Harris, Ph.D., P.E., *coastal engineering, coastal structures, beach erosion and control, physical oceanography.*

Assistant Professors
Eric D. Thosteson, Ph.D., P.E., *coastal and nearshore engineering, coastal processes, wave mechanics, sediment transport.*

Stephen L. Wood, Ph.D., P.E., *underwater robotics, underwater vehicles, advanced navigation and control systems.*

Professor Emeritus
J.C. Sainsbury, Ph.D.

Adjunct Professors
S. Bradfield, Ph.D.; A.M. Clark, Ph.D.; W.R. Dally, Ph.D., P.E.; S. Grochowalski, Ph.D.; R.P. Reichard, Ph.D.

Lecturer
W.A. Cleary, B.S., P.E.

The Department of Marine and Environmental Systems combines the expertise of both scientists and engineers. The ocean engineering faculty includes highly qualified researchers engaged in the study of port and harbor facilities, the modeling of estuarine environments, the design and construction of marine vehicles, the impact of waste disposal in the sea, the effects and prevention of coastal erosion and sediment transport, offshore engineering, hydrographic surveying and corrosion in the marine environment. In addition to these studies, various scientific investigations in the bioenvironmental, chemical, physical and geological oceanographic fields incorporate ocean engineering expertise.

Bachelor of Science Degree Program

The ocean engineering program offers education that is unique among engineering disciplines in providing an intimate and practical knowledge of the environment in which the graduate will operate. The result is a diverse curriculum with a strong foundation in all the engineering fields as well as in oceanography. The educational objectives of the program are:

1. To provide multidisciplinary hands-on education, oriented toward industry needs, with emphasis on basic engineering sciences, design experience and modern engineering tools and methods.
2. To offer a curriculum that incorporates important components of modern ocean engineering fields, and is broad enough to prepare students to enter graduate school in engineering and related fields.
3. To graduate engineers who are aware of society's needs and are able to effectively communicate the effects of technology on social development, and the impact of technology on the environment.

The first two years of study are devoted to developing a scientific foundation in mathematics, physics, chemistry, mechanics, computer programming and humanities. During the junior year, the student acquires knowledge of ocean science and the basics of engineering analysis. The fourth year is oriented toward the application of these basic techniques to ocean engineering problems. All students are

required to obtain firsthand field and sea experience during the marine field projects held during the summer between the junior and senior years. These projects encourage the student to learn to analyze, design, construct, install and operate equipment in the marine environment for a particular designated task. The College of Engineering operates several small boats and a well-equipped 60-foot research vessel, the R/V *Delphinus,* for offshore, estuarine and river work.

Degree Requirements

Candidates for a Bachelor of Science in Ocean Engineering must complete the minimum course requirements outlined in the following curriculum.

For definition of electives for engineering programs, see the *Undergraduate Information and Regulations* section of this catalog.

Freshman Year

FALL		CREDITS
BUS	1301 Basic Economics*	3
CHM	1101 General Chemistry 1	4
COM	1101 Composition and Rhetoric	3
MTH	1001 Calculus 1	4
OCN	1010 Oceanography	3
		17

SPRING		
COM	1102 Writing about Literature	3
MTH	1002 Calculus 2	4
OCE	1001 Introduction to Ocean Engineering	3
PHY	1001 Physics 1	4
PHY	2091 Physics Lab 1	1
	Restricted Elective (Computer Science)	3
		18

**Or Social Science Elective*

Sophomore Year

FALL		CREDITS
MAE	2081 Applied Mechanics: Statics	3
MTH	2001 Calculus 3	4
PHY	2002 Physics 2	4
PHY	2092 Physics Lab 2	1
OCE	3011 Engineering Materials	3
OCE	3012 Engineering Materials Lab	1
		16

SPRING		
HUM	2051 Civilization 1	3
MAE	2082 Applied Mechanics: Dynamics	3
MAE	3083 Mechanics of Materials	3
MTH	2201 Differential Equations/Linear Algebra	4
OCN	xxxx Restricted Elective (Oceanography)	3
		16

Junior Year

FALL		CREDITS
COM	2223 Scientific and Technical Communication	3
HUM	2052 Civilization 2	3
OCE	3030 Fluid Mechanics	3
OCE	3033 Fluid Mechanics Lab	1
OCN	3401 Physical Oceanography	3
	Free Elective	3
		16

SPRING		
ECE	4991 Electric and Electronic Circuits	3
MAE	3191 Engineering Thermodynamics 1	3
OCE	3521 Hydromechanics and Wave Theory	3
OCE	3522 Water Wave Lab	1
OCE	4541 Ocean Engineering Design	3
OCE	4571 Fundamentals of Naval Architecture 1	3
		16

SUMMER		
OCE	4911 Marine Field Project 1	1
OCE	4912 Marine Field Project 2	2
OCE	4913 Marine Field Project 3	3
		6

Senior Year

FALL		CREDITS
CVE	3015 Structural Analysis and Design	3
OCE	4525 Coastal Engineering: Structures	3
OCE	4545 Hydroacoustics	3
OCE	xxxx Restricted Elective (Ocean Engineering)	3
	Humanities Elective	3
		15

SPRING		
CVE	4000 Engineering Economy and Planning	3
OCE	4518 Protection of Marine Materials	3
OCE	4561 Fundamentals of Offshore Engineering	3
	Humanities or Social Science Elective	3
	Technical Elective	3
		15

TOTAL CREDITS REQUIRED 135

Note: Lists of recommended elective courses are available from the department office.

Master of Science Degree Program

The curriculum is designed to allow the ocean engineer to broaden professional expertise in preparation for a challenging career in industry or for further graduate study. Although emphasis is placed on a core of required courses, the student is encouraged to concentrate efforts in one of several areas of interest through a choice of elective courses. Both thesis and nonthesis tracks are available. Although not required for admission, an on-campus interview is highly recommended.

The Master of Science in Ocean Engineering can be earned on either a full-time or part-time basis. Although a full-time student may complete course work within two or three semesters, thesis activities normally involve a further one or two semesters of study. Graduate student assistants normally require additional time. A student can start graduate studies in either the fall or spring semester, but fall semester is recommended.

Admission Requirements

An applicant should normally have an undergraduate degree in some field of engineering or in one of the physical sciences. Every applicant should have a mathematics background through differential equations along with introductory courses in physics, chemistry and computer programming. A student who has graduated from a nonengineering program will be required to complete additional course work as part of the master's degree program. Although not required for admission, an on-campus interview is highly recommended.

Applications from international students are invited and will be evaluated with consideration given to academic standards in the country where baccalaureate studies were taken.

General admission requirements and application procedures are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The degree of Master of Science in Ocean Engineering is conferred on students who have successfully completed a minimum of 30 credit hours (including thesis) of required and elective course work. Thesis work may be primarily analytical or experimental in nature, or a comprehensive design study, or a computational investigation involving state-of-the-art computer modeling techniques. The thesis may be replaced by three courses (9 credits) following approval of a written petition to the program chair. The nonthesis track requires a minimum of 33 credit hours, an oral comprehensive examination and a technical paper. A thesis is usually required for any student receiving financial support through the Department of Marine and Environmental Systems.

Curriculum

MTH xxxx Mathematics 3
OCE 5515 Materials for Marine Applications 3
OCE 5570 Marine Hydrodynamics and Wave Theory 3
OCE 5990 Ocean Engineering Seminar 0
OCE 5999 Thesis Research* 6
OCN 5401 Principles of Physical Oceanography 3
Subject Area Courses 9
Elective 3
TOTAL CREDITS REQUIRED 30

**May be replaced by nine credits of course work and a major paper.*

Areas of Specialization

The subject area requirement is met by taking at least three courses from one of the following groups:

Coastal Processes and Engineering
OCE 5525 Coastal Processes and Engineering
OCE 5526 Advanced Coastal Engineering Structures
OCE 5563 Port and Harbor Engineering
OCE 5586 Ocean Engineering Data Analysis

Hydrographic Engineering
ENS 4010 Geographic Information Systems
OCE 4545 Hydroacoustics
OCE 5550 Bathymetry
OCE 5571 Naval Architecture
OCE 5586 Ocean Engineering Data Analysis
OCN 5704 Oceanic Remote Sensing

Materials and Structures
MAE 5050 Finite Element Fundamentals
OCE 4574 Structural Mechanics of Marine Vehicles
OCE 5519 Corrosion Engineering
OCE 5526 Advanced Coastal Engineering Structures

Naval Architecture and Ocean Systems
OCE 4573 Ship Design
OCE 5542 Ocean Engineering Systems
OCE 5571 Naval Architecture
OCE 5573 Dynamics of Marine Vehicles
OCE 5575 Applied Marine Hydrodynamics

Recommended Electives

An additional course to meet the minimum total requirements for the degree can be selected from the following list of recommended electives. Other courses can also be elected with approval of the student advisory committee.
CVE 5025 Foundation Design
ENS 5701 Environmental Regulation and Impact Assessment
MAE 5610 Advanced Dynamics
OCE 4575 Design of High-Speed Small Craft
OCN 5204 Marine Pollution
OCN 5210 Marine and Environmental Chemistry
OCN 5405 Dynamic Oceanography
OCN 5409 Geophysical Fluid Dynamics
ORP 5041 Reliability Analysis
ORP 5042 Reliability, Availability and Maintainability

Doctor of Philosophy Degree Program

Admission Requirements

Admission to doctoral study is granted to a limited number of applicants, and normally requires a master's degree, with a GPA of at least 3.3 out of 4.0, in a program that provides suitable preparation for doctoral-level studies in ocean engineering.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The doctor of philosophy degree is awarded in recognition of scientific accomplishment and the ability to investigate scientific problems independently. The program consists of advanced studies to prepare the student for engineering research, and completion of a research project that leads to a significant contribution to the knowledge of a particular problem. Each student must pass the preliminary written examination, complete an approved program of study, pass the comprehensive written and oral examinations, complete a program of significant research, publish the results of the research, and prepare and defend a dissertation concerning the research.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

Doctoral course work minimum credits beyond the master's degree 24
Doctoral thesis minimum credits 24
MINIMUM CREDITS BEYOND MASTER'S DEGREE 48

Courses must be taken in several areas to assure that all graduates of the doctoral program possess the breadth of knowledge necessary to work in the field of ocean engineering. A minimum of nine credits of course work must be taken in mathematics and computer science, and 21 credits must be taken in engineering, as part of the student's graduate course work (including master's courses). A minimum of 15 credits of course work must be directly related to the dissertation research.

The dissertation research is normally conducted on a topic related to current faculty research. The ocean engineering program faculty currently have research interests in coastal engineering, corrosion and naval architecture.

After admission to doctoral candidacy, a yearly seminar demonstrating progress must be presented to the graduate faculty.

Research Activities and Facilities

The department of marine and environmental systems occupies the first and second floors of the Link Building with laboratory, lecture, computer facilities and office space. A general description of these facilities is included under "Oceanography" in this section.

The ocean engineering program includes facilities for traditional design activities, several stations for computer-aided design techniques and a reference data collection. Ocean engineering provides facilities for structural testing and pressure testing and a Surf Mechanics Laboratory. The materials and corrosion lab specializes in design and testing

of materials (concrete, composites and plastics) for marine applications. A towing tank is available at the nearby Harbor Branch Oceanographic Institution in Fort Pierce.

Research interests of the faculty center around coastal engineering, corrosion and materials, ocean mineral exploitation, waste disposal, naval architecture and shipbuilding (including small craft), fluid dynamics, instrumentation and commercial fisheries engineering and development, and marine positioning.

A close relationship is maintained with the Engineering Division of Harbor Branch Oceanographic Institution. Graduate students, especially those having interests in submersibles, exploratory equipment and instrumentation, may have the opportunity to conduct thesis research in conjunction with the Harbor Branch staff and use facilities at the institution.

Ship and marine facilities provide an excellent base for research activities involving all aspects of offshore and coastal ship operations, structures, erosion, and environmental control applications. The sheltered waters and geography of the Indian River allow excellent conditions for undertaking control and propulsion research using large models or full-scale craft.

DEPARTMENT OF MARINE AND ENVIRONMENTAL SYSTEMS
G.A. Maul, Ph.D., Head

Oceanography

Bachelor of Science	*Master of Science*	*Doctor of Philosophy*
Areas of Concentration:	*Options in:*	
Biological Oceanography	*Biological Oceanography*	
Chemical Oceanography	*Chemical Oceanography*	
Coastal Zone Management	*Coastal Zone Management*	*(For related degree programs see Biological*
Marine Environmental Science	*Geological Oceanography*	*Sciences, Environmental Sciences and*
Physical Oceanography	*Physical Oceanography*	*Ocean Engineering)*

Program Chair
John G. Windsor Jr., Ph.D.

Professors
Iver W. Duedall, Ph.D., *chemical oceanography, physical chemistry of seawater, geochemistry, marine pollution, waste management and the ocean.*

George A. Maul, Ph.D., *ocean circulation, geophysical and socioeconomic aspects of climate and sea-level change, marine geodesy, Earth system science, satellite oceanography, hydrography.*

Geoffrey W.J. Swain, Ph.D., *marine corrosion and fouling, hydrographic and benthic surveys.*

John H. Trefry, Ph.D., *marine trace metal geochemistry, interstitial water chemistry, heavy metal pollution, hydrothermal systems.*

John G. Windsor, Ph.D., *pollution trace organic analysis, organic chemistry, sediment-sea interaction, mass spectrometry, hazardous/toxic substances research, environmental education.*

Gary A. Zarillo, Ph.D., *sediment transport technology, coastal and estuarine sedimentation, barrier island and tidal inlet processes.*

Visiting Professor
Michael Hartnett, Ph.D., *numerical modeling of the marine environment.*

Associate Professors
Charles R. Bostater Jr., Ph.D., *environmental modeling, remote sensing, estuarine particle dynamics, water quality instrumentation, environmental planning, environmental geophysical fluid dynamics.*

Lee E. Harris, Ph.D., P.E., *ocean engineering, coastal structures, beach erosion and control, physical oceanography.*

Assistant Professors
Elizabeth A. Irlandi, Ph.D., *landscape ecology in aquatic environments, seagrass ecosystems, coastal zone management.*

Kevin B. Johnson, Ph.D., *water column ecology, planktonic grazing and distributions, intraplanktonic predator prey interactions.*

Eric D. Thosteson, Ph.D., *coastal and near-shore engineering, coastal processes, wave mechanics, sediment transport.*

Professor Emeritus
Dean R. Norris, Ph.D.

Adjunct Professors
W.E. Dally, Ph.D., P.E.; M.I. Duedall, J.D.; R.G. Gilmore Jr., Ph.D.; M.D. Hanisak, Ph.D.; B.E. LaPointe, Ph.D.; D.T. Resio, Ph.D.; N.P. Smith, Ph.D.; R.W. Virnstein, Ph.D.

Lecturer
D.D. Barile, M.S.

The Department of Marine and Environmental Systems integrates the expertise and skills of ocean scientists, engineers and managers. The oceanography faculty includes highly qualified individuals devoted to research involving the study of ocean currents and waves, coastal processes, planktonic and benthonic organisms, marine meteorology, hydroacoustic applications, trace-metal and pollution identification and distribution. How these research efforts impact the deep-sea, coastal and estuarine environment is the subject of numerous publications and technical reports, which have been prepared by both faculty and students.

Much of the instructional work on estuarine and coastal waters is conducted as part of applied research contracts that utilize the program's small motor-powered skiffs and the R/V *Delphinus*, a 60-foot, twin-diesel-powered vessel for estuarine and offshore work. Access to the ocean is through Port Canaveral; the Gulf Stream can be reached in about three hours. This route to the sea also provides convenient access to the Bahamas and the Florida Keys.

Bachelor of Science Degree Program

The program leading to the Bachelor of Science in Oceanography combines classroom and laboratory work at the main campus in Melbourne with the analysis of oceanographic data collected by students using program research vessels and boats.

During the first two years, the student concentrates on building a strong foundation in biology, chemistry, mathematics, physics and the humanities. The student can then choose one of five concentrations: biological, chemical or physical oceanography, coastal zone management, or marine environmental science. Transferring from one concentration to another during the first two years will incur little or no loss of academic credits. In all concentrations, emphasis is placed on a strong scientific background for the student so that he or she is prepared for more advanced studies in graduate school or employment by industry or government. The

program promotes the concept of applied research through a summer Marine Field Project. Both programs are conducted under the direction of faculty members and are designed to help the student use previous academic course work in a relevant manner. The marine studies/oceanography undergraduate curricula are designed to prepare the graduate for a professional scientific career and graduate studies, exploring the scientific implications of human activities in and near the oceans.

Oceanography offers five program concentrations:

Biological Oceanography—Biological oceanography provides training in all areas of oceanography with emphasis on biological aspects. Advanced courses in biology supplement those in oceanography.

Chemical Oceanography—This concentration includes practical training in marine and environmental chemistry. Advanced courses in chemistry supplement those in oceanography.

Coastal Zone Management—Commonly called CZM, this concentration provides training in all areas of oceanography, while providing knowledge of decision-making and management concepts.

Marine Environmental Science—This concentration offers a flexible curriculum that can be tailored to meet specific educational/professional goals within the broad field of marine science.

Physical Oceanography—Physical oceanography is the most quantitative concentration, including advanced courses in mathematics and engineering as well as oceanography.

Students interested in environmental sciences should also see "Environmental Sciences" in this section.

Degree Requirements

All Concentrations

Freshman Year

FALL		CREDITS
ASC	1000 University Experience	1
BUS	1301 Basic Economics*	3
CHM	1101 Chemistry 1	4
COM	1101 Composition and Rhetoric	3
ENS	1001 The Whole Earth Course	3
MTH	1001 Calculus 1	4
		18

SPRING		
BIO	1020 Biological Discovery 2	4
CHM	1102 Chemistry 2	4
COM	1102 Writing about Literature	3
MTH	1002 Calculus 2	4
OCN	1010 Oceanography	3
		18

Sophomore Year

FALL		CREDITS
HUM	2051 Civilization 1	3
OCN	2602 Environmental Geology	3
PHY	1001 Physics 1	4
PHY	2091 Physics Lab 1	1
	Concentration Courses	3–6
		14–17

SPRING		
CSE	15xx Restricted Elective (Computer Science)	3
MTH	2401 Probability and Statistics	3
OCN	2407 Meteorology	3
PHY	2002 Physics 2	4
PHY	2092 Physics Lab 2	1
	Concentration Courses	0–1
		14–15

Junior Year

FALL		CREDITS
COM	2223 Scientific and Technical Communication	3
OCN	3201 Marine and Environmental Chemistry	3
OCN	3211 Marine and Environmental Chemistry Lab	1
OCN	3401 Physical Oceanography	3
OCN	3411 Physical Oceanography Lab	1
	Concentration Courses	4–7
		15–18

SPRING		
OCN	3101 Biological Oceanography	3
OCN	3111 Biological Oceanography Lab	1
OCN	3301 Geological Oceanography	3
OCN	3311 Geological Oceanography Lab	1
OCN	3911 Marine Field Projects: Proposal	1
	Concentration Courses	6–8
		15–17

SUMMER		
OCN	4911 Marine Field Projects 1**	1
OCN	4912 Marine Field Projects 2	2
OCN	4913 Marine Field Projects 3***	3
		6

Senior Year

FALL		CREDITS
HUM	2052 Civilization 2	3
OCN	4704 Remote Sensing for Oceanography	3
	Restricted Electives (OCN or ENS)	3
	Concentration Courses	6–7
		15–16

SPRING		
OCN	4204 Marine and Environmental Pollution	3
	Humanities Elective	3
	Free Elective	3
	Concentration Courses	3–6
		12–15

TOTAL CREDITS REQUIRED 133

**Or Social Science Elective*

***CZM students may take a free elective*

****CZM students may take OCN 4996 (Internship) or a Technical Elective*

Concentration Courses (29 credits)

Biological Oceanography

BIO	1010 Biological Discovery 1	4
BIO	3510 Invertebrate Zoology	4
BIO	4710 Marine Biology	4
CHM	2001 Organic Chemistry 1	3
CHM	2002 Organic Chemistry 2	3
OCN	4106 Mitigation and Restoration of Coastal Systems	3
	Technical Electives	8

Chemical Oceanography

CHM	2001 Organic Chemistry 1	3
CHM	2011 Organic Chemistry 1 Lab	2
CHM	2002 Organic Chemistry 2	3
CHM	2011 Organic Chemistry 2 Lab	2
CHM	3301 Analytical Chemistry 1	3
CHM	3311 Analytical Chemistry 1 Lab	2
OCE	4518 Protection of Marine Materials	3
	Technical Electives	11

Coastal Zone Management

BIO 1501 Introduction to Aquaculture 1
BIO 3550 Applications of Aquaculture Technology 3
BUS 2201 Accounting Principles 1 3
BUS 3501 Management Principles 3
ENS 4010 Geographical Information Systems 3
ENS 4701 Environmental Regulations/Impact Assessment 3
OCN 4106 Mitigation and Restoration of Coastal Systems 3
OCN 4996 Internship (or Technical Elective) 3
Free Elective 1
Restricted Electives (Science, Engineering, Business) 6

Marine Environmental Science

BIO 1010 Biological Discovery 1 4
ENS 4600 Radiation and Environmental Protection 3
ENS 4701 Environmental Regulations/Impact Assessment 3
OCN 4106 Mitigation and Restoration of Coastal Systems 3
Restricted Elective (OCN or ENS) 3
Technical Electives 13

Physical Oceanography

MTH 2001 Calculus 3 4
MTH 2201 Differential Equations & Linear Algebra 4
MTH 3201 Boundary Value Problems 3
OCE 3521 Hydromechanics and Wave Theory 3
OCE 3522 Water Wave Lab 1
OCN 3430 Fundamentals of Geophysical Fluids 3
OCN 3433 Geophysical Fluids Lab 1
OCN 4405 Dynamic Oceanography 3
Technical Electives 7

Master of Science Degree Program

The master of science degree can be earned in one of five options: biological, chemical, geological or physical oceanography, or coastal zone management. The successful student is well prepared for a challenging professional career or for continuing with graduate studies.

Admission Requirements

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Students may be admitted during any semester, but for optimal scheduling, the fall term is recommended. Students with deficiencies in their undergraduate preparation (up to 12 credits) may take deficiencies and courses for graduate credit concurrently. Graduate Record Examination General Test scores and a statement of objectives are required and should be sent to the Office of Graduate Admissions. Although not required for admission, an on-campus interview is highly recommended.

Biological—The applicant should have an undergraduate major in one of the physical or life sciences with a background that includes computer science, mathematics through calculus and at least one year each of college biology, chemistry and physics. The biological background should include invertebrate zoology.

Chemical—The applicant's undergraduate major should be in chemistry, mathematics, physical science or engineering. The academic background should include computer science, mathematics through calculus, and organic, physical and analytical chemistry.

Coastal Zone Management—The applicant should have an undergraduate major in one of the natural or physical sciences or engineering with course work to include computer science, mathematics through calculus, chemistry, physics and biology or geology.

Geological—The applicant should have an undergraduate major in physical or natural science or engineering. The background should include computer science, mathematics through calculus and at least one year each of chemistry and physics. The geological background should include mineralogy, petrology, sedimentation and stratigraphy.

Physical—The applicant should have an undergraduate major in physics, mathematics, physical science or engineering. The background should include computer science, at least one year of chemistry, mathematics through differential equations, statistics, thermodynamics and fluid mechanics.

Degree Requirements

The Master of Science in Oceanography is conferred on students who have successfully completed a minimum of 30 credit hours (including thesis, if required) of required and elective course work.

Curriculum

To earn the master of science degree, the student must complete the following courses or their equivalents. Equivalent course work can be substituted for required courses as recommended by the student's adviser and program chair. Representative electives for each option are available from advisers. At least six credits of thesis or internship is required, and an additional three credits can be granted in place of the three credits of elective, subject to approval by the program chair. Thesis or internship registration must be continuous from the initial registration until graduation.

OCN 5101 Principles of Biological Oceanography 3
OCN 5210 Marine and Environmental Chemistry 3
OCN 5301 Principles of Geological Oceanography 3
OCN 5401 Principles of Physical Oceanography 3
OCN 5990 Oceanography Seminar 0
Elective 3
Option Requirements 15
TOTAL CREDITS REQUIRED 30

Option Courses (15 credits)

Biological

OCN 5709 Numerical Analysis of Biological Data 3
Two of the following three courses:
OCN 5102 Marine Phytoplankton 3
OCN 5103 Marine Zooplankton 3
OCN 5104 Marine Benthos 3
Thesis 6

Chemical

Electives 9
Thesis 6

Coastal Zone Management

OCN 5801 Coastal Systems Planning 3
Internship 6
Electives 6

Geological

OCN 5304 Coastal and Estuarine Processes 3
Electives 6
Thesis 6

Physical

OCN 5403 Ocean Wave Theory 3
OCN 5405 Dynamic Oceanography 3
OCN 5409 Geophysical Fluid Dynamics 3
Thesis 6

Doctor of Philosophy Degree Program

The doctor of philosophy degree is offered to students who want to carry out advanced research in an area of existing faculty expertise. The doctoral degree is granted in recognition of high achievement in a program of study, required examinations and original research in the field of oceanography. Students may be admitted during any semester, but for optimal scheduling, the fall semester is recommended.

Admission Requirements

An applicant who has received a bachelor's or master's degree in mathematics, natural science, engineering or related fields is eligible to apply for admission to the doctoral program. All applicants should have a high scholastic record (minimum of 3.3 GPA based on a 4.0 scale), three letters of recommendation and Graduate Record Examination General Test scores. Included with the application should be a short, clear statement of the applicant's interests and objectives. Although nor required for admission, an on-campus interview is highly recommended.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The doctoral degree is primarily a research degree and is conferred in part in recognition of research accomplishments. Each student must complete an approved program of course work; demonstrate proficiency in a foreign language or a computer language, at the discretion of the doctoral committee; pass the comprehensive examinations; write an acceptable research proposal and petition for admission to candidacy; complete a program of significant original research; prepare and defend a dissertation concerning the research; and present a seminar on the research. Each candidate is expected to publish a major portion of the dissertation in refereed national or international journals. A minimum of 24 credit hours of course work and 24 credit hours of dissertation beyond a master's degree are required.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

A program of study must be approved by the student's adviser and the program chair. A wide degree of latitude is allowed in course selection and research interest within the capability of the university and the student's academic background. A student in one of the five concentrations available (biological, chemical, coastal zone management, geological and physical) must also develop a general knowledge of the various areas of oceanography.

Prior to admission to doctoral candidacy, the student may be required to demonstrate proficiency in a computer language or a reading proficiency of scientific literature in one foreign language. The chosen language should allow access to important literature in the student's area of research. This requirement is imposed at the discretion of the doctoral committee.

After admission to doctoral candidacy, a yearly seminar demonstrating progress must be presented to the graduate faculty.

Research Activities and Facilities

Research activities in the department are diverse and vary with increased knowledge from current research, changes in demands in the research community and new developments in experimental procedures and instrumentation. Separate laboratories exist for biological, chemical, physical, geological and instrumentation investigations.

Biological Oceanography

The major emphasis in this lab is directed toward pelagic and benthonic investigations. Available equipment for student and research needs include fluorometers, collection nets, trawls, grabs, and photographic and microscopic instruments. A controlled environmental room is operated within this laboratory.

Chemical Oceanography

This laboratory is equipped to enable both routine and research-level analyses on open ocean and coastal lagoonal waters. Major and minor nutrients, heavy-medal contaminants and pollutants can be quantitatively determined.

Analytical instruments include scintillation counters, organic carbon analyzers, fluorescence spectrometers, ultraviolet and visible light spectrophotometers, an atomic absorption spectrometer and field measurement equipment. Equipment for investigation of physical chemistry of seawater is also available.

Marine Geology and Geophysics Laboratory

This laboratory contains state of the art equipment for the compositional and textural analysis of sediment and water samples, including a rapid sediment analyzer and computer-assisted sieve stations. High- and low-temperature ovens, PC-based computer workstations and suspended sediment filtration systems are also available. In addition, the lab houses vibracore and sediment grab sampling equipment.

Physical Oceanography

The Physical Oceanography Laboratory supports graduate research in ocean waves, coastal processes, circulation and pollutant transport. In addition, current meters, tide and wind recorders, salinometers, wave height gauges, a side-scan sonar, CTD system and other oceanographic instruments are available.

Ocean Engineering

Ocean Engineering facilities support both traditional design activities and computer-aided design. The Engineering Test Laboratory has facilities for structural and pressure testing and a small wave tank.

Evinrude Marine Operations Center and Research Vessels

The Ralph S. Evinrude Marine Operations Center facility houses small outboard-powered craft and medium-sized workboats. These vessels are available to students and faculty for teaching and research use in the freshwater tributaries and the lagoon. The 60-ft. R/V *Delphinus* is berthed at Port Canaveral. With her own captain and a well-developed research program, she is the focal point of research in the Indian River Lagoon and coastal areas, as well as teaching in oceanography.

Vero Beach Marine Laboratory

An oceanfront marine research facility, owned and operated by Florida Tech, is located at Vero Beach, just 40 minutes from campus. Laboratory and office space total approximately 4,500 square feet. Flowing seawater allows research in such areas as aquaculture, biofouling and corrosion.

Harbor Branch Oceanographic Institution

The department maintains a close working relationship with Harbor Branch Oceanographic Institution (HBOI), located about an hour from campus between Vero Beach and Fort Pierce. Scientists and engineers from HBOI interact with Florida Tech's students and faculty and make their facilities and expertise available in directing student research.

Indian River Marine Science Platform

A platform has been established in the Indian River Lagoon for instrumentation and research.

Midwest Research Institute, Palm Bay Laboratories

Florida Tech cooperates with MRI, Florida, in the use of state-of-the-art analytical instrumentation. Current areas of research at this center (eight miles south of Florida Tech's main campus) include inductively coupled argon plasma mass spectrometry (ICP/MS) and scanning electron microscopy (SEM).

Surf Mechanics Laboratory

A 200-foot glass wave channel, one of the largest built to date, supports teaching and research in wave mechanics, marine hydrodynamics and coastal processes.

Software Engineering

DEPARTMENT OF COMPUTER SCIENCES
W.D. Shoaff, Ph.D., Head

Bachelor of Science *Master of Science*

Professors
Cem Kaner, Ph.D., *software testing, computer law.*

J. Richard Newman, Ph.D., *computer graphics, information resource management, multimedia distant learning, computer law and ethics.*

James A. Whittaker, Ph.D., *statistical testing of software, information assurance.*

Associate Professors
Phil J. Bernhard, Ph.D., *database systems, software engineering.*

Walter P. Bond, Ph.D., *operating systems, systems performance analysis, software engineering processes.*

William D. Shoaff, Ph.D., *computer graphics, analysis of algorithms, mathematical software.*

Assistant Professor
Mike Andrews, Ph.D., *debugging tools.*

Adjunct Professors
A.A. Jorgensen, Ph.D.; V.J. Kovarik, Ph.D.

Lecturer
L. Bearden, M.S.

Student Coordinator
Rosalyn Bursey

The mission of Florida Tech's computer sciences department is to pursue knowledge, truth and excellence in computer science, information systems and software engineering by nurturing student-centered academic programs characterized by shared values, unity of purpose, diversity of opinion, mutual respect and social responsibility. We are committed to expanding our range of disciplines through a well-funded and renowned research program, and to the continual improvement of the quality of our degree programs.

Bachelor of Science Degree Program

The objectives of the software engineering bachelor of science program is to graduate students who have a strong technical background in computer science and software engineering; who are good communicators and team members; who are able to develop and use a variety of systems and software applications; and who have positive attitudes toward the computing profession and a desire for lifelong learning.

The software engineering program prepares students for careers as practicing professionals in software design and implementation, and for graduate study. The engineering of software is multi-disciplinary, spanning computer science, engineering economics, engineering problem solving, epistemology, human factors management, mathematics, quality control and safety.

Because the subject matter of programming, algorithms and data structures forms a critically important foundation for all advanced computer science and software engineering courses, the minimum grade for satisfying the prerequisite requirements for these advanced courses is a grade of C for each of the following courses: CSE 1001, CSE 1002 and CSE 2010.

Candidates for a Bachelor of Science in Software Engineering must complete the minimum course requirements outlined in the following curriculum.

Freshman Year

FALL	CREDITS
COM 1101 Composition and Rhetoric	3
CSE 1001 Fundamentals of Software Development 1	4
CSE 1101 Computing Disciplines and Careers 1	1
CSE 1400 Applied Discrete Mathematics	3
MTH 1001 Calculus 1	4
	15

SPRING	
COM 1102 Writing about Literature	3
CSE 1002 Fundamentals of Software Development 2	4
HUM 2510 Logic	3
MTH 1002 Calculus 2	4
PSY 1411 Introduction to Psychology	3
	17

Sophomore Year

FALL	CREDITS
COM 2223 Scientific and Technical Communication	3
CSE 2010 Algorithms and Data Structures	4
CSE 3411 Software Testing 1	3
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
	15

SPRING

CSE	2050	Programming in a Second Language 3
CSE	2400	Applied Statistics 3
CSE	2410	Introduction to Software Engineering 3
PHY	2002	Physics 2 4
PHY	2092	Physics Lab 2 1
		Restricted Elective (Science) 3
		17

Junior Year

FALL **CREDITS**

COM	2012	Research Sources and Systems 1
CSE	3101	Machine and Assembly Language 3
CSE	4415	Software Testing 2 3
CSE	4621	Software Metrics and Modeling 3
HUM	2051	Civilization 1 3
		Restricted Elective (Science) 3
		16

SPRING

AHF	3101	Introduction to Human Factors 3
CSE	3030	Legal, Ethical and Social Issues in Computing 3
CSE	3421	Software Design Methods 3
CSE	4610	Requirements Engineering 3
HUM	2152	Civilization 2 3
		Free Elective 3
		18

Senior Year

FALL **CREDITS**

CSE	4001	Operating Systems Concepts 3
CSE	4201	Software Development Projects 1 3
		Restricted Elective (Computer Science) 3
		Social Science Elective 3
		Free Elective 3
		15

SPRING

CSE	4083	Formal Languages and Automata Theory 3
CSE	4202	Software Development Projects 2 3
		Restricted Elective (Computer Science) 3
		Humanities Elective 3
		Free Elective 3
		15

TOTAL CREDITS REQUIRED 128

Master of Science Degree Program

The master of science program in software engineering primarily serves working software engineers who want to broaden their perspectives while deepening their skills in software development. The program also accepts students who are already competent programmers and who want to prepare for careers in software engineering. Courses in this program are taught at a level that assumes that all students have technical undergraduate degrees and significant programming experience.

Admission Requirements

A bachelor's degree in computer science or a related discipline is required. Specific skills include mastery of at least one programming language and the content of Algorithms and Data Structures (CSE 2010) and Discrete Mathematics (MTH 2051), as well as at least two computer science courses at the level of Florida Tech's CSE 3xxx and 4xxx courses. Graduate Record Examination scores (General Test only) are also required.

Degree Requirements

The Master of Science in Software Engineering is offered with both thesis and nonthesis degree paths. Each requires a minimum of 32 credit hours of approved graduate study. Prior to the completion of nine credit hours, the student must submit for approval a program plan to indicate the option chosen and the specific courses to be taken. Up to six credit hours of thesis work may be included in the 32-credit-hour requirement. The nonthesis path requires successful completion of a comprehensive examination.

Curriculum

The master's degree program requires 32 credits, consisting of four required courses, four electives, two credits of seminar and/or internship, and either a thesis or two additional electives, as follows:

Required Courses

CSE	5500	Computer Science Seminar 2*
		or
CSE	5501	Computer Sciences Internship 2*
SWE	5001	Software Engineering 1 3
SWE	5002	Software Engineering 2 3
SWE	5411	Software Testing 1 3
SWE	5621	Software Metrics and Modeling 3

**One credit each in CSE 5500, CSE 5501 or two credits in either course. The internship is completed with an information technology firm or industrial organization and is provided for students with no prior experience in a practical information technology setting.*

Elective Courses

At least one elective must be selected from each of the areas of programming and foundations. Lists of courses satisfying each of these requirements are available on request. At least one other elective must be a non-required software engineering (SWE) graduate course. Typical courses satisfying the programming requirement are Network Programming (CSE 5232), Programming Languages (CSE 5250) and Computer Graphics (CSE 5280). Typical courses satisfying the foundations requirement are Formal Languages and Automata Theory (CSE 5210), Operating Systems (CSE 5230) and Database Systems (CSE 5260).

Research Activities

Software engineering faculty and students are currently conducting research in the following general areas:

- Computer-aided software engineering
- Formal methods
- Information assurance and computer security
- Software architecture and design
- Software process improvement
- Software reliability engineering
- Software testing methodologies

Systems Engineering

DEPARTMENT OF ENGINEERING SYSTEMS
M.A. Shaikh, Ph.D., Head

Master of Science

Professors
Fredric M. Ham, Ph.D., Harris Professor, *linear and nonlinear control systems, optimal control systems, optimal estimation, digital signal processing, system modeling, bio-medical engineering, neural networks.*

Cem Kaner, Ph.D., *software engineering, software testing.*

Samuel P. Kozaitis, Ph.D., *optical pattern recognition, optical signal processing.*

Muzaffar A. Shaikh, Ph.D., *management science, decision modeling, mathematical programming, management information systems, systems engineering, operations research.*

Wade H. Shaw, Ph.D., P.E., *management of technology, simulation, artificial intelligence, modeling, project engineering, information systems, quality.*

Associate Professors
William W. Arrasmith, Ph.D., *systems engineering, signal processing.*

Walter P. Bond Jr., Ph.D., *software architecture engineering processes.*

John E. Deaton, Ph.D., *aviation human factors, applied aviation psychology.*

M. Mehdi Shahsavari, Ph.D., *computer networks, secured distributed application.*

Master of Science Degree Program

The master of science program in systems engineering meets the systems engineering and system integration needs of a student who has an undergraduate degree in engineering, physical science, computing or mathematics. It draws on expertise and experience in these multidisciplinary areas, preparing the engineering or science graduate in such key advanced subjects as modeling and analysis, systems engineering principles, computer networks, digital communications, software testing, decision and risk analysis, human–machine interface and operations research.

Today, an engineer or scientist who joins the workforce in the public or private sector, especially in the high-tech realm, is faced with the challenge of integrating design and development work with the work of other inter-company or intra-company groups. Courses taught in the systems engineering curriculum prepare the engineer to meet this system design and integration challenge with emphasis on technical as well as cost and schedule requirements.

A key aspect of the program, and an alternative to completing a thesis, is the team-oriented capstone design project in which the team formulates and solves an industry problem and submits a project team paper. All nonthesis students are required to take this course in the graduating semester.

Admission Requirements

An applicant for admission must have earned a bachelor's degree in engineering, physical science, computing, or mathematics. Applicants should take the Graduate Record Examination (GRE) General Test, and are encouraged to submit letters of recommendation and a statement of educational objectives reflecting the applicant's professional experience and career goals. In the case of an international application, particular consideration is given to the academic standards of the school attended and the content of the courses.

General admission requirements and the process of applying are discussed in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

A minimum of 30 credit hours is required for graduation, including all courses on the following list of required courses and at least four courses from the list of elective courses. Thesis students must also earn six credits of thesis (SYS 5999), and nonthesis students must take SYS 5380 and one additional course from the electives list. Thesis topics may be selected from the fields of computer science, electrical engineering or systems engineering.

Required Courses (12 credit hours)

SYS	5310	Systems Engineering Principles	3
SYS	5350	System Modeling and Analysis	3
SYS	5365	Decisions and Risk Analysis	3
SYS	5370	Research Methods in Systems Engineering	3

Elective Courses (18 credit hours from the following)

AHF	5101	Human Factors in Man Machine Systems	3
ECE	5223	Digital Communications	3
ECE	5272	Special Topics in C3I	3
ECE	5534	Computer Networks 1	3
ECE	5535	Computer Networks 2	3
ECE	5595	Special Projects in Computer Engineering	3
SWE	5411	Software Testing 1	3
SWE	5440	Introduction to Software Architecture	3
SYS	5375	Military Operations Research	3
SYS	5380	Systems Engineering Design Project	3
SYS	5385	System Life Cycle Cost Estimation	3

College of Science and Liberal Arts

Dean Gordon L. Nelson, Ph.D.

Bachelor of Science

Applied Mathematics
Biochemistry
Biological Sciences
- *Aquaculture*
- *Ecology*
- *General Biology*
- *Marine Biology*
- *Molecular Biology*
- *Preprofessional Biology*

Chemistry
- *Chemical Management*
- *General Chemistry*
- *Premedical Chemistry*
- *Research Chemistry*

Communication
Interdisciplinary Science
Mathematics Education
Physics
- *Physics*
- *Preprofessional Physics*

Science Education
- *Biology*
- *Chemistry*
- *Computer Science*
- *Earth/Space Science*
- *General Science*
- *Physics*

Space Sciences
- *Astronomy/Astrophysics*
- *Space Sciences*

Bachelor of Arts

Humanities

Master of Science

Applied Mathematics
Biological Sciences
- *Biotechnology*
- *Cell and Molecular Biology*
- *Ecology*
- *Marine Biology*

Chemistry
Computer Education
Environmental Education
Mathematics Education
Operations Research
Physics
Science Education
Space Sciences
Technical and Professional Communication

Master of Arts in Teaching

Educational Specialist

Mathematics Education
Science Education

Doctor of Education

Mathematics Education
Science Education

Doctor of Philosophy

Applied Mathematics
Biological Sciences
Chemistry
Mathematics Education
Operations Research
Physics
Science Education
Space Sciences

Associate Dean, Academics
Randall L. Alford, Ph.D.

Associate Dean, Research
Terry Oswalt, Ph.D.

Organization

The College of Science and Liberal Arts consists of six degree-granting departments: biological sciences, chemistry, humanities and communication, mathematical sciences, physics and space sciences, and science and mathematics education. Degrees in the communication field include undergraduate areas of specialization in both business and professional communication, and scientific and technical communication, as well as a master's degree in technical and professional communication. An interdisciplinary science program administered by the physics and space sciences department allows students to enroll in a wide variety of science and engineering courses, supplemented by certain core courses and several carefully chosen humanities electives. An undergraduate program in biochemistry is administered jointly by the biological sciences and chemistry departments. In addition, a graduate-only program in computer education is offered by the science education department, in cooperation with the computer science program in the College of Engineering; and a graduate-only program in operations research is offered by the mathematical sciences department.

Courses in foreign languages and linguistics are offered through the Department of Humanities and Communication's Division of Languages and Linguistics, as well as an intensive English as a Second Language program for students whose first language is not English.

Admission

As a Freshman

All entering students are strongly advised to complete at least one year each of chemistry and physics, two years of algebra, one year of geometry and one-half year each of trigonometry and analytic geometry before enrolling. In addition, at least one year of high school biology is needed for students planning to major in biological sciences, chemistry or science education. Familiarity with computers and computer programming is advisable for students in all fields.

Admission decisions are based primarily on grades received in the courses listed above and in English, high school rank in class, grade point average and SAT or ACT scores.

Tests administered to entering freshmen during the week preceding the start of classes each fall semester are designed to identify deficiencies in mathematics and chemistry. Special courses are available for students needing to review these subjects or fill in areas missed in high school before going on to the courses specified in their programs. Tests are also available that allow advanced placement in chemistry, computer science and mathematics. Students who did not take high school physics are allowed to take PHY 1001 but should be prepared to do extra work to keep up with the course material. Students with no prior courses in biology are not permitted to take BIO 1010.

Written and spoken communication is extremely important in all fields of science and liberal arts. Problems with reading comprehension or speed place a student at a disadvantage in successfully completing reading assignments and taking tests. Inability to clearly state complex ideas and technical results in correct written English can result in problems in laboratory courses and other courses where written reports are required. Every effort should be made to correct any weaknesses in these areas either before arrival at the university or during the freshman year.

As a Transfer Student

Admission decisions for transfer students are made on the basis of a combination of the criteria used for new freshmen, postsecondary grade point averages and specific course grades that are applicable to the major. Where courses equivalent to at least the first year of the Florida Tech major have been completed, the level of accomplishment in these courses is normally the dominant factor.

Students choosing to attend a community college for two years before transferring to the College of Science and Liberal Arts should be guided by articulation agreements where they exist. The detailed curriculum plan for the desired program should be consulted for more specific guidance. If possible, prospective students should review their community college curriculum periodically with an appropriate university faculty member. Some of the courses normally taken in the first two years of the program of interest may be unavailable at some community colleges. As a result, it may take one or more semesters in addition to the normal two years following community college graduation to complete the desired bachelor's degree program.

Most mathematics, physics, applied mechanics, computer programming and English courses at the first- and second-year levels are offered every semester. Every effort is made to make space for new transfer students in closed sections, if necessary. Transfer students can usually be registered for a full schedule of courses that are tailored to their immediate academic needs. Exceptions, when they occur, are usually the result of the student having completed all course work in some disciplines, such as mathematics and the humanities, without having started course work in other essential areas, such as physics or chemistry.

Courses taken at other fully accredited colleges and universities in the United States or at recognized universities abroad are carefully and thoroughly reviewed for possible award of transfer credit. Except for a student transferring from a Florida community college or other college with which the university has an articulation agreement, the student must provide college catalogs containing descriptions of all courses taken. Course outlines or syllabi are also helpful in assuring that all earned transfer credit is received. In the case of courses taken at a foreign university, detailed course outlines are required for transfer credit. If there is doubt about the equivalency of a course taken elsewhere, the student is required to pass an equivalency examination to receive Florida Tech credit for the course. In any case where transfer credit is not awarded for a course passed at another college or university, the student can request an equivalency examination, if one is available.

Selection of a Major

A student typically selects a major at the time the application for admission is submitted. A faculty adviser affiliated with the major program is assigned before the start of classes. A student who prefers to postpone the selection of a major may initially enroll in a first-year nondegree program, as described below. Selection of a degree program must occur by the start of the sophomore year.

As long as the requirements for continued enrollment (See the *Undergraduate Information and Regulations* section.) are met, a student is permitted to remain in the selected major. A change of major can be initiated by the student but is subject to the approval of the new academic unit. It is generally possible to change majors between two closely related degree programs in the sophomore year or even during the early part of the junior year without greatly increasing the time needed to complete all degree requirements.

A student who wishes to postpone the selection of a major can enroll for up to two semesters under either a "General Science" (see below) or "General Studies" (See the *Nondegree Programs* section.) curriculum. These curricula are designed to be somewhat less intense than the normal freshman curriculum to allow students more time for acclimation to college life.

Course Loads

The normal course load taken by students in the College of Science and Liberal Arts is 16 or 17 credit hours. Students can enroll for lighter loads and are strongly encouraged to do so if difficulty is experienced in keeping up with all

course work when a full load is attempted, even though the duration of the program would, of necessity, be extended from eight to nine or more semesters. A student registered for 12 or more credit hours is considered full time. Students with cumulative grade point averages below 2.0 are not allowed to register for more than 15 credit hours in a semester.

Cooperative Education

Students in some curricula in the College of Science and Liberal Arts are encouraged to participate in the cooperative education program, although the availability of co-op employment opportunities varies considerably from field to field. By alternating periods of work experience in their chosen fields with academic semesters spent on campus as full-time students, participants in this program are able to earn funds needed to further their education while gaining valuable practical experience and a knowledge base that is useful in better defining career goals. The length of time needed to earn the degree is extended by an amount comparable to the number of semesters spent away from the campus. Students in this program should pay special attention to scheduling their courses well in advance to avoid conflicts between off-campus periods and the semesters when required courses are offered.

General Science

ASSOCIATE DEAN, ACADEMICS
R. L. Alford, Ph.D.

A student who wishes to postpone the selection of a major may enroll for up to one year as a general science student, following the curriculum described below. This curriculum is designed to allow students more time to become familiar with programs in the life sciences and physical sciences offered by the College of Science and Liberal Arts. Students may need to make up some credits later on—eight or fewer in most cases, if they follow the general science curriculum and make the appropriate choice between biology and physics. Students are urged to transfer to degree programs as early as possible.

FALL	CREDITS
BIO 1010 Biological Discovery 1	4
CHM 1101 General Chemistry 1	4
COM 1101 Composition and Rhetoric	3
MTH 1001 Calculus 1	4
	15

SPRING	
BIO 1020 Biological Discovery 2	4
or	
PHY 1001 Physics 1	4
CHM 1102 General Chemistry 2	4
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
	15

Students in this program are advised by the chemistry department head until a degree program is selected. Once 30 credit hours (not including remedial courses) have been successfully completed, continued registration is contingent on selection of a degree program. Acceptance into the desired degree program is automatic unless the student has been academically dismissed.

Applied Mathematics

DEPARTMENT OF MATHEMATICAL SCIENCES
V. Lakshmikantham, Ph.D., Head

Bachelor of Science *Master of Science* *Doctor of Philosophy*

Associate Head
Michael D. Shaw, Ph.D.

Professors
Ravi P. Agarwal, Ph.D., *numerical analysis, differential and difference equations, differential inequalities, fixed point theorems.*

Jewgeni H. Dshalalow, Dr. Sci., *real analysis, stochastic processes, queuing theory, operations research.*

Charles T. Fulton, Ph.D., *ordinary and partial differential equations, spectral theory of differential operators, numerical linear algebra, numerical methods for two-point boundary value problems, parallel processing.*

V. Lakshmikantham, Ph.D., *nonlinear analysis, differential and integral equations, numerical mathematics, evolution operations, nonlinear game theory.*

Syamal K. Sen, Ph.D., *computer-based numerical algorithms, error-free finite field computations, linear programming.*

Associate Professors
Ugur G. Abdulla, Ph.D., *unbounded solutions of the nonlinear heat-conduction equation with a sink, nonlinear filtration equation and nonlinear diffusion in irregular domains.*

Dennis E. Jackson, Ph.D., *partial differential equations, scattering theory.*

Tariel I. Kiguradze, Ph.D., *quasilinear partial differential equations and nonlinear hypobolic equations.*

Cecilia A. Knoll, Ph.D., *calculus mastery, differential equations, integrating technology into the curriculum.*

Semen Köksal, Ph.D., *stability analysis by Lyapunov's direct method, theory of nonlinear ordinary differential equations.*

Kanishka Perera, Ph.D., *variational and topological methods for nonlinear partial differential equations, infinite dimensional Morse theory.*

Michael D. Shaw, Ph.D., *nonlinear differential equations, Lyapunov stability theory, variation of parameters methods, initial time difference.*

Assistant Professors
Bradford D. Allen, Ed.D., *computer simulation, data analysis and reliability, statistical research methodology, testing and evaluation, modeling, mathematics education.*

Jay J. Kovats, Ph.D., *elliptic and parabolic partial differential equations.*

Instructor
G.W. Girton, M.S.

Professors Emeriti
George E. Abdo, Ph.D.; Frank C. DeSua, Ph.D.

Bachelor of Science Degree Program

During the first two years, mathematics majors share many courses with other students. The mathematics curriculum includes courses with extensive theoretical content, as well as applied courses from related departments. Students can choose electives that will enable them to apply mathematics

to engineering, the physical sciences, biological sciences, environmental studies, social sciences and business applications. Mathematics graduates who have successfully completed the program are prepared to pursue graduate work or take their place in industry along with engineers and scientists.

Degree Requirements

Required Courses

Mathematics

MTH 1001 Calculus 1	4
MTH 1002 Calculus 2	4
MTH 2001 Calculus 3	4
MTH 2051 Discrete Mathematics	3
MTH 2201 Differential Equations/Linear Algebra	4
MTH 2401 Probability and Statistics	3
MTH 3102 Introduction to Linear Algebra	3
MTH 4101 Introductory Analysis	3
MTH 4201 Models in Applied Mathematics	3
MTH 4311 Numerical Analysis	3
	34

Computer Science

CSE 1502 Introduction to Software Development with C++	3
CSE 1503 Introduction to Software Development with FORTRAN	3
CSE 2502 Advanced Software Development with C++	3
	9

Communication and Humanities Core

COM 1101 Composition and Rhetoric	3
COM 1102 Writing about Literature	3
COM 2223 Scientific and Technical Communication	3
HUM 2051 Civilization 1	3
HUM 2052 Civilization 2	3
	15

Science

CHM 1101 General Chemistry 1	4
CHM 1102 General Chemistry 2	4
PHY 1001 Physics 1	4
PHY 2002 Physics 2	4
PHY 2091 Physics Lab 1	1
PHY 2092 Physics Lab 2	1
	18

Electives

Mathematics	12
Humanities	3
Social Science	3
Liberal Arts	3
Applied Area	9
Technical Electives	9
Free Electives	6
	45

TOTAL CREDITS REQUIRED 121

Note: Upper-division mathematics courses may be offered in alternate years. Positioning of electives is unrestricted.

Elective Restrictions

Choices of electives are subject to approval by the student's adviser. Mathematics electives must include at least one proof-based course in addition to the required courses in discrete mathematics and analysis. Examples of suitable courses include Abstract Algebra (MTH 4015), Topology (MTH 4105) and Advanced Geometry (MTH 4801).

Applied area electives must be taken from a single area of application. Typically, this means from a single department or program other than mathematics. Any science or engineering program can be chosen. Suitably chosen management courses (courses with mathematics prerequisites) can also be taken.

At least 30 elective credits must be at the 3000+ level.

Master of Science Degree Program

The master's degree program in mathematics is designed to produce mathematicians with competence in analysis who have breadth and versatility in mathematics and its applications in related fields. To this end, students entering the master's program in mathematics are required to select an applied field in which they wish to develop some expertise and to complete six credits toward the degree from approved courses outside the mathematics curriculum. In addition, the master's program is organized so that students will have the freedom to select some of their mathematics electives to develop their own special interests and to complement their choice of applied field. The flexibility in the elective part of the curriculum allows some students the opportunity to achieve a breadth of experience in mathematics and its uses in physical and engineering sciences, computer science or operations research. At the same time, it will allow other students to achieve more knowledge in a particular area in which they may wish to develop expertise. In either case, the program is organized to help students obtain an appropriate background for industrial employment or to pursue further graduate studies toward the doctoral degree. In either case, students will benefit from the range of options that are available in the mathematics master's program.

Students are encouraged to consider which combinations of elective mathematics courses are appropriate for their choice of applied specialization and to discuss the program with their advisers as soon as graduate study begins.

Admission Requirements

Applicants should have the equivalent of an undergraduate major in mathematics and must have completed undergraduate courses in differential equations and statistics, and have proficiency in FORTRAN or C. (Programming languages are noncredit courses for graduate mathematics students.) Applications from graduates with undergraduate majors in the physical sciences or graduate students seeking a second master's degree are welcome. In such cases, however, it may be necessary for applicants to take courses in addition to the 36-credit degree requirement in those subjects where their backgrounds are deficient.

Degree Requirements

The master of science degree in mathematics requires a minimum of 36 credit hours of work beyond the bachelor's degree. For the thesis option, six hours of thesis are required. The thesis should demonstrate the candidate's abilities in the areas of reading and understanding mathematical literature, independent learning and written expression. Theses that combine mathematics with its applications in a related field are encouraged. A nonthesis option candidate must successfully complete an oral comprehensive examination.

Curriculum

Core Areas (18 credit hours)

Linear Algebra	3
Real Analysis	3
Complex Analysis	3
Numerical and Computational Mathematics	3
Probability and Statistics	3
Differential Equations	3

Elective Courses (12 credit hours)
Courses in mathematics or in other scientific or engineering courses with a high degree of mathematical content. Six credit hours of electives can be devoted to writing a thesis. The selection of elective courses must have the faculty adviser's approval.

Applied Field (6 credit hours)
This requirement consists of courses outside the mathematics program. The applied field courses must be at the 5000-level or above. The selection of applied field courses must have the faculty adviser's approval. Normally, only those subjects involving an appropriate degree of mathematical content are approved as applied field courses in a mathematics program.

Master's Thesis (6 credit hours)
The thesis is expected to be completed in two terms. The master's thesis in mathematics is expected to be a thorough investigation of a well-defined problem.

Doctor of Philosophy Degree Program

The doctoral program in mathematics is designed to produce a mathematician with a broad background in analysis and a strong field of specialization in nonlinear analysis, applied analysis, or numerical analysis and scientific computing. This combination of training will prepare the student for a career in a variety of areas, such as government or industrial research, or academic research and teaching. Doctoral graduates have the necessary experience in areas of application to be able to work successfully with other members of multidisciplinary research teams. Graduates also have the critical ability to think independently and analytically. They are able to make significant contributions to knowledge in their chosen fields of inquiry.

A preliminary program of study should be prepared by the student and adviser during the first semester of graduate studies. The final doctoral program of study must be approved by the student's advisory committee and program chair.

Admission Requirements

Applicants for the doctoral program in mathematics usually have a bachelor's or master's degree in mathematics. However, applications are also invited from graduates in physical and engineering sciences. In these cases, necessary undergraduate courses have to be taken to remove deficiencies before the student enters the doctoral program. In evaluating international applicants, due consideration is given to academic standards in the country in which the graduate studies were performed. Graduate teaching assistants carry on a variety of teaching assignments and in view of this, evidence of good English-speaking skills is an important criterion in processing the applications. For admission, a student should have a superior academic record and letters of recommendation. Preference will be given to applicants who have good scores on the Graduate Record Examination.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The degree of doctor of philosophy (Ph.D.) is conferred primarily in recognition of the breadth of scientific accomplishment and of the power to investigate scientific problems independently, rather than for the completion of a definite course of studies. Although demanding a strong mathematical orientation, the doctoral program in mathematics does not fall within the traditional boundaries of a single academic unit and the scope is quite broad. Consequently, every course in a student's program of study is evaluated not only as to content, but also as to the way in which it complements other courses and furnishes breadth and depth to the program. The work should consist of advanced studies and scientific research that lead to a significant contribution and knowledge of a particular area.

Each student must pass a preliminary examination covering the core courses, complete an approved program of studies, pass the comprehensive examination (usually oral), complete a program of significant original research work and defend a dissertation concerning the research work completed.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

After a bachelor's degree in mathematical sciences, a minimum of 81 credit hours is required for the doctoral program, including the courses listed below:

Core Areas (30 credit hours)

Linear Algebra	3
Real and Complex Variables	9
Numerical and Computational Mathematics	6
Probability and Statistics	6
Differential Equations	6

Areas of Specialization (21–27 credit hours)
Nonlinear Analysis
Stochastic Analysis
Optimization
Numerical Analysis and Scientific Computing
Statistics

Considerable flexibility is allowed in the selection of courses in core areas and areas of specialization. Selected course offerings from the mathematics department and other areas of science and engineering may be taken to fulfill the requirements.

Doctoral Dissertation

The dissertation consists of 24–30 credit hours of work and is expected to be completed within two years. The doctoral dissertation is expected to represent original research in mathematics. It may present new theoretical developments or new areas of application or both. The dissertation should contain results that constitute a significant contribution to the literature of the field of investigation. These results should be worthy of publication in an established technical journal.

Research Activities

Active areas of research in the mathematics program include methods of nonlinear analysis, qualitative and quantitative properties of nonlinear evolution equations (including differential equations with delay), integro-differential equations

and stochastic differential equations, spectral theory of operators, reaction-diffusion equations, approximation theory, applied statistics, sequential analysis, mathematical programming, combinatorial optimization, operations research, queuing theory, stochastic processes, mathematical modeling, neural networks, numerical and computational mathematics with emphasis on numerical methods for ordinary and partial differential equations, numerical algorithms and parallel processing.

Biochemistry

BIOLOGICAL SCIENCES AND CHEMISTRY DEPARTMENTS

Bachelor of Science

Co-Chairs

Michael W. Babich, Ph.D., Head, Department of Chemistry

Gary N. Wells, Ph.D., Head, Department of Biological Sciences

Professors

Michael W. Babich, Ph.D., *solid-state chemistry, including X-ray crystallographic structure determination, mechanisms of reactions in solids, kinetic investigations of coordination complexes, thermal analysis.*

Alan C. Leonard, Ph.D., *molecular biology, microbial growth control, DNA replication, superhelicity and methylation as regulators of DNA bioreactivity, DNA-protein interactions.*

Joshua Rokach, Ph.D., *leukotrienes, lipoxins, synthetic organic chemistry, synthetic pharmaceuticals.*

Mary L. Sohn, Ph.D., *nature of sedimentary humic acids in aquatic sediments, evaluation of humic acid-metal and humic acid-organometallic formation constants.*

Gary N. Wells, Ph.D., *protein biochemistry, molecular biology of development.*

Associate Professors

J. Clayton Baum, Ph.D., *molecular spectroscopy, including photophysical and photochemical problems, and energy transfer and relaxation processes; molecular orbital calculations.*

Alan B. Brown, Ph.D., *physical organic chemistry, stereochemistry, bio-organic chemistry.*

Michael S. Grace, Ph.D., *molecular control of photoreceptors in the retina and nonretinal photoreceptors of the brain, pineal and parietal organ.*

Julia E. Grimwade, Ph.D., *DNA replication, DNA-protein interaction, bacterial cell cycle control, antibiotic discovery.*

Charles D. Polson, Ph.D., *application and development of biotechnology in undergraduate education, nucleic acid analysis, electrophoretic separation.*

Russell C. Weigel, Ph.D., *plant physiology, plant tissue culture.*

Assistant Professors

David J. Carroll, Ph.D., *molecular basis of signal transduction at fertilization.*

Mark J. Novak, Ph.D., *biocatalysis, enzyme assisted synthesis, metabolic studies of chemical and biological warfare agents.*

Biochemists, in studying all kinds of living organisms including viruses, bacteria, fungi, plants and animals (including humans), have found that many of the fundamental biochemical properties of living systems are shared throughout the hierarchy of life forms. Because biochemists try to unravel the complex chemical reactions that occur in such a wide variety of life forms, biochemistry provides the basis for practical advances in medicine, veterinary medicine, agriculture and biotechnology. Biochemistry underlies and includes such exciting fields as molecular biology and bioengineering. As the broadest of the basic sciences, biochemistry includes many subspecialties, such as inorganic biochemistry, bio-organic chemistry, physical biochemistry, biochemical and molecular genetics, biomedical pharmacology and immunochemistry. Recent advances in many areas of biochemistry have created links among technology, chemical engineering and biochemistry. More than ever, this is the age of biochemistry because the techniques of so many different disciplines can now be applied in studying the chemistry of living systems.

Career opportunities for biochemists are rapidly expanding in the areas of agricultural research, biotechnology firms, governmental laboratories, industrial research and development and research institutes, as well as university research and teaching. Far-reaching advances in many areas of basic and applied research are projected over the next few years. These areas include plant genetics; the biochemistry of cell receptors for hormones and neurotransmitters; the diagnosis and treatment of disease, particularly inherited diseases; and toxicology. All require an understanding of biochemistry and the use of biochemical techniques.

Organization

The course of study leading to a Bachelor of Science in Biochemistry is an interdisciplinary program jointly administered by the Department of Biological Sciences and the Department of Chemistry. The curriculum has flexibility in that technical electives can be selected to provide a strong emphasis in either biology or chemistry, and prepare the biochemistry major for a variety of careers. All students take a core curriculum of basic science and mathematics during the first two years. During the junior and senior years, students take many specialized courses that reflect their choice of emphasis between biology and chemistry.

Students entering the biochemistry program as freshmen will normally be assigned faculty advisers in the department of chemistry. A student selecting an upper-division curriculum with a biological emphasis should indicate this intention by the beginning of the second semester of the sophomore year, at which time a new faculty adviser in the department of biological sciences will be assigned. A student's request for a change of advisers from chemistry to biology, or vice versa, will be honored at any time during the program.

Admission Requirements

Students intending to apply for admission to study for a Bachelor of Science in Biochemistry should complete at least one year each of high school biology, chemistry and physics. Prospective students should also have at least three years of high school mathematics, including second-year algebra and trigonometry.

Florida Institute of Technology has articulation agreements with many of the community colleges in Florida. Students contemplating transfer to Florida Tech should consult with their counselors to determine transferability of community college credits. If there is a question regarding specific courses needed, either of the biochemistry program chairs listed above should be contacted.

Degree Requirements

Candidates for a Bachelor of Science in Biochemistry must complete the minimum course requirements as outlined in the following curriculum. Electives are selected in consultation with the faculty adviser to reflect the knowledge a student needs either for employment or graduate school. Deviation from the stipulated program may occur only under unusual circumstances and requires approval of the chair. The bachelor's degree in biochemistry requires 128 credit hours for graduation.

Freshman Year

FALL	CREDITS
BIO 1010 Biological Discovery 1	4
CHM 1101 General Chemistry 1	4
COM 1101 Composition and Rhetoric	3
MTH 1001 Calculus 1	4
	15
SPRING	
BIO 1020 Biological Discovery 2	4
CHM 1102 General Chemistry 2	4
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
	15

Sophomore Year

FALL	CREDITS
BIO 2110 General Genetics	4
CHM 2001 Organic Chemistry 1	3
CHM 2011 Organic Chemistry Laboratory 1	2
MTH 2001 Calculus 3	4
PHY 1001 Physics l	4
PHY 2091 Physics Laboratory 1	1
	18
SPRING	
CHM 2002 Organic Chemistry 2	3
CHM 2012 Organic Chemistry Laboratory 2	2
CSE 1503 Introduction to Software Development with FORTRAN	3
HUM 2051 Civilization 1	3
PHY 2002 Physics 2	4
PHY 2092 Physics Laboratory 2	1
	16

Junior Year

FALL	CREDITS
COM 2223 Scientific and Technical Communication	3
HUM 2052 Civilization 2	3
Program Core Course (BIO, CHM)	4–5
Restricted Elective (BIO, CHM)	3
Technical Elective	3
	16–17
SPRING	
MTH 2401 Probability and Statistics	3
Program Core Course (BIO, CHM)	4–5
Humanities Elective	3
Restricted Elective (BIO, CHM)	4
	14–15

Senior Year

FALL	CREDITS
Program Core Course (BIO, CHM)	4–5
Liberal Arts Elective	3
Restricted Electives (BIO, CHM)	6
Social Science Elective	3
	16–17
SPRING	
Program Core Course (BIO, CHM)	4–5
Liberal Arts Elective	3
Restricted Electives (BIO, CHM)	6
Free Elective	3
	16–17
TOTALS CREDITS REQUIRED	128

Program Core Courses by Emphasis

Biological Sciences

Junior Year

FALL
BIO 4010 Biochemistry 1

SPRING
BIO 4110 Biochemistry 2

Senior Year

FALL
CHM 3001 Physical Chemistry 1
CHM 3011 Physical Chemistry Laboratory 1

SPRING
CHM 3002 Physical Chemistry 2
CHM 3012 Physical Chemistry Laboratory 2

Chemistry

Junior Year

FALL
CHM 3001 Physical Chemistry 1
CHM 3011 Physical Chemistry Laboratory 1

SPRING
CHM 3002 Physical Chemistry 2
CHM 3012 Physical Chemistry Laboratory 2

Senior Year

FALL
BIO 4010 Biochemistry 1

SPRING
BIO 4110 Biochemistry 2

Restricted Electives

Biological Sciences	
BIO 2010 Microbiology	4
BIO 3210 Mammalian Physiology	4
BIO 3220 Developmental Biology	4
BIO 4101 Molecular Biology	3
BIO 4120 Genetic Engineering Techniques	4
BIO 4130 Nucleic Acid Analysis	4
BIO 4201 Immunology	3
BIO 4210 Plant Physiology	4
BIO 4301 Cell Biology	3
Chemistry	
CHM 3301 Analytical Chemistry 1	3
CHM 3302 Analytical Chemistry 2/Instrumentation	3
CHM 3311 Analytical Chemistry Laboratory 1	2
CHM 3312 Analytical Chemistry Instrumentation Lab 2	2
CHM 4001 Inorganic Chemistry 1	3
CHM 4002 Inorganic Chemistry 2	3
CHM 4111 Advanced Physical Chemistry	3
CHM 4304 Advanced Analytical Chemistry	3
CHM 4500 Advanced Organic Chemistry	3
CHM 4550 Polymer Chemistry	3
COM 2012 Research Sources and Systems	1

Senior Thesis

The biochemistry curriculum allows for significant undergraduate research experience, culminating in a senior thesis for those students who wish to pursue postgraduate studies and are maintaining a grade point average of 3.0 or better in all science and mathematics courses. A qualified student wishing to participate in the senior thesis program must notify the appropriate department (either biological sciences or chemistry, depending on the student's research interests and curriculum emphasis) no later than the end of the fall semester of the junior year. A thesis committee, consisting of one or more faculty members from each department, will be formed to consider the thesis proposal, which must be submitted during the spring semester of the junior year. After

the approval of the senior thesis committee and the appropriate department head, based on both the proposal and the student's academic record, the student will be permitted to register for Senior Thesis in Biochemistry (BCM 4991 and BCM 4992) during the senior year. These courses and Research Sources and Systems (COM 2012), represent seven semester hours of restricted electives toward meeting the degree requirements listed above. Senior Thesis in Biochemistry students are encouraged to include at least one year of foreign language (French or German) in their degree programs.

DEPARTMENT OF BIOLOGICAL SCIENCES
G.N. Wells, Ph.D., Head

Biological Sciences

Bachelor of Science
Options in:
Aquaculture
Ecology
General Biology
Marine Biology
Molecular Biology
Preprofessional Biology

Master of Science
Options in:
Biotechnology
Cell and Molecular Biology
Ecology
Marine Biology

Doctor of Philosophy

(For related degree programs, see the Oceanography section of this catalog.)

Associate Department Heads
John G. Morris, Ph.D., Director of Graduate Programs

Richard L. Turner, Ph.D., Director of Undergraduate Programs

Professors
Charles E. Helmstetter, Ph.D., *regulation and control of cell division, molecular biology of the cell cycle.*

Alan C. Leonard, Ph.D., *molecular biology, microbial growth control, DNA replication, superhelicity and methylation as regulators of DNA bioreactivity, DNA-protein interactions.*

Junda Lin, Ph.D., *molluscan and crustacean aquaculture.*

Gary N. Wells, Ph.D., *protein biochemistry, molecular biology of development.*

Research Professors
Arvind M. Dhople, Ph.D., *microbiology and physiology of M. leprae, causative agent of human leprosy.*

John J. Thomas, Ph.D., *bioenergy and technology, alternate fuels from biological sources.*

Associate Professors
Mark B. Bush, Ph.D., *paleoecology, biogeography, Amazonian speciation, tropical conservation, wetland ecosystems.*

Michael S. Grace, Ph.D., *molecular control of photoreceptors in the retina and nonretinal photoreceptors of the brain, pineal and parietal organ.*

Julia E. Grimwade, Ph.D., *DNA replication, DNA-protein interaction, bacterial cell cycle control, antibiotic discovery.*

John G. Morris, Ph.D., *population ecology of selected mammalian and avian species, with emphasis on endangered species.*

Charles D. Polson, Ph.D., *application and development of biotechnology in undergraduate education, nucleic acid analysis, electrophoretic separation.*

Jonathan M. Shenker, Ph.D., *finfish aquaculture, biology and ecology of early life stages of fishes, environmental toxicology.*

Richard A. Tankersley, Ph.D., *ecology, physiology and behavior of marine and freshwater invertebrates.*

Ralph G. Turingan, Ph.D., *vertebrate functional morphology, community structure of fishes, ecological morphology of feeding systems.*

Richard L. Turner, Ph.D., *reproduction and life histories of marine organisms, physiological ecology of marine organisms, general biology of echinoderms.*

Russell C. Weigel, Ph.D., *plant physiology, plant tissue culture.*

Robert van Woesik, Ph.D., *population and community ecology of coral reefs, emphasis on mechanisms underlying large scale patterns in coral community structure and diversity.*

Assistant Professor
David J. Carroll, Ph.D., *molecular basis of signal transduction at fertilization.*

Research Scientist
Lisa K. Moore, Ph.D., *gap junction signaling in the vertebrate retina.*

Institutional Associate Faculty
B.G. Calman, Ph.D.; C. Cook, Ph.D.; S. Cook, Ph.D.; M. Davis-Hodgkins, Ph.D.; T. Frank, Ph.D.; R.G. Gilmore, Ph.D.; M.D. Hanisak, Ph.D.; J.V. Lopez, Ph.D.; P.M. Mikkelsen, Ph.D.; R. Paperno, Ph.D.; V.J. Paul, Ph.D.; S. Pomponi, Ph.D.; M.A. Riche, Ph.D.; W. Safranek, Ph.D.; J. Scarpa, Ph.D.; H. Swain, Ph.D.; J.W. Tucker, Ph.D.; B.J. Tunberg, Ph.D.; E.A. Widder, Ph.D.; C.M. Young, Ph.D.

Bachelor of Science Degree Program

The biological sciences examine every aspect of living organisms, from the biochemical reactions involved in supporting cellular processes to the interaction of organisms with their environment. The Bachelor of Science in Biological Sciences seeks to educate students in unifying themes in biology, while encouraging them to expand their knowledge in more specialized subject areas. The department offers six undergraduate program options in which a student may specialize: aquaculture, ecology, general biology, marine biology, molecular biology and preprofessional biology. The curriculum is organized so that in the first two years students learn concepts fundamental to all biological sciences, and in the last two years students follow their own interests in selecting courses that are more specialized.

The **aquaculture** option studies the theory and practice of finfish and shellfish culture. Following a core curriculum of basic science and mathematics, students take specialized courses in culture techniques of salt and freshwater algae, crustaceans, finfish and molluscs.

The **ecology** option provides a well-rounded background in applied and theoretical ecology. Emphasis is placed on student-led experimental design and implementation, with ample opportunity for fieldwork. Ecology majors are required to take part in summer field courses, choosing between programs in Africa, Australia, the Bahamas, Costa Rica, Peru or the United States. Graduates are fully prepared for ecology-related employment or graduate studies in ecology.

The **general biology** option offers the greatest flexibility to satisfy a student's specific interests.

The **marine biology** option includes specialized courses in marine biology and oceanography to provide the knowledge and skills for the study of marine life. Emphasis is on the diversity of marine organisms, their characteristics, interrelationships and interactions with the marine environment. The program prepares students for employment or graduate work on subjects from marine microbes to mammals, and from molecular marine biology to ecology.

The **molecular biology** option provides training in DNA and protein purification, recombinant DNA technology, gene manipulation, PCR, nucleic acid hybridization, DNA sequence analysis, gene expression assays and genomics. Students completing the program are qualified for employment in the rapidly growing biotechnology industry and for entry into graduate study in a wide variety of areas encompassed by molecular biology.

The **preprofessional biology** option is designed for premedical students interested in becoming physicians. It is also appropriate for students interested in veterinary medicine and allied health professions (such as physician's assistant, physical therapy or pharmacy). The chair of the preprofessional option serves as Florida Tech's premedical adviser, and also organizes a premedical evaluation committee to provide evaluation letters for students applying to medical school. Students graduating from this program have had an excellent acceptance rate into medical and professional schools.

Undergraduate Research

Research is an integral part of the study of biological sciences, and students are encouraged to participate in ongoing research directed by departmental faculty. Each option allows research courses to fulfill up to nine hours of restricted or free elective credit.

Summer Field Biology Courses

Between the freshman–sophomore, sophomore–junior, and junior–senior years, students can elect to participate in the summer field biology and ecology program. Field biology courses serve as required courses in the ecology option and can serve as restricted electives for various programs. Students wishing to participate are encouraged to consult with their advisers early during the academic year to reserve places in the classes. Courses in the summer field program are taught in Africa, Australia, the Bahamas, Costa Rica, Jamaica and Peru; and in the United States, in the Appalachian Mountains, Rocky Mountains, and the southwestern deserts.

Admission Requirements

Students intending to apply for admission to study in the department of biological sciences should complete at least one year each of high school biology, chemistry and physics. Prospective students should also have at least three years of high school mathematics, including second-year algebra and trigonometry.

Florida Tech has articulation agreements with many of the community colleges in Florida. Students contemplating transfer to Florida Tech should consult with the department to determine transferability of credits. If there is a question regarding specific courses needed, students should contact the associate department head for undergraduate studies.

Degree Requirements

Candidates for a Bachelor of Science in Biological Sciences must complete the minimum course requirements outlined in the following curriculum. Electives are selected in consultation with the faculty adviser to reflect the knowledge a student needs either for employment or graduate school.

Freshman Year (All Options)

FALL	CREDITS
BIO 1010 Biological Discovery 1	4
CHM 1101 General Chemistry 1	4
COM 1101 Composition and Rhetoric	3
MTH 1001 Calculus 1	4
	15

SPRING	
BIO 1020 Biological Discovery 2	4
BIO 1200 Introduction to Health Professions*	1
BIO 1500 Introduction to Aquaculture**	1
CHM 1102 General Chemistry 2	4
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
	15–16

**Required in Preprofessional option only.*

***Required in Aquaculture option only.*

Sophomore Year (Aquaculture, Ecology, General and Marine Biology Options)

FALL	CREDITS
BIO 2110 General Genetics	4
CHM 2001 Organic Chemistry 1	3
CHM 2011 Organic Laboratory 1	2
HUM 2051 Civilization 1	3
PHY 1001 Physics 1	4
	16

SPRING	
BIO 2801 Biometry	4
CHM 2002 Organic Chemistry 2	3
CHM 2012 Organic Laboratory 2	2
HUM 2052 Civilization 2	3
PHY 2002 Physics 2	4
	16

Sophomore Year (Molecular and Preprofessional Options)

FALL	CREDITS
BIO 2110 General Genetics	4
CHM 2001 Organic Chemistry 1	3
CHM 2011 Organic Laboratory 1	2
HUM 2051 Civilization 1	3
PHY 1001 Physics 1	4
PHY 2091 Physics Laboratory 1	1
	17

SPRING	
BIO 2010 Microbiology	4
CHM 2002 Organic Chemistry 2	3
CHM 2012 Organic Laboratory 2	2
HUM 2052 Civilization 2	3
PHY 2002 Physics 2	4
PHY 2092 Physics Laboratory 2	1
	17

Junior Year (Aquaculture Option)

FALL	CREDITS
BIO 3410 General Ecology	4
BIO 3510 Invertebrate Zoology	4
BIO 4010 Biochemistry 1	4
OCN 3201 Marine and Environmental Chemistry	3
OCN 3211 Marine and Environmental Chemistry Laboratory	1
	16

SPRING

BIO	2010	Microbiology 4
BIO	3625	Molluscan Aquaculture 3
COM	2223	Scientific and Technical Communication 3
		Humanities Elective 3
		Liberal Arts Elective 3
		16

Junior Year (Ecology Option)

FALL **CREDITS**

BIO	3410	General Ecology 4
BIO	3510	Invertebrate Zoology 4
BIO	3701	Evolution 3
COM	2223	Scientific and Technical Communication 3
		14

SPRING

BIO	4410	Community Ecology 4
		Humanities Elective 3
		Restricted Elective 4
		Technical Elective 3
		14

SUMMER

BIO	xxxx	Field Biology Courses 6
		6

Junior Year (General Option)

FALL **CREDITS**

BIO	3410	General Ecology 4
BIO	3510	Invertebrate Zoology 4
BIO	4010	Biochemistry 1 4
		Humanities Elective 3
		15

SPRING

BIO	2010	Microbiology 4
BIO	3220	Developmental Biology 4
COM	2223	Scientific and Technical Communication 3
		Liberal Arts Elective 3
		Technical Elective 3
		17

Junior Year (Marine Option)

FALL **CREDITS**

BIO	3410	General Ecology 4
BIO	3510	Invertebrate Zoology 4
BIO	4010	Biochemistry 1 4
		Social Science Elective 3
		15

SPRING

BIO	2010	Microbiology 4
BIO	4410	Community Ecology 4
COM	2223	Scientific and Technical Communication 3
		Humanities Elective 3
		Technical Elective 3
		17

Junior Year (Molecular Option)

FALL **CREDITS**

BIO	3210	Mammalian Physiology 4
BIO	4010	Biochemistry 1 4
COM	2223	Scientific and Technical Communication 3
		Humanities Elective 3
		14

SPRING

BIO	2801	Biometry 4
BIO	4101	Molecular Biology 3
BIO	4110	Biochemistry 2 4
BIO	4210	Plant Physiology 4
		15

Junior Year (Preprofessional Option)

FALL **CREDITS**

BIO	3210	Mammalian Physiology 4
BIO	4010	Biochemistry 1 4
COM	2223	Scientific and Technical Communication 3
		Technical Elective 3
		14

SPRING

BIO	3220	Developmental Biology 4
BIO	3801	Biometry 4
		Humanities Elective 3
		Restricted Elective (BIO) 4
		15

Senior Year (Aquaculture Option)

FALL **CREDITS**

BIO	4620	Fish Aquaculture and Management 4
BIO	4625	Crustacean Aquaculture 3
		Restricted Elective (BIO, CHM, ENS, OCN) 4
		Social Science Elective 3
		Technical Elective 3
		17

SPRING

BIO	4530	Biology of Fishes 4
		Liberal Arts Elective 3
		Restricted Elective (BIO, CHM, ENS, OCN) 6
		Free Elective 3
		16

Senior Year (Ecology Option)

FALL **CREDITS**

BIO	3210	Mammalian Physiology 4
BIO	4010	Biochemistry 1 4
ENS	4800	Limnology 3
		Restricted Elective (BIO, CHM, ENS, OCN) 3
		Social Science Elective 3
		17

SPRING

BIO	4210	Plant Physiology 4
		Liberal Arts Elective 3
		Restricted Elective (BIO, CHM, ENS, OCN) 4
		Free Elective 3
		14

Senior Year (General Option)

FALL **CREDITS**

BIO	3210	Mammalian Physiology 4
BIO	3701	Evolution 3
BIO	4550	Comparative Vertebrate Anatomy 4
		Restricted Elective (BIO, CHM, ENS, OCN) 3
		Social Science Elective 3
		17

SPRING

BIO	4210	Plant Physiology 4
		Liberal Arts Elective 3
		Restricted Elective (BIO, CHM, ENS, OCN) 7
		Free Elective 3
		17

Senior Year (Marine Option)

FALL **CREDITS**

BIO	3710	Evolution 3
BIO	4550	Comparative Vertebrate Anatomy 4
BIO	4710	Marine Biology 4
		Liberal Arts Elective 3
		Restricted Elective (BIO, CHM, ENS, OCN) 3
		17

SPRING

BIO	4720	Marine Ecology 4
		Liberal Arts Elective 3
		Restricted Elective (BIO, CHM, ENS, OCN) 7
		Free Elective 3
		17

Senior Year (Molecular Option)

FALL **CREDITS**

BIO	4120	Genetic Engineering Techniques 4
		Liberal Arts Elective 3
		Restricted Elective (BIO, CHM, ENS, OCN) 7
		Social Science Elective 3
		17

SPRING

BIO 4130	Nucleic Acid Analysis	4
	Liberal Arts Elective	3
	Restricted Elective (BIO, CHM, ENS, OCN)	4
	Technical Elective	3
	Free Elective	3
		17

Senior Year (Preprofessional Option)

FALL		CREDITS
BIO 4550	Comparative Vertebrate Anatomy	4
	Liberal Arts Elective	3
	Restricted Elective (BIO, CHM, ENS, OCN)	7
	Social Science Elective	3
		17

SPRING

BIO 4201	Immunology	3
	Liberal Arts Elective	3
	Restricted Elective (BIO, CHM, ENS, OCN)	8
	Free Elective	3
		17

Total Credits Required by Option

Aquaculture	128
Ecology	127
General Biology	128
Marine Biology	128
Molecular Biology	127
Preprofessional	128

Master of Science Degree Programs

Biology

The master of science degree in biology can be earned in one of three options: ecology, marine biology or cell and molecular biology. The purpose of each option is to prepare the student either for a professional career or for further graduate study. This goal is achieved through a balance of course work and research activities.

Admission Requirements

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog. For this program, Graduate Record Examination scores (General Test only), three letters of recommendation and a statement of objectives are required. Admission decisions for fall semester enrollment are made by March 15, and for spring semester enrollment by October 1.

Degree Requirements

The master of science degree requires the successful completion of 34 credit hours, including formal course work, presentation of a graduate thesis seminar, and preparation and oral defense of a thesis. The thesis involves the completion of original research of publishable quality.

The student's thesis research and program of study reflect the emphasis of the option. All thesis research is conducted under the direction of an adviser and an advisory committee. The advisory committee is composed of at least three members: two from the department (including the adviser) and one from another academic unit.

Curriculum

The adviser assists the student in devising a program of study. The latter requires approval by the program of study committee and the department head. The student must complete courses appropriate for the option. These can be chosen from the offerings of any academic unit in the College of Science and Liberal Arts, College of Engineering and School of Psychology. Students wanting to acquire special research skills should enroll in Biological Research Rotation (BIO 5998). A master's student must elect the Biological Sciences Seminar (BIO 5990) every semester it is offered, except for the semester in which the student presents a thesis seminar. During this semester, the student will register for both Thesis (BIO 5999) and Biological Research Seminar (BIO 5991). Each student must present a departmental thesis seminar before graduation.

SUMMARY OF PROGRAM REQUIREMENTS

Formal Course Work (minimum)	18
Biological Research Seminar	1
Biological Research or Biological Research Rotation	0–9
Thesis (maximum)	6
TOTAL CREDITS REQUIRED	34

Biotechnology

The marine environment is a rich source of pharmaceuticals, polymers, diagnostic reagents and genetically diverse organisms. The biological processes of the majority of marine organisms are not well understood and the biotechnology industry lacks individuals trained to develop and practice biotechnology using marine animals, plants and microorganisms. The master's program in biotechnology is a nonthesis program that builds on Florida Tech's unique location on the Atlantic coast, and its established strengths in marine biology, marine ecology, natural products chemistry, molecular biology and biochemistry to provide a path for students who aspire to learn biotechnology and earn jobs in industry. The program is focused on those areas of biotechnology related to microbiology, natural products chemistry and molecular biology of marine organisms. Students are provided with a diverse combination of classroom experience, field studies, chemical and molecular biological laboratory techniques and development of communication skills most appropriate for an industrial or academic research career.

Summer Internships

The goal of this training program is to produce individuals with a strong interdisciplinary background in biology and chemistry, who will be qualified to meet the needs of biotechnology in industrial or academic settings. To provide additional experience with state-of-the-art technology, students in this program have the opportunity to include summer internships in an industrial laboratory as part of their degree training. In most cases, these internships are related to collaboration between Florida Tech faculty and a particular laboratory in a biotechnology firm. Internship sites include Merck, Sharp and Dohme (Rahway, N.J.), Lederle Labs (Pearl River, N.Y.) and Zymogenetics (Seattle, Wash.). Those students wishing to receive internship training locally may substitute a research experience with Florida Tech faculty, subject to approval.

Admission Requirements

The applicant must have a bachelor of science degree in biology, chemistry, biochemistry or equivalent. Applicants deficient in organic chemistry, genetics, biochemistry or microbiology are required to take undergraduate courses before starting the master of science program. Admission decisions for fall semester enrollment are made by March 15, and for spring semester enrollment, admission decisions are made by October 1.

Degree Requirements

The master's degree in biotechnology is a nonthesis option and requires the satisfactory completion of 33 credit hours, including 21 credit hours of required core courses, six credit hours of elective courses, seminars (BIO 5990) and six credit hours of summer laboratory experience at Florida Tech (BIO 5537) or an industrial internship (BIO 5997). A project report on the research experience is written, presented and defended before a committee. The composition of the committee will be similar to the master's degree committee. The committee may ask questions relating to previous course work.

Curriculum

Core Areas (21 credit hours)

BIO 5501 Cellular and Molecular Biology
BIO 5515 Pharmacology and Drug Design
BIO 5535 Current Topics in Biotechnology
BIO 5539 Microbial Biotechnology
BIO 5546 Growth and Division of Cells 2: Eukaryotes
BIO 5575 Biology of Cancer
CHM 5507 Natural Products

Electives (6 credit hours)

A choice from the following courses is suggested. In addition to this list, courses from oceanography, chemistry or engineering may be chosen with approval of the Graduate Studies Committee.

BIO 5030 Conservation Biology
BIO 5080 Mechanisms of Biological Clocks
BIO 5502 Molecular Biology of Signal Transduction
BIO 5520 Regulation of Animal and Plant Development
BIO 5540 Biochemical Toxicology
BIO 5545 Growth and Division of Cells: Prokaryote
BIO 5635 Introductory Neurobiology
BIO 5725 Pathogenic Bacteriology
BIO 5815 Molecular Studies of Marine Biodiversity

SUMMARY OF PROGRAM REQUIREMENTS

Required Course Core	21
Elective Courses	6
Internship or summer laboratory experience	6
	33

Doctor of Philosophy Degree Program

The doctor of philosophy degree is offered for students who want to carry out advanced research in the biological sciences. A student's research can encompass any area represented by a faculty member. The objective is to prepare the student at the highest academic level for a productive career in research, teaching and/or administration.

Admission Requirements

A doctoral applicant must have a bachelor's or master's degree. For admission, a student should have a superior academic record, with a minimum of 3.0 (on a scale of 4.0) in undergraduate work or 3.2 in graduate work, three letters of recommendation and scores from the Graduate Record Examination (both the General Test and the Subject Test in biology).

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog. Admission decisions for fall semester enrollment are made by March 1, and for spring semester enrollment, admission decisions are made by October 1.

Degree Requirements

The doctor of philosophy degree is primarily a research degree and is conferred in recognition of research accomplishments as well as completion of a program of study. Each student must complete an approved program of study, pass a comprehensive written and/or oral examination, write an acceptable research proposal and file a petition for admission to candidacy, complete a program of significant original research, prepare and defend a dissertation concerning the research and present a dissertation seminar. Each candidate is expected to publish major portions of the dissertation in refereed national or international journals.

Each doctoral student must prepare a program of study within one year after entering the program. To assure that the student possesses a satisfactory knowledge of biological principles, the student might be required to take certain courses in biological sciences and related disciplines. The student has an advisory committee appointed by his or her adviser with the approval of the department head. The committee is composed of at least five members: four faculty members (including the adviser) from the department and one faculty member from another academic unit.

The proposal represents the research plan that the student will pursue for the dissertation. It should be written under the close supervision of the adviser, and the proposal must be presented to and approved by the advisory committee.

Doctoral research represents a significant contribution to the knowledge of a particular problem. A student must be prepared to devote considerable time and effort to research. With the adviser's approval, the student presents the preliminary copies of the dissertation to the advisory committee for critical evaluation. Once the dissertation satisfies the advisory committee, the student then orally defends the work. If the defense is satisfactory, the advisory committee will approve the dissertation once the final revisions are completed.

Prior to graduation, the student must present a dissertation seminar to the faculty and graduate students.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

The adviser assists the student in devising a program of study, which requires approval by the program of study committee and the department head. The committee and department head must also approve any revision of the program of study.

In developing a program of study, considerable latitude is allowed for course selection and research interests. Appropriate courses can be selected from the offerings of any academic unit in the College of Science and Liberal Arts, College of Engineering or School of Psychology. The student may register for Biological Research Rotation (BIO 5998) to learn specific skills and techniques available from the faculty. All doctoral students must elect the Biological Sciences Seminar (BIO 5990) every semester it is offered, except for the semester the student presents a dissertation seminar (Biological Research Seminar, BIO 5991).

SUMMARY OF PROGRAM REQUIREMENTS

Formal Course Work Beyond Bachelor's Degree (minimum)	24
Biological Research Seminar	1
Biological Research*	0–24
Doctoral Dissertation (maximum)	30

**Inclusion of Biological Research Rotation (BIO 5998) is recommended.*

A minimum of 79 credits beyond the bachelor's degree is required.

For students entering with a master's degree, former course work completed for the master's degree can fulfill a significant portion of the 24 credit hours of required doctoral course work. Nonetheless, the student should be prepared to complete some additional course work.

Research Activities and Facilities

The department faculty are conducting research in the following general areas:

Biochemistry, Molecular Biology and Molecular Genetics

A variety of molecular and biochemical approaches are used in the department to answer questions related to regulation of cell duplication, signal transduction in early development, circadian rhythms and sensory systems, microbial pathogenesis, plant growth, and the assembly of subcellular structures. A major effort is underway to develop novel cell culture systems for production of synchronously growing populations of human cells. Intracellular complexes of DNA and protein are under study to elucidate the regulatory mechanisms that trigger DNA replication and cell division in bacteria. The role of signal transduction pathways induced by calcium in the fertilization step of embryogenesis is another active area of research. Drug discovery efforts are focused on the genetics of the polyketide synthesis pathway in a variety of uncharacterized microorganisms collected from extreme environments. Development and analysis of new bacterial growth inhibitors is also underway for *Mycobacterium*, *Escherichia* and other important bacterial pathogens. Another expanding research area is the neurophysiological and molecular analysis of photoreceptors, particularly the infrared receptors in snakes. The diversity of biochemical and molecular research conducted by members of the biological sciences department provides for a rich and interactive environment for graduate students.

Marine Biology

The marine biology faculty maintain active research programs in finfish, crustacean, molluscan, coral and echinoderm biology. The evolution and ecological physiology of organismal design are investigated using high-speed videography, electromyography, and biomechanical and ecomorphological analysis of feeding in field-caught and laboratory-reared fish. Fisheries research includes analyses of early-life history and recruitment patterns of estuarine-dependent sport fish species. Crustacean research centers on the ecology and physiology of adult and early-life history stages, especially the migratory behavior of spawning female crabs and the recruitment and habitat selection of post larvae. Research on suspension-feeding invertebrates examines the mechanisms responsible for food capture, selection and processing. Remote sensing, as well as laboratory and field investigations of corals, explores the effects of global-climate change on coral reefs. Studies of echinoderms have concentrated on their reproduction, anatomy, systematics and ecology by using physiological, histological, morphological and field techniques. Aquaculture programs are investigating the reproductive and feeding biology of ornamental shellfish and finfish species.

Molecular Marine Biology

Collaborative research among diverse faculty and students enables the application of molecular biological techniques to marine biology topics such as genetic identification of fishery and manatee populations, biochemistry of molluscan shell growth, response of marine organisms to anthropogenic pollutants, genetic engineering in aquaculture and the relationship of enzymes to rates of calcification and skeletogenesis in commercially significant marine organisms.

Plant Physiology and Plant Tissue Culture

Studies are conducted on the initiation of *in vitro* plant cultures of various plant species, and on the changes that accompany *in vitro* differentiation. Research on the identity of genes that are specific to particular stages of differentiation, and attempts to propagate rare species with tissue culture techniques, are in progress.

Ecology and Conservation Biology

Research activities include studies of coral reef ecology, paleobotany, biogeography, biodiversity, freshwater and marine aquaculture, fisheries ecology, population ecology of marine mammals, ecomorphology and the life history and ecology of selected crustaceans and echinoderm species. Study locations range from local to international, including the Indian River Lagoon, sites along the Atlantic seaboard and offshore from New Jersey to Florida, the Bahamas and Amazonia.

DEPARTMENT OF CHEMISTRY
M.W. Babich, Ph.D., Head

Chemistry

Bachelor of Science — *Master of Science* — *Doctor of Philosophy*

Options in:
- *Chemical Management*
- *General Chemistry*
- *Premedical Chemistry*
- *Research Chemistry*

Professors

Michael W. Babich, Ph.D., *solid-state chemistry, including X-ray crystallographic structure determination, mechanisms of reactions in solids, kinetic investigations of coordination complexes, thermal analysis.*

Gordon L. Nelson, Ph.D., *polymers, polymer flammability and aging, C-13 NMR.*

Joshua Rokach, Ph.D., *leukotrienes, lipoxins, synthetic organic chemistry, synthetic pharmaceuticals.*

Mary L. Sohn, Ph.D., *nature of sedimentary humic acids in aquatic sediments, evaluation of humic acid-metal and humic acid-organometallic formation constants.*

Associate Professors

J. Clayton Baum, Ph.D., *molecular spectroscopy, including photophysical and photochemical problems, and energy transfer and relaxation processes; molecular orbital calculations.*

Alan B. Brown, Ph.D., *physical organic chemistry, stereochemistry, bio-organic chemistry.*

Virender K. Sharma, Ph.D., *analytical, geochemistry and environmental chemistry.*

Assistant Professors

Monica Baloga, Ph.D., *bio-organic chemistry, physical organic chemistry.*

Nasri A. Nesnas, Ph.D., *bio-organic chemistry.*

Mark J. Novak, Ph.D., *biocatalysis, enzyme assisted synthesis, metabolic studies of chemical and biological warfare agents.*

Joel A. Olson, Ph.D., *scanning tunneling microscopy.*

Kurt Winkelmann, Ph.D., *physical and materials chemistry including photochemistry, catalysis, surface chemistry.*

Bachelor of Science Degree Program

The Department of Chemistry offers a bachelor of science degree program in chemistry that is accredited by the American Chemical Society. This program prepares the graduate for the many diverse career opportunities available to the chemist in government, private industry and academia. There are four program options:

Research chemistry—Students receive an ACS-certified degree by following this option. Research chemistry is the best choice for those who wish to pursue an advanced degree after graduation and are interested in a career in chemical research. This option features a full year of undergraduate research during the senior year.

General chemistry—This option is similar to the research chemistry option but without senior research, thus allowing greater flexibility for the addition of electives during the senior year. It also provides excellent preparation for professional or graduate schools, or for a career in industry.

Chemical management—This option is designed for the student interested in a business career in the chemical industry. Chemical management provides a complete program in chemistry, supplemented with selected business course work.

Premedical chemistry—This option is designed for the student interested in a solid background in chemistry in preparation for a career in medicine or a related professional field. The curriculum includes all required course work to make the student competitive for admission to medical, dental or veterinary schools. The adviser to this program provides up-to-date information on admission requirements for most of those schools, as well as admission test information.

A dual-degree option is available for students with interest in both chemistry and chemical engineering. This option requires approximately one additional year of study and allows the student to complete bachelor's degrees in both chemistry and chemical engineering.

In addition, a bachelor's degree program in biochemistry is cosponsored with the biological sciences department. For more information on this program, see "Biochemistry."

Degree Requirements

Candidates for a Bachelor of Science in Chemistry must complete the minimum course requirements as indicated for each option. Deviation from the recommended program can be made only with the approval of the student's adviser and the concurrence of the department head.

Because the subject matter in general chemistry forms a critically important foundation for all of the advanced chemistry courses, both CHM 1101 and CHM 1102 must be passed with grades of at least C before taking any other chemistry courses.

All Options Except Premedical

Freshman Year

FALL	CREDITS
BUS 1301 Basic Economics	3
CHM 1101 General Chemistry 1*	4
COM 1101 Composition and Rhetoric	3
CSE 1503 Introduction to Software Development/FORTRAN	3
MTH 1001 Calculus 1	4
	17
SPRING	
CHM 1102 General Chemistry 2	4
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics 1 Lab	1
	16

**Credit can be obtained based on College Board Advanced Placement examinations taken prior to enrollment at Florida Tech. Students interested in receiving advanced-placement credit for chemistry should take the College Board Advanced Chemistry examination and request that the results be sent to Florida Tech.*

Sophomore Year

FALL	CREDITS
CHM 2001 Organic Chemistry 1	3
CHM 2011 Organic Chemistry Laboratory 1	2
HUM 2051 Civilization 1	3
MTH 2001 Calculus 3	4
PHY 2002 Physics 2	4
PHY 2092 Physics Laboratory 2	1
	17
SPRING	
CHM 2002 Organic Chemistry 2	3
CHM 2012 Organic Chemistry Laboratory 2	2
HUM 2052 Civilization 2	3
MTH 2201 Differential Equations/Linear Algebra	4
Technical Elective	3
	15

General Chemistry and Research Chemistry Options

Junior Year

FALL	CREDITS
CHM 3001 Physical Chemistry 1	3
CHM 3011 Physical Chemistry Laboratory 1	2
CHM 3301 Analytical Chemistry 1	3
CHM 3311 Analytical Chemistry Laboratory 1	2
Social Science Elective	3
Technical Elective	3
	16
SPRING	
CHM 3002 Physical Chemistry 2	3
CHM 3012 Physical Chemistry Laboratory 2	2
CHM 3302 Analytical Chemistry 2	3
CHM 3312 Analytical Chemistry Laboratory 2	2
COM 2012 Research Sources and Systems	1
Humanities Elective	3
Free Elective	3
	17

General Chemistry Option

Senior Year

FALL		CREDITS
CHM 4001	Inorganic Chemistry 1	3
CHM 4900	Chemistry Seminar	0
	Humanities Elective	3
	Restricted Elective* (Chemistry)	3
	Technical Electives	6
		15

SPRING		
CHM 4611	Advanced Laboratory Techniques	2
CHM 4900	Chemistry Seminar	0
COM 2223	Scientific and Technical Communication	3
	Technical Elective	3
	Restricted Electives* (Chemistry)	6
		14

TOTAL CREDITS REQUIRED 127

The technical electives are selected in consultation with the student's adviser. The undergraduate research sequence, CHM 4800 and CHM 4801, may be taken with departmental approval.

Research Chemistry Option**

Senior Year

FALL		CREDITS
BIO 4010	Biochemistry 1	4
CHM 4001	Inorganic Chemistry 1	3
CHM 4900	Chemistry Seminar	0
CHM 4910	Senior Thesis in Chemistry	3
COM 2223	Scientific and Technical Communication	3
	Restricted Elective* (Chemistry)	3
		16

SPRING		
CHM 4002	Advanced Inorganic Chemistry	3
CHM 4611	Advanced Laboratory Techniques	2
CHM 4901	Senior Research Seminar	1
CHM 4911	Senior Thesis in Chemistry	3
	Restricted Electives* (Chemistry)	6
		15

TOTAL CREDITS REQUIRED 129

Chemical Management Option

Junior Year

FALL		CREDITS
BUS 2304	Microeconomics	3
CHM 3001	Physical Chemistry 1	3
CHM 3011	Physical Chemistry Laboratory 1	2
CHM 3301	Analytical Chemistry 1	3
CHM 3311	Analytical Chemistry Laboratory 1	2
MTH 2401	Probability and Statistics	3
		16

SPRING		
BUS 2211	Introduction to Financial Accounting	3
CHM 3002	Physical Chemistry 2	3
CHM 3012	Physical Chemistry Laboratory 2	2
CHM 3302	Analytical Chemistry 2	3
CHM 3312	Analytical Chemistry Laboratory 2	2
	Social Science Elective	3
		16

Senior Year

FALL		CREDITS
BUS 3401	Corporate Finance	3
CHM 4001	Inorganic Chemistry 1	3
CHM 4900	Chemistry Seminar	0
COM 2012	Research Sources and Systems	1
	Humanities Elective	3
	Restricted Elective* (Chemistry)	3
	Free Elective	3
		16

SPRING		
BUS 3501	Management Principles	3
BUS 3601	Marketing Principles	3
CHM 4900	Chemistry Seminar	0
COM 2223	Scientific and Technical Communication	3
	Humanities Elective	3
	Restricted Elective* (Chemistry)	3
		15

TOTAL CREDITS REQUIRED 128

**Selected from the following list:*

CHM4002	*Advanced Inorganic Chemistry* *3*
CHM4111	*Advanced Physical Chemistry* *3*
CHM4304	*Advanced Analytical Chemistry* *3*
CHM4500	*Advanced Organic Chemistry* *3*
CHM4550	*Polymer Chemistry* *3*

***To enter the senior year of the research chemistry option, a cumulative grade point average of 3.0 in all chemistry courses at the end of the fall semester of the junior year is required.*

Premedical Chemistry Option

Freshman Year

FALL		CREDITS
BIO 1010	Biological Discovery 1	4
CHM 1101	General Chemistry 1	4
COM 1101	Composition and Rhetoric	3
MTH 1001	Calculus 1	4
		15

SPRING		
BIO 1020	Biological Discovery 2	4
BIO 1200	Introduction to the Health Professions	1
CHM 1102	General Chemistry 2	4
COM 1102	Writing about Literature	3
MTH 1002	Calculus 2	4
		16

Sophomore Year

FALL		CREDITS
CHM 2001	Organic Chemistry 1	3
CHM 2011	Organic Chemistry Lab 1	2
HUM 2051	Civilization 1	3
MTH 2001	Calculus 3	4
PHY 1001	Physics 1	4
PHY 2091	Physics Lab 1	1
		17

SPRING		
CHM 2002	Organic Chemistry 2	3
CHM 2012	Organic Chemistry Lab 2	2
HUM 2052	Civilization 2	3
MTH 2201	Differential Equations/Linear Algebra	4
PHY 2002	Physics 2	4
PHY 2092	Physics Lab 2	1
		17

Junior Year

FALL		CREDITS
BIO 2110	General Genetics	4
BIO 3210	Mammalian Physiology	4
	or	
BIO 4010	Biochemistry 1	4
CHM 3001	Physical Chemistry 1	3
CHM 3301	Analytical Chemistry 1	3
CHM 3311	Analytical Chemistry Lab 1	2
		16

SPRING		
CHM 3002	Physical Chemistry 2	3
CHM 3302	Analytical Chemistry 2	3
CHM 3312	Analytical Chemistry Lab 2	2
COM 2012	Research Sources and Systems	1
COM 2223	Scientific and Tech Communication	3
CSE 1503	Introduction to Software Development/FORTRAN	3
		15

Senior Year

FALL	CREDITS
CHM 3011 Physical Chemistry Lab 1	2
CHM 4001 Inorganic Chemistry 1	3
CHM 4900 Chemistry Seminar	0
Liberal Arts Elective	3
Restricted Elective (Chemistry)	3
Technical Elective	3
Social Science Elective	3
	17

SPRING	
CHM 3012 Physical Chemistry Lab 2	2
CHM 4900 Chemistry Seminar	0
Humanities Elective	3
Liberal Arts Elective	3
Restricted Electives (Chemistry)	6
Free Elective	3
	17

TOTAL CREDITS REQUIRED 130

Master of Science Degree Program

Admission Requirements

An applicant for admission to the master's program should have an undergraduate degree in chemistry or in a related area. Typically, a minimum of eight semester courses should have been taken in four of the five major fields of chemistry: organic, analytical, physical, inorganic and biochemistry; as well as appropriate courses in mathematics and physics. Applicants may be admitted on a provisional basis with the requirement that undergraduate deficiencies be corrected during the first year of study. Proficiency examinations are administered to all new students the week before the beginning of classes as an aid in planning each program of study.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The Master of Science in Chemistry is based on successful completion of a minimum of 34 graduate credits following an approved program plan. A research proposal, thesis and oral examination in defense of the thesis are required.

Thesis Research

A thesis based on research conducted in residence at Florida Tech under the direction of a member of the chemistry department graduate faculty is required. During the first academic semester, the student selects a faculty member to serve as research adviser. During the same semester and with the assistance of the adviser, the student selects an advisory committee, prepares a program plan, and defines a research topic. The student then progressively continues through the stages of research proposal, research, thesis and oral examination. Throughout this period, the advisory committee provides assistance and direction to the student and serves as the review board for the research proposal, thesis and oral examination.

Curriculum

Each student follows an individual program plan. The program plan must have a minimum of 34 credits and include four core chemistry courses, three additional chemistry courses, one technical elective, nine credits of thesis and one credit of seminar. The student must register for Graduate Seminar (CHM 5900) each semester offered, concluding with Thesis Seminar (CHM 5901) during the last semester of thesis research. All courses selected for inclusion on the program plan are subject to approval by the department head.

Core Courses

CHM 5002 Advanced Inorganic Chemistry
CHM 5111 Advanced Physical Chemistry
CHM 5304 Advanced Analytical Chemistry
CHM 5500 Advanced Organic Chemistry

Chemistry Electives

Three courses, chosen from different areas of specialization, must be taken from the following list:
CHM 5017 Physical Methods in Inorganic Chemistry
CHM 5018 Special Topics in Inorganic Chemistry
CHM 5095 Chemical Research Projects
CHM 5112 Special Topics in Physical Chemistry
CHM 5114 Applied Optical Spectroscopy
CHM 5119 Chemical Dynamics
CHM 5501 Interpretation of Chemical Spectra
CHM 5503 Organic Synthesis
CHM 5504 Theoretical Organic Chemistry
CHM 5507 Natural Products
CHM 5550 Polymer Chemistry

Technical Elective

The technical elective may be selected from other courses offered within the chemistry department or other departments of the university.

Doctor of Philosophy Degree Program

Admission Requirements

A candidate for the doctoral program will typically have a bachelor's or master's degree in chemistry with outstanding performance. Students enrolled in the master's program can apply to change their status to work directly toward the doctorate after completing 14 credits of graduate course work at Florida Tech with a cumulative grade point average of at least 3.3.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The doctoral degree is primarily a research degree and is conferred in part in recognition of research accomplishments. Each student must pass the cumulative written examinations, complete an approved program of course work, demonstrate proficiency in a foreign language and/or computer languages, pass the comprehensive oral examination, write an acceptable research proposal and file a petition for admission to candidacy, complete a significant original research study, prepare and defend a dissertation concerning the research, and present a seminar on the dissertation research. The dissertation research is expected to be of publishable quality, according to the standards of peer-reviewed national or international journals.

Each new doctoral student is required to pass six cumulative examinations. At least four must be in the chosen area of concentration and up to two can be in an additional area. Students must begin these examinations in their second semester in residence. Four examinations are offered each semester. A maximum of 11 attempts is allowed.

A doctoral student must have a program of study approved by the doctoral committee and the department head by the end of the second semester in residence. This program is based on the student's goals and background.

Before admission to candidacy, the doctoral student must demonstrate a reading proficiency of the scientific literature in a foreign language. German, Russian and French are the preferred languages. No other language will be approved unless necessary for access to important literature in the student's specific research area. With the approval of the adviser and academic unit head, appropriate computer languages may be substituted.

The proposal presents the research plan to be followed in the dissertation work. It is developed under close supervision of the adviser. Areas of specialization are included under research activities. The proposal is presented to and approved by the student's committee and department head.

After the research project is completed and approved by the adviser, the dissertation is submitted to the advisory committee for critical evaluation. The student then orally defends the dissertation.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

In developing a program of study for the doctoral degree, considerable latitude is allowed to accommodate research interests. The following guidelines apply to students entering with a bachelor's degree:

Approved Chemistry Courses (minimum)	24
Additional Course Work	9
Chemistry Research	0–18
Dissertation (maximum)	30
MINIMUM REQUIRED BEYOND BACHELOR'S DEGREE	81

For students entering with a master's degree, course work completed for the master's degree can fulfill a significant proportion of the 33 hours of required doctoral course work. The student should be prepared to complete some additional course work.

Research Activities

Research areas presently of interest to department faculty and available for master's research projects are the following:

- Aquatic Organic Chemistry
- Bio-organic Chemistry
- Complexation Chemistry
- Electroanalytical Chemistry
- Energy Transfer
- Environmental Chemistry
- Molecular Spectroscopy
- Natural Products
- Organometallic Chemistry
- Pharmaceutical Chemistry
- Physical Organic Chemistry
- Solar Energy Applications
- Solid-Phase Reaction Kinetics
- Stereochemistry
- Synthetic Organic Chemistry
- Thermal Methods of Analysis

Physical and synthetic organic, synthetic pharmaceutical, natural products and marine natural products are the areas of specialization offered for doctoral research at the present time. Doctoral research in any other area requires approval of the research adviser and department head before admission to the program. Additional areas of specialization will be developed.

Communication

DEPARTMENT OF HUMANITIES AND COMMUNICATION
N.I. Matar, Ph.D., Head

Bachelor of Science *Master of Science (See Technical and Professional Communication)*

Program Chair
Carol M.H. Shehadeh, M.A.

Associate Professors
Randall L. Alford, Ph.D., *general linguistics, grammatical theory, language education, German, English as a second language.*

Judith B. Strother, Ph.D., *theoretical and applied business communication, scientific and technical communication, editing, applied linguistics, psycholinguistics.*

Jane T. Tolbert, Ph.D., *journalism, mass communication, scientific and technical communication.*

Assistant Professors
Marcia Denius, M.F.A., *poetry, creative writing, scriptwriting, women writers.*

Sharon C. Irvin, M.A., *technical writing, simplified English, technical documentation.*

Carol M.H. Shehadeh, M.A., *Internet publishing, business/technical writing and editing, documentation, instructional technology.*

Angela Tenga, Ph.D., *scientific and technical communication, Old and Middle English literature, English, German.*

Adjunct Professors
P. Krist, Ph.D.; W. Picard, Ph.D.

Instructors
P. Bernard, M.S.; C. Frongillo, Ph.D.; B. Leach, M.A.; M. Mullins, M.A.; M. Ruane, M.A.; D. Russell, M.S.; J. Stottler, M.A.; J. Teegen, M.A.; F. Wallace, M.S.Ed.

Lecturers
A. Belyi, M.A.; C. Bowering, M.S.; K.D. Nichols, A.S.

Bachelor of Science Degree Program

The major in communication prepares graduates to meet today's ever-growing demand for skilled communicators who have specialized backgrounds in business, science or technology. Course work emphasizing either business or science and engineering augments a strong foundation in theoretical communication, in visual communication, and in written and oral communication. Graduates of this program are able to plan, research, write, edit and design reports, proposals, articles, brochures and other kinds of communication for both print and electronic delivery. Additionally, students learn to create and deliver effective professional presentations.

Graduates specializing in business and marketing communication typically find employment in public relations, marketing, publications research, advertising, copywriting, editing,

training and development, public information or consumer relations. Graduates specializing in scientific and technical communication are typically employed as technical or scientific writers and editors, documentation designers, technical publications specialists, instructional designers, Web page designers or proposal writers.

Degree Requirements

Candidates for the Bachelor of Science in Communication require a total of 120 hours for graduation. On reaching the junior year, candidates must choose an area of concentration and include 21 semester hours of specialized course work. A senior with a GPA over 3.25 may apply for a six-semester-hour communication internship that reflects the area of concentration. The composition of the 120 credit program must correspond to the following distribution of required and elective courses.

BUS 2601 Legal and Social Environments of Business 3
BUS 3501 Management Principles 3
COM 1101 Composition and Rhetoric 3
COM 1102 Writing about Literature 3
COM 2223 Scientific and Technical Communication 3
or
COM 2224 Business and Professional Writing 3
COM 2241 Journalism 3
COM 2370 Speech 3
COM 2425 Introduction to Communication 3
COM 2501 Introduction to Visual Communication 3
COM 2502 Layout and Design 3
COM 3070 Professional Communication for Executives 3
COM 3210 Editing 3
COM 3425 Mass Communication 3
COM 4026 Publishing and the Internet 3
COM 4430 Research Methods and Materials in Technical and Professional Communication 3
CSE 1301 Introduction to Computer Applications 3
HUM 2051 Civilization 1 3
HUM 2052 Civilization 2 3
LNG xxxx Foreign Language 12
MTH 1701 College Algebra 3
MTH 1702 Applied Calculus 3
Humanities Electives 6
Free Electives 12
Physical or Life Sciences Electives 6
Social Science 3
Concentration (select one) 21

Concentration (Select one 21-credit specialization)

Business and Marketing Communication

BUS 3601 Marketing Principles 3
COM 3440 Public Relations 3
COM 4424 Advanced Business and Professional Communication 3
and 12 hours from the following:
BUS 3xxx ..... up to 9
COM 3xxx ..... up to 6
COM 4090 Communication Internship (upon qualification) 6

Scientific and Technical Communication

COM 3223 Advanced Technical Writing 3
COM 3231 Writing about Science 3
and 12 hours from the following:
Restricted Electives (Computer Science, Engineering or Science) ..... up to 9
COM 3xxx ..... up to 6
COM 4090 Communication Internship (upon qualification) 6
CSE xxxx Computer Science Elective 3

Freshman Year

FALL	CREDITS
COM 1101 Composition and Rhetoric	3
CSE 1301 Introduction to Computer Applications	3
MTH 1701 College Algebra	3
Restricted Elective (Physical or Life Science)	3
Social Science Elective	3
	15

SPRING	
COM 1102 Writing about Literature	3
COM 2370 Speech	3
MTH 1702 Applied Calculus	3
Restricted Elective (Physical or Life Science)	3
Free Elective	3
	15

Sophomore Year

FALL	CREDITS
COM 2223 Scientific and Technical Communication	3
or	
COM 2224 Business and Professional Writing	3
COM 2425 Introduction to Communication	3
COM 2501 Introduction to Visual Communication	3
HUM 2051 Civilization 1	3
LNG xxxx Foreign Language	3
	15

SPRING	
BUS 2601 Legal and Social Environments of Business	3
COM 2241 Journalism*	3
COM 2502 Layout and Design	3
HUM 2052 Civilization 2	3
LNG xxxx Foreign Language	3
	15

Junior Year

FALL	CREDITS
COM 3210 Editing*	3
COM 3425 Mass Communication	3
LNG xxxx Foreign Language	3
Concentration Course	6
	15

SPRING	
BUS 3501 Management Principles	3
COM 3070 Professional Communication for Executives	3
COM 4026 Publishing and the Internet	3
LNG xxxx Foreign Language	3
Concentration Course	3
	15

Senior Year

FALL	CREDITS
COM 4430 Research Methods and Materials in Technical and Professional Communication	3
HUM xxxx Humanities Elective	3
Concentration Courses	6
Free Elective	3
	15

SPRING	
HUM xxxx Humanities Elective	3
Concentration Courses	6
Free Electives	6
	15

TOTAL CREDITS REQUIRED 120

**Not always offered in semester indicated.*

Master of Science Degree Program

(See Technical and Professional Communication.)

Computer Education

Master of Science
Concentrations in:
Computer Science Certification
Instructional Technology

Professors
David E. Cook, Ph.D., *chemistry education, computers in education, informal science education, education policy.*

Robert H. Fronk, Ph.D., *computer/technology and geology/biology education, experimental design.*

J. Richard Newman, Ph.D., *computer graphics, information resource management.*

Associate Professors
Michael A. Gallo, Ph.D., *statistics, research design, educational theory, computer technology and networking.*

Assistant Professors
Bradford Allen, Ed.D., *computer simulation, data analysis and reliability, statistical research methodology, testing and evaluation, modeling.*

Richard E. Enstice, Ph.D., *administration in higher education, computers in education, computer networking.*

Master of Science Degree Program

The master's degree in computer education is designed for all teachers who want to further their education in the use of educational technology and microcomputers in school. It is appropriate for teachers at any grade level and for any subject matter area. The curricula are designed for students with minimal background in computers.

Two degree options are offered. The first is for students wishing to teach computer science in high school (requires certification in computer science). The second is Instructional Technology and is for students interested in teaching with technology and computers, and teaching computer applications and computer literacy (does not require certification in computer science).

The master's degree in computer education can be earned either on a full-time or part-time basis. All courses are available in the late afternoon or evening. Full-time students can normally complete the degree in a minimum of three semesters. Students can select either a thesis or nonthesis option.

The goal of the program (depending on the option) is to enable a teacher to teach introductory computer science, computer literacy and programming; use technology and microcomputers in a wide variety of school settings; and evaluate and create educational software materials.

Admission Requirements

Applicants must have a bachelor's degree. In addition, if the program is to be used for teacher certification purposes, the applicant must hold certification (or be certifiable) at the elementary, middle and/or high school levels.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The master's degree in computer education is conferred on students who have successfully completed 30 credit hours including a six-credit thesis or 33 credit hours including three credits of research. The thesis option concludes with an oral thesis presentation/defense. The nonthesis option concludes with a written exam for EDS 5070, 5203 and 5095, and an oral comprehensive examination.

Up to 12 hours of appropriate transfer credit may be applied.

Curriculum

The following core courses are required for both concentrations:

EDS	5070 Educational Statistics*	3
EDS	5095 Essentials of Educational Research*	3
EDS	5203 Theories and Trends in Education*	3
EDS	5226 Introduction to Computers in Education	3
EDS	5227 Educational Software Evaluation and Design	3
EDS	5229 Methods of Teaching Computer Literacy and Computer Science	3

**These three courses must be taken at Florida Tech. Exceptions may be considered only through a written petition to be reviewed by the department's graduate faculty.*

Students selecting the computer science certification concentration with thesis take the six core courses plus six hours of thesis (EDS 5999), a computer language course and one computer science elective, for a total of 30 hours.

Students selecting the computer science certification concentration without thesis take the six core courses plus a computer language course, one computer science elective, three hours of research (EDS 5081) and six hours of electives, for a total of 33 hours.

Students selecting the instructional technology concentration with thesis take the six core courses plus six hours of thesis (EDS 5999), a current topics in computer education course (EDS 5299) and one computer science or computer education elective, for a total of 30 hours.

Students selecting the instructional technology concentration without thesis take the six core courses plus a current topics in computer education course (EDS 5299), one computer science or computer education elective, three hours of research (EDS 5081) and six hours of electives, for a total of 33 hours.

Any schedule that meets the above requirements within a seven-year period is acceptable. Any combination of part-time and/or full-time semesters can be used, as well as any combination of evening and summer courses.

The following is an example of a full-time schedule in the computer science certification concentration without thesis:

FALL		CREDITS
CSE	xxxx Computer Language	3
EDS	5095 Essentials of Educational Research	3
EDS	5226 Introduction to Computers in Education	3
	Elective	3
		12

SPRING

EDS	5070	Educational Statistics 3
EDS	5203	Theories and Trends in Education 3
EDS	5227	Educational Software Evaluation and Design 3
EDS	5229	Methods of Teaching Computer Literacy and Computer Science 3
		12

SUMMER

CSE	xxxx	Computer Science Elective 3
EDS	5081	Research 1 3
		Elective 3
		9

The following is an example of a full-time schedule in the instructional technology concentration without thesis:

FALL		CREDITS
EDS	5095	Essentials of Educational Research 3
EDS	5226	Introduction to Computers in Education 3
EDS	5299	Current Topics in Computers in Education 3
		Elective 3
		12

SPRING

EDS	5070	Educational Statistics 3
EDS	5203	Theories and Trends in Education 3
EDS	5227	Educational Software Evaluation and Design 3
EDS	5229	Methods of Teaching Computer Literacy and Computer Science 3
		12

SUMMER

EDS	5081	Research 1 3
		Computer Science or Computer Education Elective 3
		Elective 3
		9

Facilities

Three technology-teaching laboratories are currently used for this program. A variety of microcomputers and other types of hardware are available for student use in the Science Education Resource Center. The resource center also includes a large number of microcomputer periodicals and current software catalogs. Evans Library houses an additional 70-microcomputer laboratory with an extensive software library.

Departmental research includes study in a variety of aspects of computer education, educational technology and interactive videodisc production.

DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION
D.E. Cook, Ph.D., Head

Environmental Education

Master of Science

Program Chair
Thomas J. Marcinkowski, Ph.D.

Professors
David E. Cook, Ph.D., *chemistry education, computers in education, informal science education, education policy.*

Robert H. Fronk, Ph.D., *computer/technology and geology/biology education, experimental design.*

Associate Professors
Michael A. Gallo, Ph.D., *statistics, research design, educational theory, computer technology and networking.*

Cecilia A. Knoll, Ph.D., *calculus mastery, differential equations, integrating technology into the curriculum.*

Thomas J. Marcinkowski, Ph.D., *environmental studies, curriculum and instruction, research and evaluation design.*

Assistant Professors
Bradford Allen, Ed.D., *computer simulation, data analysis and reliability, statistical research methodology, testing and evaluation, modeling.*

Richard Enstice, Ph.D., *administration in higher education, computers in education, computer networking.*

Master of Science Degree Program

The master's degree program in environmental education is for individuals with experience and/or active interest in formal programs (i.e., schools) and nonformal programs (e.g., nature/environmental centers, agencies, parks, gardens, zoos and museums). The program is designed to provide graduate education in science and environmental content, as well as to expand and improve environmental education teaching skills. To this end, the program includes graduate course work in environmental content, in environmental education and in educational research.

The master's degree program includes course work in an environmental content concentration. Each concentration is designed around a unifying theme for the purpose of expanding environmental knowledge and skills pertinent to that theme (e.g., a disciplinary theme such as ecology; a natural resource theme such as estuaries; or a problem-oriented theme such as water quality). Concentrations reflect the academic and research strengths of programs within the university. Programs that offer course work for inclusion in environmental content concentrations include ecology and marine biology; environmental science and environmental resources management; biological, chemical and geological oceanography; coastal zone management and marine environmental science. Further, to provide breadth to the development of knowledge and skills, concentrations are designed to include course work in each of the following areas: ecology or another foundational science; environmental problems; environmental fieldwork or monitoring; and environmental policy, planning or management.

The master's degree program also includes course work in environmental education foundations and methods. The foundations course is designed to develop and expand knowledge of the field and of educational practices in the field from diverse perspectives. The methods courses are designed to develop and improve teaching skills. To accommodate students' differing backgrounds and interests, course projects and assignments allow students to develop and apply these skills in relevant contexts or settings.

Admission Requirements

The master's program is designed for individuals holding bachelor's degrees in areas of science, environmental studies, environmental interpretation or K–12 education. All entering students are expected to have a background in the sciences and in education that will permit them to successfully

complete graduate course work. Individuals for whom this may be a concern are encouraged to discuss this directly with the program chair.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog. This section also contains information on financial assistance.

Degree Requirements

The master of science degree is conferred on students who have successfully completed 33 credit hours, as specified in the following section. The program concludes with a written exam for EDS 5070 and 5095, and an oral comprehensive examination.

Curriculum

The following courses are required:

EDS	5070 Educational Statistics*	3
EDS	5081 Research 1	3
EDS	5095 Essentials of Educational Research*	3
EDS	5410 Foundations of Environmental Education	3
EDS	5420 Methods in Ecology and Environmental Content	3
EDS	5430 Methods for Environmental Problems and Issue Investigation	3
EDS	5440 Methods for Citizenship and Environmental Responsibility	3

** These two courses must be taken at Florida Tech. Exceptions may be considered only through a written petition to be reviewed by the department's graduate faculty.*

In addition to these seven courses, a minimum of 12 credit hours (i.e., usually four content courses) must be taken in a chosen environmental content concentration. With departmental approval, up to six credit hours of 3000- and 4000-level course work may be included in the content concentration.

Any schedule that would meet these requirements within a seven-year period is acceptable. Any combination of part-time and/or full-time semesters can be used, as well as any combination of daytime, evening, and weekend and summer courses. The following is one example of a common schedule.

FALL		CREDITS
EDS	5410 Foundations of Environmental Education	3
	Environmental Content Concentration Course	3
		6
SPRING		
EDS	5420 Methods in Ecology and Environmental Science Content	3
	Environmental Content Concentration Courses	6
		9
FALL		
EDS	5095 Essentials of Educational Research	3
EDS	5430 Issue Investigation and Evaluation	3
	Environmental Content Concentration Course	3
		9
SPRING		
EDS	5070 Educational Statistics	3
EDS	5081 Research 1	3
EDS	5440 Citizenship and Environmental Responsibility	3
		9
	TOTAL CREDITS REQUIRED	33

DEPARTMENT OF HUMANITIES AND COMMUNICATION
N.I. Matar, Ph.D., Head

Humanities

Bachelor of Arts

Professors

Nabil I. Matar, Ph.D., *17th-century English literature, Anglo-Islamic history in the Renaissance, civilization of Islam.*

Gordon M. Patterson, Ph.D., *19th- and 20th-century intellectual history, American history, history of science and technology.*

Rudolph W. Stoeckel, Ph.D., *English Renaissance drama, medieval and renaissance Tuscan history, contemporary American literature.*

Associate Professors

Randall L. Alford, Ph.D., *general linguistics, grammatical theory, language education, German, English as a second language.*

Robert L. Shearer, Ph.D., *history of philosophy, existentialism, logic, music history and performance.*

Judith B. Strother, Ph.D., *theoretical and applied business communication, scientific and technical communication, editing, applied linguistics, psycholinguistics.*

Robert A. Taylor, Ph.D., *modern American history, American Civil War, Florida history.*

Jane T. Tolbert, Ph.D., *journalism, mass communication, scientific and technical communication.*

Assistant Professors

Marcia Denius, M.F.A., *poetry, creative writing, scriptwriting, women writers.*

Lars Jones, Ph.D., *medieval and renaissance European art, photojournalism, iconography.*

Alan M. Rosiene, Ph.D., *rhetorical theory, history of literary theory, deconstruction, cultural studies, freshman composition.*

Peter-Otto Uhr, Ph.D., *foreign languages, literature, history.*

Adjunct Professors

D. Bailey, Ph.D.; W. Picard, Ph.D.

Professors Emerita

Margot A. Haberhern, Ph.D.; Jane E. Patrick, Ph.D.

Instructors

P. Bernard, M.S.; C. Frongillo, Ph.D.; B. Leach, M.A.; M. Mullins, M.A.; M. Ruane, M.A.; D. Russell, M.S.; J. Stottler, M.A.; J. Teegen, M.A.; F. Wallace, M.S.Ed.

Bachelor of Arts Degree Program

The major in humanities is an interdisciplinary program of liberal studies with an emphasis on literature, history, philosophy and the fine arts. As a study of the thoughts, actions and values of human beings, along with a comprehensive background in science, mathematics and computers, the humanities major has broad applicability. As a result of the ample allotment of electives, students may adapt the program to individual needs and interests. The major also prepares graduates for a wide variety of careers, including teaching, editing, scriptwriting, public relations, advertising and copywriting. Students wishing to pursue graduate study will be prepared to enter programs in their respective areas of concentration, such as history, philosophy or literature.

Degree Requirements

Candidates for a Bachelor of Arts in Humanities require a total of 120 hours for graduation as follows.

COM	1101 Composition and Rhetoric	3
COM	1102 Writing about Literature	3
COM	xxxx Business and Professional Writing or Speech	3
HUM	2051 Civilization 1	3
HUM	2052 Civilization 2	3

Foreign Language (12 hours)—Four courses in the same language.

Concentration (12 hours)—2000- and higher-level courses from one of the following areas: literature, history or philosophy. The senior capstone project consists of original research resulting in a substantial written work about a significant issue in the humanities.

Humanities (27 hours)—Including at least three hours in each of the following areas: art, music, history, literature and philosophy.

Mathematics (6 hours)

Physical or Life Sciences (6 hours)

Computer Science (3 hours)

Liberal Arts Electives (24 hours)

Social Science Elective (3 hours)

Free Electives (12 hours)

Freshman Year

FALL		CREDITS
COM 1101	Composition and Rhetoric	3
CSE 1301	Introduction to Computer Applications	3
LNG xxxx	Foreign Language	3
MTH 1701	College Algebra	3
	Restricted Elective (Science)	3
		15
SPRING		
COM 1102	Writing about Literature	3
LNG xxxx	Foreign Language	3
MTH 1702	Applied Calculus	3
	Restricted Elective (Science)	3
	Free Elective	3
		15

Sophomore Year

FALL		CREDITS
COM 2224	Business and Professional Writing	3
HUM 2051	Civilization 1	3
LNG xxxx	Foreign Language	3
	Humanities Elective	3
	Liberal Arts Elective	3
		15
SPRING		
HUM 2052	Civilization 2	3
HUM xxxx	Humanities Elective	3
LNG xxxx	Foreign Language	3
	Liberal Arts Elective	3
	Social Science Elective	3
		15

Junior Year

FALL		CREDITS
	Concentration	3
HUM xxxx	Humanities Electives	6
	Liberal Arts Elective	3
	Free Elective	3
		15
SPRING		
	Concentration	3
HUM xxxx	Humanities Elective	3
	Liberal Arts Electives	6
	Free Elective	3
		15

Senior Year

FALL		CREDITS
	Concentration	3
HUM xxxx	Humanities Electives	6
	Liberal Arts Elective	3
	Free Elective	3
		15
SPRING		
HUM 4100	Senior Capstone Project	3
HUM xxxx	Humanities Electives	6
	Liberal Arts Electives	6
		15

TOTAL CREDITS REQUIRED 120

Interdisciplinary Science

DEPARTMENT OF PHYSICS AND SPACE SCIENCES
Laszlo Baksay, Ph.D., Head

Bachelor of Science
Military Science Option

Professors
Michael W. Babich, Ph.D., *chemistry.*

Laszlo Baksay, Ph.D., *physics and space sciences.*

Thomas V. Belanger, Ph.D., *marine and environmental systems.*

Robert H. Fronk, Ph.D., *science education.*

Nabil I. Matar, Ph.D., *humanities.*

Lt. Col. Thomas L. Tate, *military science.*

Gary N. Wells, Ph.D., *biological sciences.*

Gary A. Zarillo, Ph.D., *oceanography.*

Assistant Professor
Hector Gutierrez, Ph.D., *mechanical and aerospace engineering.*

Bachelor of Science Degree Program

Because of the increasing importance of science and technology in our daily lives, Florida Tech has recognized the need for an interdisciplinary program in the sciences that allows a student to enroll in a wide variety of science and engineering courses, supplemented by certain core courses and several carefully chosen electives. The most important characteristics of this degree are that it is flexible and tailored to the individual student's needs, and that it emphasizes broad training in science. The graduate will have a well-rounded appreciation of science and its place in society, and will have acquired specific tools for his or her career.

The bachelor's degree in interdisciplinary science is intended for students who plan graduate study in professional fields, those who are interested in a broadly based degree oriented toward the sciences or engineering, former science and engineering students who want a degree with wider scope and students seeking military careers.

Graduates normally seek employment opportunities in aerospace, environmental work, medicine and health technology, personnel work, purchasing, development, management, the military, social work, marketing—in general, a wide variety of positions requiring an interdisciplinary background—as well as opportunities for advanced study, especially in the professional fields.

Because of the great flexibility of the interdisciplinary science program, it is important that a student plan his or her program with an adviser as soon as possible. The adviser will be one of the department heads in the College of Science and Liberal Arts (listed above) or another faculty member designated by them. The student's committee will be composed of those faculty deemed most appropriate to the student's goals and objectives. A committee normally consists of three members, including the adviser. The basic requirements of the degree are given below, followed by a sample four-year program. The interdisciplinary science courses are chosen by the student to conform to his or her program plan. These courses must have the approval of the student's adviser and committee, as well as the program chair. Students should start with a firm idea about the purpose of their degree and plan the program accordingly. The adviser will present some explicit four-year programs and suggest ideas about what courses are available, but each four-year program is tailored to specific needs, and therefore must be developed jointly by the student and adviser. Before enrolling for more than 30 semester credits, the student is required to file a detailed plan of study. The plan must list the courses the student wishes to take, and explain why this set of courses fulfills his or her objectives. If the objectives change, modifications of the plan of study will be allowed if approved by the student's committee. During the final semester, as part of the capstone experience, the student is required to write and orally present a paper.

Degree Requirements

Communication (9 hours)
COM 1101 Composition and Rhetoric
COM 1102 Writing about Literature
COM 2223 Scientific and Technical Communication

Computer Science (3 hours)
CSE 1502 Introduction to Software Development/C++
or
CSE 1503 Introduction to Software Development/FORTRAN

Humanities (12 hours)
HUM 2051 Civilization 1
HUM 2052 Civilization 2
HUM 3351 History of Science and Technology 1
HUM 3352 History of Science and Technology 2

Mathematics (8 hours)
MTH 1001 Calculus 1
MTH 1002 Calculus 2

Interdisciplinary Science (44 hours)
(at least 21 hours must be 3000/4000-level science courses)

Liberal Arts Electives (12 hours)
(at least 6 hours must be 3000/4000-level courses, and at least 3 hours must be in the social sciences)

Physical or Life Science Electives (8 hours)

Technical Electives (Science or Engineering) (22 hours)
(at least 3 hours must be 3000/4000-level courses)

Free Electives (6 hours)

Capstone Seminar (1 hour)
(must follow at least 37 hours of 3000- or 4000-level courses)

Typical Curriculum

The interdisciplinary science curriculum is extremely flexible since many students enter this major after several semesters at Florida Tech. Although program plans are typically designed on a student-by-student basis to meet individual needs and interests while fulfilling all degree requirements listed above, the following provides a general model that is followed by many students.

Freshman Year

FALL	CREDITS
COM 1101 Composition and Rhetoric	3
MTH 1001 Calculus 1	4
Physical/Life Science Electives	4
Technical Electives	4
	15

SPRING	
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
Physical/Life Science Electives	4
Technical Elective	4
	15

Sophomore Year

FALL	CREDITS
COM 2223 Scientific and Technical Communication	3
HUM 2051 Civilization 1	3
Interdisciplinary Science Courses	7
Technical Elective	3
	16

SPRING	
CSE 15xx Restricted Elective (Computer Science)	3
HUM 2052 Civilization 2	3
Interdisciplinary Science Course	3
Technical Electives	8
	17

Junior Year

FALL	CREDITS
HUM 3351 History of Science and Technology 1	3
Interdisciplinary Science Courses	7
Liberal Arts Elective	3
Technical Elective	3
	16

SPRING	
HUM 3352 History of Science and Technology 2	3
Interdisciplinary Science Courses	9
Liberal Arts Elective	3
	15

Senior Year

FALL	CREDITS
Interdisciplinary Science Courses	9
Liberal Arts Elective	3
Free Elective	3
	15

SPRING	
EDS 4900 Capstone Seminar	1
Interdisciplinary Science Courses	9
Liberal Arts Elective	3
Free Elective	3
	16

TOTAL CREDITS REQUIRED 125

Military Science Option

The military science option prepares Florida Tech ROTC cadets to serve as commissioned officers in the United States Army, Army Reserve and Army National Guard. Technical, scientific and military studies are incorporated into the curriculum with emphasis on applied leadership and problem solving skills. A popular option is attendance at the ROTC basic camp, "Camp Challenge," during the summer between the second and third years. This 32-day camp provides students with basic military and problem solving skills, combined with physical training.

The bachelor of science degree in interdisciplinary science, military science option, is earned by satisfying the degree requirements listed above and completing the advanced military science program, as described in the *Nondegree Programs* section of this catalog. All military science (MSC) courses taken are applicable to this degree, with up to 17 credits being applicable toward meeting the interdisciplinary science requirement. See the *Nondegree Programs* section for descriptions of the ROTC program and the sequencing and descriptions of the military science courses.

Mathematics Education

DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION
D.E. Cook, Ph.D., Head

Bachelor of Science *Master of Science* *Education Specialist* *Doctor of Education* *Doctor of Philosophy*

Professors
David E. Cook, Ph.D., *chemistry education, computers in education, informal science education, education policy.*

Robert H. Fronk, Ph.D., *computer/technology and geology/biology education, experimental design.*

Associate Professors
Michael A. Gallo, Ph.D., *statistics, research design, educational theory, computer technology and networking.*

Cecilia A. Knoll, Ph.D., *calculus mastery, differential equations, integrating technology into the curriculum.*

Thomas J. Marcinkowski, Ph.D., *environmental studies, curriculum and instruction, research and evaluation design.*

Assistant Professors
Bradford Allen, Ed.D., *computer simulation, data analysis and reliability, statistical research methodology, testing and evaluation, modeling.*

Richard Enstice, Ph.D., *administration in higher education, computers in education, computer networking.*

Instructor and Director, Teacher Education
Debra S. Blenis, M.S.

Bachelor of Science Degree Program

The recommended program plan is given below. Teacher certification areas may be Mathematics 6–12 or Middle Grades Mathematics 5–9. All applicants must meet the current entrance requirements for teacher-education programs established by the Florida Department of Education.

A full year of student teaching during the senior year provides the student with many experiences encountered in the teaching profession. To graduate from a teacher-education program approved by the Florida Board of Education, the student must meet all requirements for obtaining a Florida Educator's Certificate including completing the course work from an approved program plan with a minimum 2.5 GPA, passing the General Knowledge Skills Test, passing the Professional and Subject areas of the Florida Teacher Certification examination and earning a minimum 3.0 grade point average for 18 credit hours of student teaching. (See Chapter 6A-4.004 of the Rules of the Department of Education, State Board of Education.)

Teacher preparation programs in the state of Florida are required by Title II, section 207, of the Higher Education Act to make public their Institutional Report Cards. Florida Tech's report card is on our Web site: www.fit.edu/education.

Freshman Year

FALL	CREDITS
COM 1101 Composition and Rhetoric	3
EDS 1005 Introduction to Education	3
MTH 1001 Calculus 1	4
PSY 1411 Introduction to Psychology	3
	13

SPRING	
COM 1102 Writing about Literature	3
COM 2370 Speech	3
EDS 1032 Survey of Science 2	3
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
	18

Sophomore Year

FALL	CREDITS
EDS 2032 Educational Technology	3
HUM 2051 Civilization 1	3
MTH 2401 Probability and Statistics	3
MTH 2001 Calculus 3	4
PHY 2002 Physics 2	4
PHY 2092 Physics Lab 2	1
	18

SPRING	
EDS 2042 Literacy Instruction in Secondary School Content	3
HUM 3332 American History: From Reconstruction to the Present	3
MTH 2201 Differential Equations/Linear Algebra	4
MTH 4801 Advanced Geometry	3
PSY 2443 Psychology of Education	3
or	
PSY 3421 Psychology of Learning and Motivation	3
	16

Junior Year

FALL	CREDITS
EDS 3033 Measurement and Evaluation	3
EDS 3095 Clinical and Field Experience 1	2
EDS 4051 Methods and Management of Middle and High School Teaching	4
MTH 2051 Discrete Mathematics	3
Restricted Elective (Earth Science)	3
	15

SPRING	
EDS 3034 Assessment and Evaluation	3
EDS 3096 Clinical/Field Experience 2	2
EDS 4072 Methods and Strategies for Teaching Middle and Secondary Mathematics	4
HUM 3352 History of Science and Technology: Renaissance to Present	3
HUM xxxx Restricted Elective (Fine Arts)	3
MTH xxxx Restricted Elective (Mathematics)	3
	18

Senior Year

FALL	CREDITS
EDS 4061 Multilingual/Multicultural Education	3
EDS 4095 Student Teaching 1	6
MTH 4101 Introductory Analysis	3
Free Elective	3
	15

SPRING	
EDS 4096 Student Teaching 2	12
	12

TOTAL CREDITS REQUIRED 125

Master of Science Degree Program

The master's program for students holding bachelor's degrees in mathematics includes advanced graduate training in mathematics, in addition to courses designed to develop and improve teaching skills. One program offers regular graduate work in mathematics while also providing the necessary course requirements for state certification of secondary school teachers. A second program is designed for those not wishing to teach in a secondary school and does not lead to certification.

The master's program for students holding bachelor's degrees in mathematics education includes courses for teachers in mathematics, in addition to advanced graduate courses in mathematics education. The mathematics courses are designed to develop and upgrade subject matter knowledge. The mathematics education courses complement previous educational experience and are aimed specifically at mathematics teaching.

Admission Requirements

The master's program is designed for individuals holding bachelor's degrees either in mathematics or in middle or secondary school mathematics education.

If the program is to be used for teacher certification purposes, the applicant must hold certification (or be certifiable) at the elementary, middle and/or high school levels.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The master of science degree requires successful completion of 30 credit hours including six credits of thesis, or 33 credit hours including three credits of research. The thesis option concludes with an oral thesis presentation/defense. The non-thesis option concludes with a written exam for EDS 5070, 5203 and 5095, and an oral comprehensive examination.

Curriculum

The following courses are required and must be taken at Florida Tech. Exceptions may be considered only through a written petition to be reviewed by the department's graduate faculty:

EDS 5070 Educational Statistics 3
EDS 5095 Essentials of Educational Research 3
EDS 5203 Theories and Trends in Education 3

A minimum of three mathematics courses (9 credit hours) is required.

A minimum of two additional graduate education courses (6 credit hours) and six credit hours of Thesis (EDS 5999) are required for the thesis option.

A minimum of three additional graduate education courses (9 credit hours), three credit hours of electives and three credit hours of Research (EDS 5081) are required for the nonthesis option.

With departmental approval, up to six credit hours of senior-level courses can be applied toward the master of science program.

Any schedule that would meet these requirements within a seven-year period is acceptable. Any combination of part-time and/or full-time semesters may be used, as well as any combination of evening and summer courses. The following is an example of a common schedule (nonthesis option):

FALL		CREDITS
EDS 5095	Essentials of Educational Research	3
	Education Electives	6
	Mathematics Elective	3
		12
SPRING		
EDS 5070	Educational Statistics	3
EDS 5203	Theories and Trends in Education	3
	Education Elective	3
	Mathematics Elective	3
		12
SUMMER		
EDS 5081	Research 1	3
	Mathematics Elective	3
	Elective	3
		9
	TOTAL CREDITS REQUIRED	33

Educational Specialist Degree Program

The primary emphasis of the educational specialist degree is on the development of specific competencies needed in mathematics education.

Admission Requirements

The applicant to the educational specialist program must hold a master's degree in mathematics or education, with mathematics as the teaching area.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

A candidate for the educational specialist degree must maintain a grade point average of 3.0 or better in a 30-credit-hour program. Although research methodologies are included in the curriculum, no thesis is required. A final examination is given in the last semester of enrollment by a three-member committee appointed by the department head and approved by the Graduate School office. A student can transfer up to 12 hours of graduate credit from other approved institutions offering at least the educational specialist degree.

Curriculum

Candidates for the educational specialist degree must complete 30 credit hours of course work beyond the master's degree as follows:

Current Research and Methodologies in Mathematics Education (9 credit hours)—Must be taken at Florida Tech; exceptions may be considered only through a written petition to be reviewed by the department's graduate faculty.

EDS 5070 Educational Statistics 3
EDS 5095 Essentials of Educational Research 3
EDS 5203 Theories and Trends in Education 3

Mathematics (9 credit hours)—The candidate must have earned a minimum of 21 graduate hours in mathematics beyond the bachelor's degree. These hours include the nine specifically required for the specialist degree and any other hours from approved postbaccalaureate mathematics courses.

Education (9 credit hours)—Approved by the head of the department.

Electives (3 credit hours)—Each student chooses an elective to fit a particular certification and/or interest area.

Doctoral Degree Programs

The doctor of philosophy (Ph.D.) and doctor of education (Ed.D.) programs are designed to provide increased competence in mathematics, mathematics education and research. Recipients gain the appropriate knowledge and skills for positions in college and university mathematics education programs; teaching, administration and supervisory posts in state and local school systems; positions teaching mathematics in liberal arts colleges and introductory mathematics courses in universities; and as research directors in mathematics education.

The primary difference between the Ph.D. and Ed.D. programs is in the focus of the dissertation work. The focus of the Ph.D. is typically theoretical, while the focus of the Ed.D. is more applied and intended for the practitioner. While Ph.D. dissertation research is oriented for the student going into a university graduate teaching and research setting, Ed.D. dissertation research is oriented for the K–12 school or business/industry practitioner and typically involves a practical field problem.

The two programs also differ in the requirement of two specialty area courses in the Ed.D. These two courses are typically in mathematics education, but may also be in science education, instructional technology or environmental education.

Doctoral students interested in theory-based research should consider the Ph.D. For those more interested in practical field research, the Ed.D. would be more appropriate.

Admission Requirements (both programs)

An applicant to the doctoral program in mathematics education must have a master's degree in mathematics or mathematics education, with a cumulative grade point average of at least 3.2 on a 4.0 scale. At least three years' teaching experience is also highly recommended.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements (both programs)

A minimum of 48 credit hours beyond the master's degree is required to earn the doctoral degree. These credits include 24 credit hours of dissertation in addition to the required course work.

REQUIRED COURSES	CREDITS
EDS 5070 Educational Statistics	3
EDS 5095 Essentials of Educational Research	3
EDS 5203 Theories and Trends in Education	3
EDS 6070 Statistics for Educational Research	3

These courses must be taken at Florida Tech. Exceptions may be considered only through a written petition to be reviewed by the department's graduate faculty.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Written comprehensives and oral comprehensives must be completed in the same semester. The doctoral comprehensive examinations are given in the last full week of September and January.

Curriculum

Doctor of Philosophy (Ph.D.)

Major Technical Area—A minimum of 21 credit hours beyond the bachelor's degree must be taken in mathematics. These 21 hours may include courses from previous graduate degrees as well as courses taken as part of the Ph.D. program.

Research—A minimum of 24 credit hours must be devoted to dissertation research including at least three hours of Readings in Educational Research (EDS 6000), at least three hours of Research Practicum (EDS 6010) and at least 18 hours of Dissertation (EDS 6999).

Doctor of Education (Ed.D.)

Major Technical Area—A minimum of 18 credit hours beyond the bachelor's degree must be taken in mathematics. These 18 hours may include courses from previous graduate degrees as well as courses taken as part of the Ed.D. program.

Specialty Area—A minimum of six credit yours must be taken in mathematics education. (Specialty area credits may also be in science education, instructional technology or environmental education.)

Research—A minimum of 24 credit hours must be devoted to dissertation research including at least three hours of Readings in Educational Research (EDS 6000), at least three hours of Research Practicum (EDS 6010) and at least 18 hours of Dissertation (EDS 6999). A non-credit Research Seminar (EDS 6090) is also required.

Operations Research

DEPARTMENT OF MATHEMATICAL SCIENCES
V. Lakshmikantham, Ph.D., Head

Master of Science *Doctor of Philosophy*

Associate Head
Michael D. Shaw, Ph.D.

Professors
Jewgeni H. Dshalalow, Dr. Sci., *real analysis, stochastic processes, queuing theory.*

V. Lakshmikantham, Ph.D., *nonlinear analysis, differential and integral equations, numerical mathematics, evolution operations, nonlinear game theory.*

Muzaffar A. Shaikh, Ph.D., *management science, decision modeling, mathematical programming, management information systems.*

Wade H. Shaw Jr., Ph.D., *management of technology, simulation, artificial intelligence, modeling, information systems and quality.*

Associate Professor
Michael D. Shaw, Ph.D., *nonlinear differential equations, Lyapunov stability theory, variation of parameters methods, initial time difference.*

Assistant Professor
Bradford Allen, Ed.D., *computer simulation, mathematics education, data analysis and reliability, statistical research methodology, testing and evaluation, modeling.*

Professor Emeritus
Frederick B. Buoni, Ph.D.

Operations research is a scientific approach to analyzing problems and making decisions. It uses mathematics and mathematical modeling on computers to forecast the implications of various choices and identify the best alternatives.

Operations research methodology is applied to a broad range of problems in both the public and private sectors. These problems often involve designing systems to operate in the most effective way. Many problems deal with the allocation of scarce human resources, money, materials, equipment or facilities. Applications include staff scheduling, vehicle routing, warehouse location, product distribution, quality control, traffic light phasing, police patrolling, preventive maintenance scheduling, economic forecasting, design of experiments, power plant fuel allocation, stock portfolio optimization, cost-effective environmental protection, inventory control and university course scheduling.

Operations research is interdisciplinary and draws heavily from the mathematics program. It also uses courses from computer science, engineering management and other engineering programs.

Master of Science Degree Program

The Master of Science in Operations Research offers concentrations that emphasize those areas of application most in demand in today's job market. Graduates have skills that include probability and statistics, deterministic and stochastic models, optimization methods, computation and simulation, decision analysis and the ability to effectively communicate with clients and managers. In addition, graduates have a breadth of knowledge that allows them to work in teams, interacting with people who bring different expertise to a problem. All areas involve expertise with standard computer software packages.

Admission Requirements

An applicant for the master's program in operations research should have an undergraduate major in a science or engineering discipline that requires a significant amount of mathematics. Business majors with strong quantitative backgrounds are also encouraged to apply. A proficiency in mathematics covering topics in calculus and linear algebra and the use of a high-level programming language such as FORTRAN, Pascal or C must be demonstrated by testing or suitable course work.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The master of science degree can be pursued with either a thesis or nonthesis option; each requires 33 credit hours. Under the thesis option, up to six credit hours of thesis may be granted in place of electives toward the required 33 hours and an oral defense is required. The nonthesis option requires a comprehensive examination. Courses taken to satisfy admission prerequisites cannot be counted toward the degree requirements.

Curriculum

The program's curriculum is designed to provide breadth with some flexibility to accommodate the diversity of backgrounds typically found in an operations research program. Greater flexibility is provided for the elective courses beyond the core. A student has the choice of developing greater depth in one area of specialization, aiming at eventual research in that area, or continuing to develop breadth across more than one area. By choosing courses in a related field of application, students can prepare for careers in specialty areas such as management science, actuarial science or economic modeling in addition to conventional areas of operations research.

Each student will complete a program plan that satisfies the requirements listed below, subject to approval of the adviser and program chair. Substitutions are sometimes permitted.

Core Courses (12 credits)
MTH 5411 Mathematical Statistics 1
ORP 5001 Deterministic Operations Research Models
ORP 5002 Stochastic Operations Research Models
ORP 5010 Mathematical Programming
or
ORP 5003 Operations Research Practice

Restricted Electives (9 credits from the following list)
MTH 5051 Applied Discrete Mathematics
MTH 5102 Linear Algebra
MTH 5401 Applied Statistical Analysis
MTH 5412 Mathematical Statistics 2
ORP 5020 Theory of Stochastic Processes
ORP 5021 Queuing Theory

Computation/Computer Science Elective (3 credits from the following list)
CSE 5100 Data Structures and Algorithms
CSE 5210 Formal Languages and Automata Theory
CSE 5211 Analysis of Algorithms
CSE 5290 Artificial Intelligence
CSE 5610 Computational Complexity
MTH 5301 Numerical Analysis
MTH 5305 Numerical Linear Algebra
MTH 5320 Neural Networks
ORP 5050 Discrete System Simulation

Free Electives (9 credits)

Nonthesis option—Three courses in areas of interest to the student as approved in the student's program plan.

Thesis option—At least one course plus up to six credits for a thesis. The thesis should be an in-depth study of some topic and/or problem in operations research, subject to the approval of the thesis committee.

Doctor of Philosophy Degree Program

The doctor of philosophy program provides a more advanced level of education, as well as demonstrated ability to perform independent research. These additional strengths should qualify the graduate for vital positions of leadership in industry, business, government and academia.

Admission Requirements

An applicant for the doctoral program will normally have completed a master's degree in operations research or a related discipline. If the master's degree is not in operations research, then the student will be required to take the core courses for Florida Tech's master's degree in operations research. These courses may be used toward fulfilling the credit requirements for the Ph.D. in operations research. Students also will be required to take a written qualifying examination equivalent to Florida Tech's master's comprehensive examination.

General admission requirements are discussed in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

A minimum of 48 credit hours beyond the requirements for the master's degree is required to earn the doctoral degree. These credits include 24 credit hours of dissertation research in addition to normal course work.

Each student must complete an approved program of study, pass a comprehensive examination, complete a program of significant original research, and defend a dissertation concerning the research.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

The individual doctoral program of study must be approved by the student's doctoral committee and the program chair. Students who have not taken MTH 5001 and MTH 5102, or their equivalents, will be required to take them. Students are also required to take at least two courses from the Computation/Computer Science list above.

The doctoral program in operations research does not fall within the traditional boundaries of a single discipline. The scope is broad and interdisciplinary. Consequently, every course in a student's program of study is evaluated in terms of how it complements other courses and provides breadth and depth to the program. Considerable latitude is permitted in course selection, provided the core requirements for operations research/mathematics/computation are met. The remaining courses are selected in collaboration with the Doctoral Committee according to the interests and research objectives of the student.

Research

Current active research efforts include the modeling of controlled queuing systems, stochastic processes, applied statistics, design of experiments, neural networks, parallel processing and algorithms, decision-making under uncertainty, simulation, engineering management, quality control, optimization models and methods, scheduling and timetabling algorithms, applied graph theory and integer programming.

DEPARTMENT OF PHYSICS AND SPACE SCIENCES
Laszlo Baksay, Ph.D., Head

Physics

Bachelor of Science *Master of Science* *Doctor of Philosophy*
Preprofessional Physics Option

Professors

Laszlo Baksay, Ph.D., *experimental high-energy physics at LHC and LEP/CERN, detector development, maglev.*

T. Dwayne McCay, Ph.D., *materials science, materials processing in space.*

Terry D. Oswalt, Ph.D., *stellar spectroscopy and photometry, white dwarf stars, binary stars, stellar activity, minor planets and comets.*

Associate Professors

Marc M. Baarmand, Ph.D., *experimental particle physics at Fermi National Accelerator Laboratory and CERN.*

Joseph R. Dwyer, Ph.D., *space physics, solar and heliospheric energetic particle observations, space instrumentation, upward propagating lightning.*

Rong-sheng Jin, Ph.D., *terrestrial geomagnetism, especially changes in Earth's field with time; correlation with Earth's rotation rate.*

Hamid K. Rassoul, Ph.D., *observation and modeling of magnetic storms and substorms, photochemistry of Earth's upper-atmosphere, solar wind-magnetosphere interactions, upward propagating lightning.*

Matthew A. Wood, Ph.D., *astrophysics, theory and observations of white dwarf stars, cataclysmic variables.*

Ming Zhang, Ph.D., *cosmic radiation and interactions with the plasma and magnetic fields in the interstellar medium, the heliosphere and magnetospheres.*

Assistant Professors

Marcus Hohlmann, Ph.D., *particle physics, experimental high-energy physics with L3 and CMS experiments at CERN, development of particle detectors.*

James G. Mantovani, Ph.D., *condensed matter theory and experiment, particularly surface physics and electron microscopy.*

Benjamin M. Sawyer, M.S., *physics education.*

Adjunct Professor

Marcelo Alonso, Ph.D.

Professors Emeriti

Joel H. Blatt, Ph.D.; Jay Burns, Ph.D.; James D. Patterson, Ph.D.

Director of Undergraduate Laboratories

J.A. Gering, M.S.

Bachelor of Science Degree Program

Physics is the discipline most directly concerned with understanding the physical world on a fundamental level. As such, it covers an extremely broad range of subjects and areas of specialization that seek to unify and understand this diversity in terms of the smallest possible number of laws and principles. A physicist therefore must receive a broad, general training in science. Mathematics, a primary tool, must be developed, as well as experimental laboratory skills. Most important is the development of a variety of problem-solving skills and a critical, incisive approach to physical problems. The curriculum includes core courses in physics, mathematics and related sciences, plus a liberal mixture of applied courses from engineering fields and an enriching selection of humanities electives. Students considering a career in medicine or other health sciences should consider the physics preprofessional option detailed below. A degree in physics provides an excellent background for entering the health sciences.

Undergraduate Research

Research is a major activity of the department, which possesses good instrumentation required for research in selected areas of physics. Participation in research programs by undergraduates is strongly encouraged. A maximum of six semester hours of research can be used to fulfill technical and free elective requirements.

Degree Requirements

Candidates for the Bachelor of Science in Physics must complete the course requirements listed in the following sample curriculum. Because the subject matter of general physics forms a critically important foundation for all advanced physics courses, the minimum grade for satisfying the prerequisite requirements for a physics major is a grade of C for each of the following courses: PHY 1001, PHY 2002, PHY 2003, PHY 2091 and PHY 2092.

Freshman Year

FALL	CREDITS
CHM 1101 Chemistry 1	4
COM 1101 Composition and Rhetoric	3
MTH 1001 Calculus 1	4
PHY 1050 Physics and Space Science Seminar	1
SPS 1010 Introduction to Astronomy	3
	15

SPRING	
CHM 1102 Chemistry 2	4
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics Laboratory 1	1
	16

Sophomore Year

FALL	CREDITS
CSE 15xx Restricted Elective (Computer Science)	3
HUM 2051 Civilization 1	3
MTH 2001 Calculus 3	4
PHY 2002 Physics 2	4
PHY 2092 Physics Laboratory 2	1
	15

SPRING	
HUM 2052 Civilization 2	3
MTH 2201 Differential Equations/Linear Algebra	4
PHY 2003 Modern Physics	3
Social Sciences Elective	3
Free Elective	3
	16

Junior Year

FALL	CREDITS
COM 2223 Scientific/Technical Communication	3
MTH 3101 Complex Variables	3
PHY 3011 Physical Mechanics	4
PHY 3060 Thermodynamics, Kinetic Theory and Statistical Mechanics	4
Free Elective	3
	17

SPRING	
MTH 3201 Boundary Value Problems	3
PHY 3035 Quantum Mechanics	4
PHY 3152 Electronic Measurement Techniques	4
PHY 3440 Electromagnetic Theory	3
Humanities Elective	3
	17

Senior Year

FALL	CREDITS
PHY 4020 Optics	3
PHY 4021 Experiments in Optics	1
PHY 4033 Introduction to Solid State Physics	3
PHY 4200 Senior Seminar 1	1
Restricted Elective (MTH or CSE)	3
Technical Elective or Senior Research	3
Free Elective	3
	17

SPRING	
PHY 4030 Introduction to Subatomic Physics	3
PHY 4071 Senior Laboratory 2	2
PHY 4210 Senior Seminar 2	1
Free Elective	3
Humanities or Social Science Elective	3
Technical Elective or Senior Research	3
	15

TOTAL CREDITS REQUIRED 128

Preprofessional Physics Option

This option offers the courses needed to meet the entrance requirements of essentially all schools of medicine, dentistry, osteopathic medicine, podiatry and optometry, as well as the nonagricultural courses for veterinary medicine. The preprofessional adviser has up-to-date information on admission requirements for most professional schools, including appropriate admission tests. The preprofessional committee provides the professional schools with required evaluations of student performance. A student contemplating admission to a professional school should consult the preprofessional adviser early in the program.

Freshman Year

FALL	CREDITS
BIO 1010 Biological Discovery 1	4
CHM 1101 Chemistry 1	4
COM 1101 Composition and Rhetoric	3
MTH 1001 Calculus 1	4
PHY 1050 Physics and Space Science Seminar	1
	16

SPRING	
BIO 1020 Biological Discovery 2	4
BIO 1200 Introduction to the Health Professions	1
CHM 1102 Chemistry 2	4
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
	17

Sophomore Year

FALL	CREDITS
CHM 2001 Organic Chemistry 1	3
CHM 2011 Organic Chemistry Lab 1	2
COM 1102 Writing about Literature	3
MTH 2001 Calculus 3	4
PHY 2002 Physics 2	4
PHY 2091 Physics Lab 1	1
	17

SPRING	
CHM 2002 Organic Chemistry 2	3
CHM 2012 Organic Chemistry Lab 2	2
COM 2223 Scientific/Technical Communication	3
MTH 2201 Differential Equations/Linear Algebra	4
PHY 2003 Modern Physics	3
PHY 2092 Physics Lab 2	1
	16

Junior Year

FALL	CREDITS
HUM 2051 Civilization 1	3
MTH 3201 Boundary Value Problems	3
PHY 3011 Physical Mechanics	4
PHY 3060 Thermodynamics, Kinetic Theory and Statistical Mechanics	4
Technical Elective*	3
	17

SPRING

HUM	2052 Civilization 2	3
PHY	3035 Quantum Mechanics	4
PHY	3152 Electronic Measurement Techniques	4
PHY	3440 Electromagnetic Theory	3
	Technical Elective*	3
		17

Senior Year

FALL		CREDITS
PHY	4020 Optics	3
PHY	4021 Experiments in Optics	1
PHY	4033 Introduction to Solid State Physics	3
or	Technical Elective	3
or	Senior Research	3
PHY	4200 Senior Seminar 1	1
	Humanities Elective	3
	Technical Elective*	3
		14

SPRING

CSE	1301 Introduction to Computer Applications	3
PHY	4030 Introduction to Subatomic Physics	3
or	Technical Elective	3
PHY	4071 Senior Laboratory 2	2
PHY	4210 Senior Seminar 2	1
	Social Science Elective	3
	Technical Elective	3
		15

TOTAL CREDITS REQUIRED 129

**BIO 2010, BIO 2110 and BIO 3210 are recommended as Technical Electives.*

Master of Science Degree Program

Graduate study in physics at the master's level generally follows one of two tracks. Either it aims to provide a sound core-course education in several fundamental, broad areas of physics at an advanced level to prepare the student for continued and specialized study toward the doctorate, or it may be directed toward preparing the student to apply physics in industry or in other nonacademic environments. Course work for the latter track tends to be more specialized and narrowly oriented. The master of science program in physics attempts to serve both types of objectives and offers a balanced combination of basic core courses and those designed for applied physicists.

Admission Requirements

An applicant for admission should have an undergraduate major in physics, mathematics or an engineering field. All entering physics graduate students are required to be prepared in mathematics at least through vector analysis.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The master's degree is conferred on students who have satisfactorily completed a minimum of 33 credit hours of graduate study. A master's thesis is optional.

The six-credit Mathematical Methods in Science and Engineering sequence (MTH 5201, MTH 5202) is required unless equivalent courses have already been taken. The other 27 credits required for the degree are to be taken from courses on the following list, all of which are given at least every other year on a rotating schedule.

ECE	5410 Electrodynamics 1	3
ECE	5411 Electrodynamics 2	3
PHY	5015 Analytical Mechanics 1	3
PHY	5030 Quantum Mechanics 1	3
PHY	5031 Quantum Mechanics 2	3
PHY	5035 Solid State Physics 1	3
PHY	5036 Solid State Physics 2	3
PHY	5045 Introduction to Elementary Particle Physics	3
PHY	5080 Thermodynamics	3
PHY	5081 Statistical Mechanics	3
PHY	5999 Thesis	3–6

Students who do not plan to go beyond the master's degree can substitute other courses for the courses listed above with the approval of the department head. Up to six semester hours of credit may be earned in thesis research and preparation. Students not taking the thesis option must take three semester hours of graduate laboratory work unless excused by the department head.

A general written examination is required in the second semester of residence for diagnosing any deficiencies in undergraduate preparation. Any deficiencies must be removed before a degree will be granted, as evidenced by written examination.

Before the master's degree is granted, the student must pass a final oral examination administered by a committee of three or more members of the graduate faculty selected by the student and the departmental adviser and including at least one member from outside the physics department. The oral examination emphasizes, but is not necessarily restricted to, subject matter related to the field of the thesis. For students not electing to do a thesis, the oral examination covers the general area of the student's graduate studies.

Doctor of Philosophy Degree Program

The doctoral degree is conferred primarily to recognize the individual who has demonstrated a satisfactory breadth and level of scientific accomplishment and has the ability to investigate scientific problems independently. It is also expected that the successful candidate for the degree will have advanced or played a significant part in the advancement of fundamental knowledge in physics.

Admission Requirements

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

Each candidate for the doctoral degree must prepare and carry out a program of study approved by the major adviser and the department head, pass a departmental qualifying examination, pass a written doctoral comprehensive examination, submit a dissertation proposal that gains the approval of the student's Doctoral Committee, complete a program of significant original research, and write and successfully defend a dissertation based on the program of research. Students with master's degrees in physics or appropriate related fields may opt to omit the qualifying exam if they take and pass the comprehensive exam within 13 months of starting the program. The dissertation research, or a significant portion thereof, must have been accepted for publication in a major, refereed journal before the degree can be awarded.

The Doctor of Philosophy in Physics is by nature a research degree and formal course requirements are kept to a minimum. At least 81 credits beyond the bachelor's degree (or 48 beyond the master's) are required, including credits for individual study, research and dissertation. At least 24 of these credits must be formal classroom courses that may include courses for the master's degree and must include at least 18 credits taken at Florida Tech. Each of the following courses must be taken if credit for equivalent material was not previously earned.

PHY 5015 Analytical Mechanics 1 3
PHY 5030 Quantum Mechanics 1 3
PHY 5031 Quantum Mechanics 2 3
PHY 5080 Thermodynamics 3
PHY 5081 Statistical Mechanics 3

After completing formal course work, the student must pass a written comprehensive examination emphasizing the student's major area of concentration and an acceptable dissertation proposal must be submitted before the student is formally admitted to candidacy.

An applicant without a master's degree is normally required to spend some time in residence at Florida Tech, preferably by obtaining the master's degree, before being accepted into the doctoral program in physics.

Research Activities and Facilities

Current research activities include experimental solid-state physics, terrestrial geomagnetism, auroral and magnetospheric physics, applied optics, experimental high-energy physics, instrumentation development, solar and heliospheric energetic particle observations, cosmic rays and engineering physics.

Experimental research in physics is carried out in a variety of laboratories operated by the department of physics and space sciences, as well as at national and international research facilities. Facilities that are currently available to graduate students include the following laboratories.

Applied Optics Laboratory

This facility offers the study of applied optics in physics and space sciences, including 3-D vision and imaging spectroscopy.

Noncontact laser video systems are being studied for applications such as remote measurement of surface shapes. These studies are carried out in an applied optics laboratory equipped with lasers and other sources, two large isolation tables and computer-interfaced and optically processed video systems.

High-Energy Physics Lab

This laboratory is centered around the L3 and CMS experiments at the European Center for Particle Physics (CERN) using LEP, the world's highest energy accelerator colliding electrons and positrons, and using LHC, which will provide the world's highest energy proton-proton collisions, scheduled to start running in 2006. L3 and CMS are international collaborations of scientists whose goal is to make precise measurements of the laws governing the known elementary particles and the forces between them, as well as to search for new phenomena such as the Higgs and supersymmetric particles. In this research, an important role is taken by the design and building of instrumentation using new technologies and methods. The activities are carried out on campus and at CERN.

On L3, Florida Tech is the lead institution responsible for precision monitoring of the electron drift velocity in the large outer drift chamber system and for the optical alignment system of the silicon microvertex detector.

The Florida Tech High Energy Physics Group is also responsible for construction and testing of a laser calibration system for the forward hadron calorimeter of the CMS detector.

Scanning Probe Microscopy Laboratory

This facility provides researchers with the ability to image the surface structure of a solid, and to probe the electronic surface properties of a material down to the atomic scale, using a scanning tunneling microscope (STM). This laboratory also investigates novel applications of the STM (e.g., in the field of electrochemistry) and is interested in the development of other types of scanning probe microscopes.

Computational Facilities

The department's facilities include a network of Linux workstations. A National Science Foundation-funded computational physics laboratory consisting of 12 Pentium PCs capable of running Linux/X-Windows and MS Windows is available to students.

Interdisciplinary Research in Physics and Space Sciences

Terrestrial geomagnetic research is aimed at extracting long-term periodicities in changes in Earth's magnetic field and correlation between secular changes in the geomagnetic field and fluctuations in the length of the day.

Auroral and magnetospheric research is being done using data from polar orbiting satellites. Current work concentrates on auroral electron and proton precipitating particle energies, intensities and distribution in latitude, with relation to magnetic substorms in the magnetosphere. Space-based energetic particle observations are aimed at understanding acceleration and propagation of particles in the heliosphere.

In addition, the department's space science laboratories are used by physics students from time to time. See the "Research Facilities" listing under Space Sciences.

Teaching and Research Assistantships

The department offers a number of teaching and research assistantships each year. Teaching assistants participate in laboratory instruction or in the preparation of teaching materials. Research assistants work on research projects that are often related to their own master's thesis or doctoral dissertation investigations. Both types of assistantships are awarded on a competitive basis, and provide graduate course fee remission and a stipend for living expenses. To increase the probability of receiving an assistantship, applicants are advised to apply as early as possible in the academic year prior to requested admission.

Science Education

Bachelor of Science
Options in:
Biology
Chemistry
Computer Science
Earth/Space Science
General Science
Physics

Master of Science
Concentrations in:
Biology
Chemistry
Environmental Science
General Science
Oceanography/Earth Science
Physics

Educational Specialist
Doctor of Education
Doctor of Philosophy

Professors
David E. Cook, Ph.D., *chemistry education, computers in education, informal science education, education policy.*

Robert H. Fronk, Ph.D., *computer/technology and geology/biology education, experimental design.*

Associate Professors
Michael A. Gallo, Ph.D., *statistics, research design, educational theory, computer technology and networking.*

Thomas J. Marcinkowski, Ph.D., *environmental studies, curriculum and instruction, research and evaluation design.*

Assistant Professor
Richard E. Enstice, Ph.D., *administration in higher education, computers in education, computer networking.*

Professor Emeritus
Robert F. Richmond, Ed.S.

Instructor and Director, Teacher Education
Debra S. Blenis, M.S.

Bachelor of Science Degree Program

The curriculum leads to a bachelor of science degree with options in biology, chemistry, computer science, earth and space science, physics and middle grades general science. All applicants must meet the current entrance requirements for teacher-education programs established by the Florida Department of Education.

A full year of student teaching during the senior year provides the student with many experiences encountered in the teaching profession. To graduate from a teacher-education program approved by the Florida Board of Education, the student must meet all requirements for obtaining a Florida Educator's Certificate, including completing the course work from an approved program plan with a minimum 2.5 GPA, passing the General Knowledge Test, passing the Professional and Subject areas of the Florida Teacher Certification examination and earning a minimum 3.0 grade point average for 18 credit hours of student teaching. (See Chapter 6A-4.004 of the Rules of the Department of Education, State Board of Education.)

Teacher preparation programs in the state of Florida are required by Title II, section 207, of the Higher Education Act to make public their Institutional Report Cards. Florida Tech's report card is on our Web site: www.fit.edu/education.

Biology Option

Freshman Year

FALL		CREDITS
BIO 1010	Biological Discovery 1	4
COM 1101	Composition and Rhetoric	3
EDS 1005	Introduction to Education	3
MTH 1001	Calculus 1	4
PSY 1411	Introduction to Psychology	3
		17

SPRING		
BIO 1020	Biological Discovery 2	4
BIO 1500	Introduction to Aquaculture	1
COM 1102	Writing about Literature	3
COM 2370	Speech	3
MTH 1002	Calculus 2	4
	Free Elective	3
		18

Sophomore Year

FALL		CREDITS
BIO 2110	General Genetics	4
CHM 1101	Chemistry 1	4
EDS 2032	Educational Technology	3
HUM 2051	Civilization 1	3
	Restricted Elective (Fine Arts)	3
		17

SPRING		
CHM 1102	Chemistry 2	4
EDS 2042	Literacy Instruction in Secondary School Content	3
HUM 3332	American History: Reconstruction to the Present	3
PHY 1001	Physics 1	4
PHY 2091	Physics Lab 1	1
PSY 2443	Psychology of Education	3
or		
PSY 3421	Psychology of Learning and Motivation	3
		18

Junior Year

FALL		CREDITS
BIO xxxx	Restricted Elective (Biology)	3
CHM 2001	Organic Chemistry 1	3
EDS 3033	Measurement and Evaluation	3
EDS 3095	Clinical and Field Experience 1	2
EDS 4051	Methods and Management of Middle and High School Teaching	4
		15

SPRING		
BIO 2010	Microbiology	4
EDS 3034	Assessment and Evaluation	3
EDS 3096	Clinical and Field Experience 2	2
EDS 4071	Methods and Strategies for Teaching Middle and High School Science	4
HUM 3352	History of Science and Technology: Renaissance to Present	3
		16

Senior Year

FALL		CREDITS
EDS 4061	Multilingual/Multicultural Education	3
EDS 4095	Student Teaching 1	6
	Restricted Elective (Biology)	3
	Restricted Elective (Earth Science)	3
		15

SPRING		
EDS 4096	Student Teaching 2	12
		12

TOTAL CREDITS REQUIRED 128

Chemistry Option

Freshman Year

FALL		CREDITS
BIO	1010 Biological Discovery 1	4
CHM	1101 Chemistry 1	4
COM	1101 Composition and Rhetoric	3
EDS	1005 Introduction to Education	3
MTH	1001 Calculus 1	4
		18

SPRING		
CHM	1102 Chemistry 2	4
COM	1102 Writing about Literature	3
COM	2370 Speech	3
MTH	1002 Calculus 2	4
	Free Elective	3
		17

Sophomore Year

FALL		CREDITS
EDS	2032 Educational Technology	3
MTH	2001 Calculus 3	4
PHY	1001 Physics 1	4
PHY	2091 Physics Laboratory 1	1
PSY	1411 Introduction to Psychology	3
	Restricted Elective (Earth Science)	3
		18

SPRING		
CHM	2001 Organic Chemistry 1	3
CHM	2011 Organic Chemistry Lab 1	2
EDS	2042 Literacy Instruction in Secondary School Content	3
HUM	2051 Civilization 1	3
PHY	2002 Physics 2	4
PSY	2443 Psychology of Education	3
	or	
PSY	3421 Psychology of Learning and Motivation	3
		18

Junior Year

FALL		CREDITS
CHM	2002 Organic Chemistry 2	3
CHM	2012 Organic Chemistry Lab 2	2
EDS	3033 Measurement and Evaluation	3
EDS	3095 Clinical and Field Experience 1	2
EDS	4051 Methods and Management of Middle and High School Teaching	4
	Restricted Elective (Fine Arts)	3
		17

SPRING		
EDS	3034 Assessment and Evaluation	3
EDS	3096 Clinical and Field Experience 2	2
EDS	4071 Methods and Strategies for Teaching Middle and High School Science	4
HUM	3332 American History: Reconstruction to the Present	3
HUM	3352 History of Science and Technology: Renaissance to Present	3
		15

Senior Year

FALL		CREDITS
CHM	3001 Physical Chemistry 1	3
CHM	3011 Physical Chemistry Lab 1	2
EDS	4061 Multilingual/Multicultural Education	3
EDS	4095 Student Teaching 1	6
		14

SPRING		
EDS	4096 Student Teaching 2	12
		12

TOTAL CREDITS REQUIRED 129

Computer Science Option

Freshman Year

FALL		CREDITS
COM	1101 Composition and Rhetoric	3
CSE	1001 Fundamentals of Software Development 1	4
EDS	1005 Introduction to Education	3
MTH	1001 Calculus 1	4
	Restricted Elective (Earth Science)	3
		17

SPRING		
COM	1102 Writing about Literature	3
COM	2370 Speech	3
CSE	1002 Fundamentals of Software Development 2	4
EDS	1032 Survey of Science 2	3
MTH	1002 Calculus 2	4
		17

Sophomore Year

FALL		CREDITS
CSE	1101 Computing Disciplines and Careers	1
CSE	xxxx Restricted Elective (CSE)	3
EDS	2032 Educational Technology	3
HUM	2051 Civilization 1	3
PHY	1001 Physics 1	4
PHY	2091 Physics Lab 1	1
PSY	1411 Introduction to Psychology	3
		18

SPRING		
CSE	xxxx Restricted Elective (CSE)	3
EDS	2042 Literacy Instruction in Secondary School Content	3
HUM	3332 American History: Reconstruction to the Present	3
PSY	2443 Psychology of Education	3
	or	
PSY	2441 Child and Adolescent Development	3
	Restricted Elective (Fine Arts)	3
		15

Junior Year

FALL		CREDITS
CSE	2010 Algorithms and Data Structures	4
EDS	3033 Measurement and Evaluation	3
EDS	3095 Clinical and Field Experience 1	2
EDS	4051 Methods and Management of Middle and High School Teaching	4
MTH	2401 Probability and Statistics	3
		16

SPRING		
CSE	2410 Introduction to Software Engineering	3
EDS	3034 Assessment and Evaluation	3
EDS	3096 Clinical and Field Experience 2	2
EDS	4073 Methods and Strategies for Teaching Computer Science K–12	4
HUM	3352 History of Science and Technology: Renaissance to Present	3
	Restricted Elective (Computer Science)	3
		18

Senior Year

FALL		CREDITS
EDS	4061 Multilingual/Multicultural Education	3
EDS	4095 Student Teaching 1	6
	Restricted Elective (Computer Science)	3
	Free Elective	3
		15

SPRING		
EDS	4096 Student Teaching 2	12
		12

TOTAL CREDITS REQUIRED 128

Earth/Space Science Option

Freshman Year

FALL	CREDITS
CHM 1101 Chemistry 1	4
COM 1101 Composition and Rhetoric	3
EDS 1005 Introduction to Education	3
ENS 1001 The Whole Earth Course	3
MTH 1001 Calculus 1	4
	17

SPRING	
BIO 1020 Biological Discovery 2	4
CHM 1102 Chemistry 2	4
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
SPS 1020 Introduction to Space Sciences	3
	18

Sophomore Year

FALL	CREDITS
BIO 1010 Biological Discovery 1	4
EDS 2032 Educational Technology	3
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
PSY 1411 Introduction to Psychology	3
SPS 1010 Introduction to Astronomy	3
	18

SPRING	
COM 2370 Speech	3
EDS 2042 Literacy Instruction in Secondary School Content	3
HUM 2051 Civilization 1	3
OCN 2407 Meteorology	3
PSY 2443 Psychology of Education	3
or	
PSY 3421 Psychology of Learning and Motivation	3
SPS 2010 Observational Astronomy	3
	18

Junior Year

FALL	CREDITS
EDS 3033 Measurement and Evaluation	3
EDS 3095 Clinical and Field Experience 1	2
EDS 4051 Methods and Management of Middle and High School Teaching	4
OCN 2602 Environmental Geology	3
Restricted Elective (Fine Arts)	3
	15

SPRING	
EDS 3034 Assessment and Evaluation	3
EDS 3096 Clinical and Field Experience 2	2
EDS 4071 Methods and Strategies for Teaching Middle and High School Science	4
ENS 4001 The Earth System	3
HUM 3332 American History: Reconstruction to the Present	3
HUM 3352 History of Science and Technology: Renaissance to Present	3
	18

Senior Year

FALL	CREDITS
EDS 4061 Multilingual/Multicultural Education	3
EDS 4095 Student Teaching 1	6
Free Elective	3
	12

SPRING	
EDS 4096 Student Teaching 2	12
	12

TOTAL CREDITS REQUIRED 128

General Science Option

Freshman Year

FALL	CREDITS
CHM 1101 Chemistry 1	4
COM 1101 Composition and Rhetoric	3
EDS 1005 Introduction to Education	3
ENS 1001 The Whole Earth Course	3
MTH 1001 Calculus 1	4
	17

SPRING	
CHM 1102 Chemistry 2	4
COM 1102 Writing about Literature	3
COM 2370 Speech	3
MTH 1002 Calculus 2	4
SPS 1020 Introduction to Space Sciences	3
	17

Sophomore Year

FALL	CREDITS
BIO 1010 Biological Discovery 1	4
CHM 2001 Organic Chemistry 1	3
EDS 2032 Educational Technology	3
PSY 1411 Introduction to Psychology	3
SPS 1010 Introduction to Astronomy	3
	16

SPRING	
BIO 1020 Biological Discovery 2	4
EDS 2042 Literacy Instruction in Secondary School Content	3
HUM 2051 Civilization 1	3
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
PSY 2443 Psychology of Education	3
or	
PSY 2441 Child and Adolescent Development	3
	18

Junior Year

FALL	CREDITS
EDS 3033 Measurement and Evaluation	3
EDS 3095 Clinical and Field Experience 1	2
EDS 4051 Methods and Management of Middle and High School Teaching	4
OCN 2602 Environmental Geology	3
Restricted Elective (Fine Arts)	3
	15

SPRING	
EDS 3034 Assessment and Evaluation	3
EDS 3096 Clinical and Field Experience 2	2
EDS 4071 Methods and Strategies for Teaching Middle and High School Science	4
HUM 3332 American History: Reconstruction to the Present	3
HUM 3352 History of Science and Technology: Renaissance to Present	3
OCN 2407 Meteorology	3
	18

Senior Year

FALL	CREDITS
EDS 4061 Multilingual/Multicultural Education	3
EDS 4095 Student Teaching 1	6
Technical Electives	3
Free Elective	3
	15

SPRING	
EDS 4096 Student Teaching 2	12
	12

TOTAL CREDITS REQUIRED 128

Physics Option

Freshman Year

FALL		CREDITS
BIO	1010 Biological Discovery 1	4
COM	1101 Composition and Rhetoric	3
EDS	1005 Introduction to Education	3
MTH	1001 Calculus 1	4
PSY	1411 Introduction to Psychology	3
		17

SPRING		
COM	1102 Writing about Literature	3
COM	2370 Speech	3
MTH	1002 Calculus 2	4
PHY	1001 Physics 1	4
PHY	2091 Physics Lab 1	1
PSY	2443 Psychology of Education	3
	or	
PSY	3421 Psychology of Learning and Motivation	3
		18

Sophomore Year

FALL		CREDITS
CHM	1101 Chemistry 1	4
EDS	2032 Educational Technology	3
HUM	2051 Civilization 1	3
MTH	2001 Calculus 3	4
PHY	2002 Physics 2	4
		18

SPRING		
CHM	1102 Chemistry 2	4
EDS	2042 Literacy Instruction in Secondary School Content	3
HUM	3332 American History: Reconstruction to the Present	3
MTH	2201 Differential Equations/Linear Algebra	4
PHY	2003 Modern Physics	3
		17

Junior Year

FALL		CREDITS
EDS	3033 Measurement and Evaluation	3
EDS	3095 Clinical and Field Experience 1	2
EDS	4051 Methods and Management of Middle and High School Teaching	4
PHY	2092 Physics Laboratory 2	1
PHY	3011 Physical Mechanics	4
	Restricted Elective (Fine Arts)	3
		17

SPRING		
EDS	3034 Assessment and Evaluation	3
EDS	3096 Clinical and Field Experience 2	2
EDS	4071 Methods and Strategies for Teaching Middle and High School Science	4
HUM	3352 History of Science and Technology: Renaissance to Present	3
PHY	3035 Quantum Mechanics	4
		16

Senior Year

FALL		CREDITS
EDS	4061 Multilingual/Multicultural Education	3
EDS	4095 Student Teaching 1	6
	Free Elective	3
	Restricted Elective (Earth Science)	3
		15

SPRING		
EDS	4096 Student Teaching 2	12
		12

TOTAL CREDITS REQUIRED 130

Master of Science Degree Program

The master's program for students holding bachelor's degrees in science includes advanced graduate training in a science field in addition to courses designed to develop and improve teaching skills. One program offers graduate work in science while also providing the necessary course requirements for state certification of secondary school teachers. A second program is designed for those not wishing to teach in a secondary school and does not lead to certification.

The master's program for students holding bachelor's degrees in science education includes science courses for teachers in a selected science area, in addition to advanced graduate courses in science education. The science courses are designed to develop and upgrade subject matter knowledge in specific, selected areas of science. The science education courses will complement previous educational experience and are aimed specifically at science teaching.

Admission Requirements

The master's program is designed for individuals holding bachelor's degrees either in areas of science or in secondary school science education.

If the program is to be used for teacher certification purposes, the applicant must hold certification (or be certifiable) at the elementary, middle and/or high school levels.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The master of science degree is conferred on students who have successfully completed 30 credit hours including six credits of thesis, or 33 credit hours including three credits of research. The thesis option concludes with an oral thesis presentation/defense. The nonthesis option concludes with a written exam for EDS 5070, 5203 and 5095, and an oral comprehensive examination.

Curriculum

The following courses are required, and must be taken at Florida Tech. Exceptions may be considered only through a written petition, reviewed by the department's graduate faculty:

EDS	5070 Educational Statistics	3
EDS	5095 Essentials of Educational Research	3
EDS	5203 Theories and Trends in Education	3

A minimum of three science courses (9 credit hours) is required. These courses are to be in the selected concentration area: biology, chemistry, environmental science, physics, oceanography/earth science or general science (for middle- and junior-high school teachers). Each concentration area corresponds to a degree program at Florida Tech, with the exception of general science. Any graduate course taken in a science department will qualify as a science course in the corresponding concentration. In addition, science courses offered through the science education department, specifically for teachers, may also be used to partially fulfill the science course requirement. The general science concentration involves several areas and will be constructed based on the student's needs.

A minimum of two additional graduate science education courses (6 credit hours) and six credit hours of Thesis (EDS 5999) are required for the thesis track.

A minimum of three additional graduate science education courses (9 credit hours), three credit hours of electives and three credit hours of Research (EDS 5081) are required for the nonthesis track.

With departmental approval, up to six credit hours of senior-level courses can be applied toward the master of science program.

Any schedule that would meet these requirements within a seven-year period is acceptable. Any combination of part-time and/or full-time semesters can be used, as well as any combination of evening and summer courses. Following is an example of a common schedule (nonthesis option):

FALL	CREDITS
EDS 5095 Essentials of Educational Research	3
Science Course in Concentration	3
Science Education Electives	6
	12
SPRING	
EDS 5070 Educational Statistics	3
EDS 5203 Theories and Trends in Education	3
Science Course in Concentration	3
Science Education Elective	3
	12
SUMMER	
EDS 5081 Research 1	3
Science Course in Concentration	3
Elective	3
	9
TOTAL CREDITS REQUIRED	33

Educational Specialist Degree Program

The primary emphasis of the educational specialist degree is placed on the development of specific competencies needed in science education.

Admission Requirements

The applicant to the educational specialist program must hold a master's degree in science or education with science as the teaching area.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

A candidate for the educational specialist degree must maintain a grade point average of 3.0 or better in a 30-credit-hour program. Although research methodologies are included in the curriculum, no thesis is required. A final examination is given in the last semester of enrollment by a three-member committee appointed by the department head and approved by the Graduate School office. A student can transfer up to 12 hours of graduate credit from other approved institutions offering at least the educational specialist degree.

Curriculum

Candidates for the educational specialist degree must complete 30 credit hours of course work beyond the master's degree as follows:

Current Research and Methodologies in Science Education (9 credit hours)—Must be taken at Florida Tech; exceptions may be considered only through a written petition reviewed by the department's graduate faculty.

EDS 5070 Educational Statistics 3
EDS 5095 Essentials of Educational Research 3
EDS 5203 Theories and Trends in Education 3

Science (9 credit hours)—The candidate must have earned a minimum of 21 graduate hours in science beyond the bachelor's degree. These hours include the nine specifically required for the specialist degree and any other hours from approved postbaccalaureate science courses.

Science Education (9 credit hours)—As approved by the head of the department.

Electives (3 credit hours)—Each student chooses an elective to fit a particular certification and/or interest area.

Doctoral Degree Programs

The doctor of philosophy (Ph.D.) and doctor of education (Ed.D.) programs are designed to provide increased competence in science, science education and research. Recipients gain the appropriate knowledge and skills for positions in college and university science education programs; teaching, administration and supervisory posts in state and local school systems; positions teaching science in liberal arts colleges and introductory science courses in universities; and as research directors in science education.

The primary difference between the Ph.D. and Ed.D. programs is in the focus of the dissertation work. The focus of the Ph.D. is typically theoretical, while the focus of the Ed.D. is more applied and intended for the practitioner. While Ph.D. dissertation research is oriented for the student going into a university graduate teaching and research setting, Ed.D. dissertation research is oriented for K–12 school or business/industry practitioners and typically involves a practical field problem.

The two programs also differ in the requirement of two specialty area courses in the Ed.D. These two courses are typically in science education, instructional technology or environmental education, but may also be in mathematics education.

Doctoral students interested in theory-based research should consider the Ph.D. For those more interested in practical field research, the Ed.D. would be more appropriate.

Admission Requirements (both programs)

An applicant to the doctoral program in science education must have a master's degree in a field of science, technology, aeronautics or science education, with a cumulative grade point average of at least 3.2 on a 4.0 scale. At least three years' teaching experience is also highly recommended. An applicant with a major technical area in aeronautics must also have FAA certification and enough practical experience to qualify as a professional in the aviation field.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements (both programs)

A minimum of 48 credit hours beyond the master's degree is required to earn the doctoral degree. These credits include 24 credit hours of dissertation in addition to the required course work.

REQUIRED COURSES	CREDITS
EDS 5070 Educational Statistics	3
EDS 5095 Essentials of Educational Research	3
EDS 5203 Theories and Trends in Education	3
EDS 6070 Statistics for Educational Research	3

These courses must be taken at Florida Tech. Exceptions may be considered only through a written petition, reviewed by the department's graduate faculty.

General degree requirements are presented in the *Graduate Information and Regulations* section of this catalog.

Written comprehensives and oral comprehensives must be taken in the same semester. The doctoral comprehensive examinations are given in the last full week of September and January.

Curriculum

Doctor of Philosophy (Ph.D.)

Major Technical Area—A minimum of 21 credit hours beyond the bachelor's degree must be taken in the student's chosen major technical area. The student may choose from the following major technical areas: aeronautics, biology, chemistry, computer science, engineering, environmental science, oceanography/earth science or physics. These 21 hours may include courses from previous graduate degrees as well as courses taken as part of the Ph.D. program and must include AVM 5101 if the major technical area is aeronautics.

Research—A minimum of 24 credit hours will be devoted to dissertation research, including at least three hours of Readings in Educational Research (EDS 6000), at least three hours of Research Practicum (EDS 6010) and at least 18 hours of Dissertation (EDS 6999).

Doctor of Education (Ed.D)

Major Technical Area—A minimum of 18 credit hours beyond the bachelor's degree must be taken in the student's chosen major technical area. The student may choose from the following major technical areas: aeronautics, biology, chemistry, computer science, engineering, environmental science, oceanography/earth science or physics. These 18 hours may include courses from previous graduate degrees as well as courses taken as part of the Ed.D. program and must include AVM 5101 if the major technical area is aeronautics.

Specialty Area—A minimum of six credit hours must be taken in science education, instructional technology or environmental education. (Specialty area credits may also be in mathematics education.)

Research—A minimum of 24 credit hours will be devoted to dissertation research, including at least three hours of Readings in Educational Research (EDS 6000), at least three hours of Research Practicum (EDS 6010) and at least 18 hours of Dissertation (EDS 6999).

Space Sciences

DEPARTMENT OF PHYSICS AND SPACE SCIENCES
Laszlo Baksay, Ph.D., Head

Bachelor of Science *Master of Science* *Doctor of Philosophy*
Astronomy and Astrophysics Option

Professors

Laszlo Baksay, Ph.D., *experimental high-energy physics at LHC and LEP/CERN, detector development, maglev.*

Terry D. Oswalt, Ph.D., *stellar spectroscopy and photometry, white dwarf stars, binary stars, stellar activity, minor planets and comets.*

Associate Professors

Marc M. Baarmand, Ph.D., *experimental particle physics at Fermi National Accelerator Laboratory and CERN.*

Joseph R. Dwyer, Ph.D., *space physics, solar and heliospheric energetic particle observations, space instrumentation, upward propagating lightning.*

Rong-sheng Jin, Ph.D., *terrestrial geomagnetism, especially changes in Earth's field with time, correlation with Earth's rotation rate.*

Hamid K. Rassoul, Ph.D., *observation and modeling of magnetic storms and substorms, photochemistry of Earth's upper-atmosphere, solar wind-magnetosphere interactions, upward propagating lightning.*

Matthew A. Wood, Ph.D., *astrophysics, theory and observation of white dwarf stars, cataclysmic variables.*

Ming Zhang, Ph.D., *cosmic radiation and interactions with the plasma and magnetic fields in the interstellar medium, the heliosphere and magnetospheres.*

Assistant Professors

Sydney Barnes, Ph.D., *astrophysics, theory and observation of stellar evolution.*

Marcus Hohlmann, Ph.D., *particle physics, experimental high-energy physics with L3 and CMS experiments at CERN, development of particle detectors.*

James G. Mantovani, Ph.D., *condensed matter theory and experiment, particularly surface physics and electron microscopy.*

Adjunct Professor

Marcelo Alonso, Ph.D.

Professors Emeriti

Joel H. Blatt, Ph.D.; Jay Burns, Ph.D.; J.D. Patterson, Ph.D.

Director of Undergraduate Laboratories

J.A. Gering, M.S.

Bachelor of Science Degree Program

The space sciences undergraduate program is designed for students interested in pursuing space-related careers, either upon graduation or after completing graduate studies in the Earth, planetary or space sciences. Emphasis in the curriculum is on achieving a broad but sound education in the basic physical, mathematical and engineering sciences as a foundation for successful entry into any of the many subfields of modern space science activity. Students may gain experience in designing space missions and instrumentation and working on current NASA spacecraft (ACE, Wind and Ulysses). Current research topics include solar energetic particle measurements, X-ray and gamma-ray observations of lightning, cosmic-ray astrophysics, the impact of solar eruptions on the geospace environment, and atmospheric optical and UV observations. (For more details, see "Geospace Physics Laboratory" in the *Research: Institutes, Centers and Major Laboratories* section of this catalog.)

Degree Requirements

Candidates for a Bachelor of Science in Space Sciences must complete the minimum course requirements outlined in the following curricula. The student must choose between the basic curriculum and the astronomy and astrophysics option.

Because subject matter in general physics and astronomy forms a critically important foundation for all advanced course work in space sciences, the minimum grade for satisfying the prerequisite requirements for a space sciences major is a grade of C for each of the following courses: PHY 1001, PHY 2002, PHY 2003, PHY 2091, PHY 2092; and SPS 1010, SPS 1020.

Freshman Year

FALL		CREDITS
CHM 1101	Chemistry 1	4
COM 1101	Composition and Rhetoric	3
MTH 1001	Calculus 1	4
PHY 1050	Physics and Space Science Seminar	1
SPS 1010	Introduction to Astronomy	3
		15

SPRING		
CHM 1102	Chemistry 2	4
MTH 1002	Calculus 2	4
PHY 1001	Physics 1	4
PHY 2091	Physics Laboratory 1	1
SPS 1020	Introduction to Space Sciences	3
		16

Sophomore Year

FALL		CREDITS
COM 1102	Writing about Literature	3
CSE 15xx	Restricted Elective (Computer Science)	3
MTH 2001	Calculus 3	4
PHY 2002	Physics 2	4
PHY 2092	Physics Laboratory 2	1
	Free Elective	3
		18

SPRING		
HUM 2051	Civilization 1	3
MTH 2201	Differential Equations/Linear Algebra	4
PHY 2003	Modern Physics	3
PHY 3152	Electronic Measurement Techniques	4
SPS 2010	Observational Astronomy	3
		17

Junior Year

FALL		CREDITS
HUM 2052	Civilization 2	3
PHY 3011	Physical Mechanics	4
PHY 3060	Thermodynamics, Kinetic Theory and Statistical Mechanics	4
SPS 3010	Geophysics	3
SPS 3040	Fundamentals of Remote Sensing	3
or		
MET 4233	Remote Sensing for Meteorology	3
or		
OCN 4704	Remote Sensing for Oceanography	3
		17

SPRING		
COM 2223	Scientific and Technical Communication	3
MTH 3201	Boundary Value Problems	3
PHY 3440	Electromagnetic Theory	3
SPS 4025	Introduction to Space Plasma Physics*	3
or		
SPS 4035	Comparative Planetology*	3
	Humanities Elective	3
		15

Senior Year

FALL		CREDITS
MAE 3061	Fluid Mechanics 1	3
or		
OCE 3030	Fluid Mechanics	3
PHY 4020	Optics	3
PHY 4021	Experiments in Optics	1
SPS 3030	Orbital Mechanics	3
SPS 4010	Astrophysics 1	3
SPS 4200	Senior Seminar 1	1
	Technical Elective or Senior Research	3
		17

SPRING		
SPS 4025	Introduction to Space Plasma Physics*	3
or		
SPS 4035	Comparative Planetology*	3
SPS 4030	Physics of the Atmosphere	3
SPS 4210	Senior Seminar 2	1
	Technical Elective or Senior Research	3
	Social Science Elective	3
	Free Elective	3
		16

TOTAL CREDITS REQUIRED 131

Astronomy and Astrophysics Option

This option is designed to meet the needs of students intending to pursue graduate education and a career in the astronomical sciences.

Freshman Year

FALL		CREDITS
CHM 1101	Chemistry 1	4
COM 1101	Composition and Rhetoric	3
MTH 1001	Calculus 1	4
PHY 1050	Physics and Space Science Seminar	1
SPS 1010	Introduction to Astronomy	3
		15

SPRING		
CHM 1102	Chemistry 2	4
MTH 1002	Calculus 2	4
PHY 1001	Physics 1	4
PHY 2091	Physics Lab 1	1
SPS 1020	Introduction to Space Sciences	3
		16

Sophomore Year

FALL		CREDITS
COM 1102	Writing about Literature	3
CSE 15xx	Restricted Elective (Computer Science)	3
MTH 2001	Calculus 3	4
PHY 2002	Physics 2	4
PHY 2003	Modern Physics 1	3
PHY 2092	Physics Lab 2	1
		18

SPRING		
COM 2223	Scientific and Technical Communication	3
HUM 2051	Civilization 1	3
MTH 2201	Differential Equations/Linear Algebra	4
SPS 2010	Observational Astronomy	3
	Free Elective	3
		16

Junior Year

FALL		CREDITS
HUM 2052	Civilization 2	3
MTH 3101	Complex Variables	3
PHY 3011	Physical Mechanics	4
PHY 3060	Thermodynamics, Kinetic Theory and Statistical Mechanics	4
SPS 3010	Geophysics	3
		17

SPRING

MTH	3201	Boundary Value Problems 3
PHY	3035	Quantum Mechanics 4
PHY	3440	Electromagnetic Theory 3
SPS	3020	Methods and Instrumentation 3
		Social Science Elective 3
		16

Senior Year

FALL			CREDITS
MAE	3061	Fluid Mechanics 1	3
	or		
OCE	3030	Fluid Mechanics	3
PHY	4020	Optics	3
PHY	4021	Experiments in Optics	1
SPS	4010	Astrophysics 1	3
SPS	4200	Senior Seminar 1	1
		Technical Elective or Senior Research	3
		Humanities Elective	3
			17

SPRING

SPS	4020	Astrophysics 2 3
SPS	4025	Introduction to Space Plasma Physics* 3
	or	
SPS	4035	Comparative Planetology* 3
SPS	4210	Senior Seminar 2 1
		Technical Elective or Senior Research 3
		Free Elective 3
		13

TOTAL CREDITS REQUIRED 128

**Courses taught on an alternate-year basis.*

Master of Science Degree Program

The space sciences graduate program stresses astrophysics, astrodynamics, space and planetary physics, cosmic ray physics, space instrumentation, physics of lightning, solar-terrestrial interrelations, terrestrial geomagnetism and stellar photometry. Graduate study in space sciences at the master's level prepares the graduate for a wide range of scientific and technical responsibilities in industry and government related directly or indirectly to the space program.

Admission Requirements

An applicant for admission should have a bachelor's degree in physics, mathematics, space science or an engineering field, and should submit Graduate Record Examination (GRE) scores from both the General Test and the Subject Test in physics.

General admission requirements and the process of applying are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

The graduate program is a continuation of the space sciences undergraduate curriculum at Florida Tech; students who have had a different undergraduate curriculum may have to take senior-level undergraduate courses to make up deficiencies. With the approval of the department, students may be given credit toward the master's degree for up to six semester credit hours of senior-level courses taken as a graduate student. Specialized space sciences senior-level courses commonly taken include astrophysics, planetary geophysics and remote multispectral sensing.

The master of science degree is conferred after satisfactory completion of 33 credit hours of required and elective courses. Twenty-seven hours must be taken from the following core-course requirements:

Mathematics/Computer Science (2 courses)

MTH 5051 Applied Discrete Mathematics
MTH 5201 Math Methods in Science and Engineering 1
MTH 5202 Math Methods in Science and Engineering 2
MTH 5301 Numerical Analysis 1
MTH 5401 Applied Statistical Analysis
CSE 5001 Assembly Language and Organization
CSE 5100 Data Structure and Algorithms

Physics (3 courses)

PHY 5015 Analytical Mechanics 1
PHY 5030 Quantum Mechanics 1
PHY 5031 Quantum Mechanics 2
PHY 5081 Statistical Mechanics
ECE 5410 Electrodynamics 1
ECE 5411 Electrodynamics 2

Space Sciences (4 courses)

SPS 5010 Astrophysics 1: Stellar Structure and Evolution
SPS 5011 Astrophysics 2: Galactic Structure and Cosmology
SPA 5020 Space Physics 1: The Low-Energy Universe
SPS 5030 Planetary Sciences 1: Interiors
SPS 5031 Planetary Sciences 2: Atmospheres
SPS 5050 Astrodynamics

Courses taken during undergraduate years and applied to a bachelor's degree or equivalent may not be used to fulfill the core-course requirements. Substitutions may be made in special cases with the approval of the department head.

Electives can be selected with the adviser's approval from a wide variety of space science (SPS), space systems (SPC), physics (PHY), electrical and computer engineering (ECE), mechanical and aerospace engineering (MAE), computer science (CSE) and mathematics (MTH) offerings, including:

ECE 5350 Optical Electronics
ECE 5353 Optical Computing
ECE 5425 Antennas 1
ECE 5426 Antennas 2
PHY 5016 Analytical Mechanics 2
PHY 5020 Optics
PHY 5034 Semiconductor Physics
PHY 5035 Solid State Physics 1
PHY 5036 Solid State Physics 2
PHY 5054 Fourier Optics
PHY 5080 Thermodynamics
SPC 5004 Space Propulsion Systems
SPC 5005 Space Power Systems
SPC 5006 Space Communications and Data Systems
SPC 5017 Aerospace Remote Sensing Systems
SPC 5080 Space Missions

A thesis is optional and up to six semester hours of credit may be allowed for work leading to the thesis.

A general written examination is given by the department twice each year during the spring semester. A graduate student is normally required to take this examination in the second semester of residence. Before the master's degree is granted, the student must pass a final oral examination administered by a committee of three or more members of the graduate faculty selected by the student and the departmental adviser, and including at least one member from outside the department. The examination pertains primarily to areas related to the field of the thesis. If the nonthesis option is chosen, the student is required to pass an oral examination, administered as above, covering the general area of the student's graduate studies.

Doctor of Philosophy Degree Program

The space sciences comprise an interdisciplinary field that includes astronomy, astrophysics, and planetary and solar studies. By nature a broad subject, graduate study in the space sciences can be narrowly focused within one of these specializations. Florida Tech's doctoral degree in space sciences provides training with the breadth and depth consistent with the highest level degree. Such training produces qualified professionals for teaching and research in academic institutions and for research and related work in government and industry.

Admission Requirements

Admission to the doctoral program is granted to a limited number of applicants who have completed a master's degree in space sciences or a related field, such as astronomy or physics, with a cumulative GPA of 3.3 or higher. A recommendation for doctoral-level study is required, and if the degree is from Florida Tech, the recommendation must come from the student's examining committee. Graduate Record Examination (GRE) scores from both the General Test and the Subject Test in physics, three letters of recommendation, a résumé of academic and work experience and a statement of objectives must be provided.

A student enrolled in Florida Tech's master of science program in space sciences may be considered for transfer to the doctoral program on completion of 15 credit hours after admission to that program, with a cumulative GPA of 3.3 or higher and a passing score on a qualifying examination administered by the department.

A doctoral student whose bachelor's degree is in an area other than space sciences might be required to complete one or more deficiency courses as identified by the department head at the time of admission.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The doctoral degree is conferred primarily to recognize a person who has demonstrated a satisfactory breadth and level of scientific accomplishment and has the ability to investigate scientific problems independently. It is also expected that the successful candidate for the degree will have advanced or played a significant part in the advancement of fundamental knowledge in the space sciences.

Each candidate for the doctoral degree must prepare and carry out a program of study approved by the major adviser and the department head; pass a departmental qualifying examination; pass a written doctoral comprehensive examination, which emphasizes the student's major area of concentration; submit a dissertation proposal that gains the approval of the student's Doctoral Committee; complete a program of significant original research; and write and successfully defend a dissertation based on the program of research. Students with master's degrees in physics or appropriate related fields may opt to omit the qualifying exam if they take and pass the comprehensive exam within 13 months of starting the program.

The Doctor of Philosophy in Space Sciences is by nature a research degree. Dissertation research is normally begun immediately after successful completion of the comprehensive examination by the end of the second year of full-time graduate course work. The comprehensive examination includes both a written and oral evaluation of the candidate's aptitude and preparation for independent research. Dissertation research is closely supervised by the student's adviser. Because of this high level of personal commitment by the adviser, a prospective doctoral candidate must be willing to undertake dissertation research in an area of current active interest by the department's faculty. Prior to the award of the Doctor of Philosophy in Space Sciences, the candidate presents the completed dissertation manuscript and orally presents and defends the research results to the doctoral committee.

The student is also expected to present a seminar on the dissertation research. The dissertation, or a significant portion thereof, must have been accepted for publication in a major, refereed journal before the degree can be awarded.

The department does not require candidates for the doctorate to present evidence of competence in a foreign language, but because of the importance of communications with foreign scientists, it is strongly urged that candidates for the doctorate acquire reading competency in at least one language in addition to English. The student is also advised to be proficient with at least one programming language.

Completion of the doctoral program in space sciences requires a minimum of 81 credits beyond the bachelor's degree (or 48 hours beyond the master's) including dissertation credit and at least 24 semester hours of required and elective courses. Course work, including courses that may have been applied toward a master of science degree, must include at least 15 semester hours of core courses, 24 semester hours of foundation courses and 12 semester hours of electives, and must include at least 18 credits taken at Florida Tech. The core courses offered by the department are usually offered every other year; therefore, the student is advised to plan his/her curriculum carefully.

Core Courses (15 credits)

SPS 5010 Astrophysics 1: Stellar Structure and Evolution
SPS 5011 Astrophysics 2: Galactic Structure and Cosmology
SPS 5020 Space Physics 1: The Low-Energy Universe
SPS 5021 Space Physics 2: The High-Energy Universe
SPS 5030 Planetary Sciences 1: Interiors
SPS 5031 Planetary Sciences 2: Atmospheres
SPS 5050 Astrodynamics

Foundation Courses (24 credits)

ECE 5410 Electrodynamics 1
ECE 5411 Electrodynamics 2
MTH 5201 Math Methods in Science and Engineering 1
MTH 5202 Math Methods in Science and Engineering 2
MTH 5301 Numerical Analysis
PHY 5015 Analytical Mechanics 1
PHY 5016 Analytical Mechanics 2
PHY 5030 Quantum Mechanics 1
PHY 5031 Quantum Mechanics 2
PHY 5054 Introduction to Fourier Optics
PHY 5080 Thermodynamics
PHY 5081 Statistical Mechanics

Electives (12 credits)—Electives can be other space sciences courses, or selected courses in mathematics, computer science, electrical engineering or physics. A complete list of approved elective courses is available from the physics and space sciences department. The substitution of electives outside this list is allowed with concurrence of the adviser and the department head.

Many of the core and foundation courses will probably have been taken at the master's level, as well as other courses that would qualify as electives. Therefore, the number of core, foundation and elective credit hours beyond the master's degree could be as low as 24.

Teaching and Research Assistantships

The department offers a number of teaching and research assistantships each year. Teaching assistants participate in laboratory instruction, or in the preparation of teaching materials and the grading of papers. Research assistants work on research projects that are often related to their own master's thesis or doctoral dissertation investigations. Both types of assistantships are awarded on a competitive basis, and provide graduate course fee remission and a stipend for living expenses. To increase the probability of receiving an assistantship, applicants are advised to apply as early as possible in the academic year prior to requested admission.

Research Activities

Graduate students can pursue both theoretical and experimental research in the following fields of specialty, which are active in the department.

Astrophysics

- Gravitational redshifts and evolution of white dwarf stars
- Astronomical image processing
- Photoelectric photometry and theoretical models of close binary systems
- Astrophysical fluid dynamics

Solar Physics and Planetary Science

- Solar corona and interplanetary medium
- Time dependence of geomagnetic field strength, correlation with changes in Earth rotation rate
- Multicolored photometry and occultation studies of minor planets and comets
- Auroral and ionosphere physics, solar particle flux
- Space-based energetic particle observations
- Cosmic-ray propagation modeling

Remote Sensing and Instrumentation

- Moiré profilometry, especially of space structures
- Ground- and space-based IR studies of global atmospheric CO_2 content and other trace gases
- Night sky brightness, light pollution

Other

- Infrared detection by narrow bandgap semiconductors
- Magnetostatic field calculations for traveling wave tubes
- Optical properties of solids
- Experiments in microgravity

Research Facilities

Experimental research in space sciences is carried out in a variety of laboratories operated by the department of physics and space sciences. Facilities that are currently available to graduate students include:

Computational Facilities

The department's facilities include a network of Linux workstations and numerous microcomputers. The Computational Physics Laboratory, consisting of 12 Pentium PCs capable of running Linux/X-Windows, is available to students.

Geospace Physics Laboratory (GPL)

See *Research: Institutes, Centers and Major Laboratories* in this catalog.

Astronomy and Astrophysics Laboratory

This facility offers image processing using Image Reduction and Analysis Facility (IRAF) software for Linux workstations; applications to astronomical spectra; and image processing. Current research includes CCD spectral line profile analysis of white dwarf stars.

SARA 0.9-M Telescope at Kitt Peak National Observatory

Florida Tech is the administrative institution for the Southeastern Association for Research in Astronomy (SARA). SARA has recommissioned a 0.9-m telescope at Kitt Peak National Observatory near Tucson, Arizona, for CCD imaging and photometry. In addition to conventional on-site use of the telescope, the fully automated telescope may also be remotely accessed via the Internet. Approximately one-fourth of all annual observing time on this facility is allocated to Florida Tech faculty and student research projects.

Teaching

DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION
D.E. Cook, Ph.D., Head

Master of Arts in Teaching

Professors

David E. Cook, Ph.D., *chemistry education, computers in education, informal science education, education policy.*

Robert H. Fronk, Ph.D., *computer/technology and geology/biology education, experimental design.*

Associate Professors

Michael A. Gallo, Ph.D., *statistics, research design, educational theory, computer technology and networking.*

Cecilia A. Knoll, Ph.D., *calculus mastery, differential equations, integrating technology into the curriculum.*

Thomas J. Marcinkowski, Ph.D., *environmental studies, curriculum and instruction, research and evaluation design.*

Assistant Professors

Bradford Allen, Ed.D., *computer simulation, data analysis and reliability, statistical research methodology, testing and evaluation, modeling.*

Richard Enstice, Ph.D., *administration in higher education, computers in education, computer networking.*

Instructor and Director, Teacher Education

Debra S. Blenis, M.S.

Master of Arts in Teaching Degree Program

The Master of Arts in Teaching (M.A.T.) program is a post-baccalaureate program for individuals with bachelor's degrees in content areas, who are either current teachers with 3-year temporary teaching certificates or are planning to enter the teaching field. The program is designed to help students earn an advanced degree while also completing course work that can lead to Florida teacher certification. It consists of a minimum of 32 graduate semester hours.

Admission Requirements

An applicant must have a bachelor's degree from an accredited college or university in mathematics or science, or in an area in which state certification is sought.

Degree Requirements

A minimum grade point average of 3.0 must be maintained throughout the program. Students must also satisfy a field experience requirement that can be met either by a concurrent part- or full-time teaching position or by completing concurrent field experience courses taken either at Florida Tech or another accredited university. Students must pass the Professional Education Florida Teacher Certification Examination and an oral examination given in the last semester of enrollment.

Curriculum

At least 10 courses (minimum 32 credits) are required, as follows:

EDS 5045 Multilingual/Multicultural Education 3
EDS 5051 Methods and Management of Middle and High School Teaching 4
EDS 5055 Foundations and Management of Classroom Instruction 3
EDS 5067 Measurement and Evaluation 3
EDS 5071 Methods and Strategies for Teaching Middle and High School Science 4
or
EDS 5072 Methods and Strategies for Teaching Middle and High School Mathematics 4
EDS 5135 Reading in the Content Area 3
EDS 5203 Theories and Trends in Education 3
EDS 5226 Introduction to Computers in Education 3
Electives 6
TOTAL CREDITS REQUIRED 32

All courses except EDS 5071 (or EDS 5072) and the electives must be taken at Florida Tech. Electives and a methods course in an area other than mathematics or science may be transferred from graduate-level studies elsewhere, subject to faculty approval.

Professional Certificate*

The Professional Certificate is for students seeking an alternative route to professional certification in Florida. This certificate program is a subset of the M.A.T. degree program and is designed expressly for individuals who hold bachelor's degrees in content areas and are current teachers with 3-year temporary teaching certificates. It consists of four graduate-level courses that, when combined with approved alternative certification inservice modules, prepares teachers for state certification. The course requirements may be completed in 14 months (two regular terms and two summer sessions). Up to 15 credits may be applied within five years of completion to the M.A.T. degree.

Admission Requirements

An applicant must have a bachelor's degree in mathematics or science, or in an area in which state certification is sought, from an accredited college or university.

Certificate Requirements*

The Professional Certificate requires passing the four courses (13 semester hours) listed below with a grade point average of at least 3.0. All courses must be taken at Florida Tech.

EDS 5045 Multilingual/Multicultural Education 3
EDS 5051 Methods and Management of Middle and High School Teaching 4
EDS 5067 Measurement and Evaluation 3
EDS 5203 Theories and Trends in Education 3

**Curriculum guided by state requirements and subject to change.*

DEPARTMENT OF HUMANITIES AND COMMUNICATION

Technical and Professional Communication

N. I. Matar, Ph.D., Head

Bachelor of Science *Master of Science*
(See Communication)

Program Chair
Judith B. Strother, Ph.D.

Associate Professors
Randall L. Alford, Ph.D., *general linguistics, grammatical theory, language education, German, English as a second language.*

Judith B. Strother, Ph.D., *theoretical and applied business communication, scientific and technical communication, editing, applied linguistics, psycholinguistics.*

Jane T. Tolbert, Ph.D., *journalism, mass communication, scientific and technical communication.*

Assistant Professors
Alan M. Rosiene, Ph.D., *rhetorical theory, history of literary theory, deconstruction, cultural studies, freshman composition.*

Carol M.H. Shehadeh, M.A., *Internet publishing, business/technical writing and editing, documentation, instructional technology.*

Master of Science Degree Program

The master of science program in technical and professional communication stresses the development of practical, career-oriented written, oral and analytical skills necessary for success in business, industry and management, and in a wide variety of technical and professional contexts. The degree program combines theory and document analysis with practice in

- generating written documents in a wide variety of forms and styles—from research-based papers and academic articles to formal reports and proposals;
- revising and editing technical, scientific and managerial documents for a variety of professional purposes;
- constructing and delivering business and technical presentations;

- designing and publishing professional-quality documents; and
- problem solving and communication-oriented decision making in collaborative team environments.

Admission Requirements

An applicant should have a bachelor's degree (B.A., B.S. or B.B.A.) prior to admission. Because of the interdisciplinary nature of this graduate program, students with undergraduate degrees in a wide variety of fields (e.g., biological sciences, business, communication, computer science, engineering, English, journalism, management, psychology, and physical and social sciences) are encouraged to apply.

Applicants should submit official transcripts of all undergraduate and graduate work undertaken previously; two letters of recommendation from academic or professional sources; GRE Verbal and Analytical test scores totaling at least 1,000; and a discursive writing sample (e.g., an academic research or critical paper, professional proposal, manual, or business or technical report).

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The program consists of 36 credit hours of approved graduate course work, including both required courses and electives tailored to meet the student's professional needs. Students are required to enroll in 15 hours of core courses, 12 hours of advanced course work in technical and professional communication, and six hours of elective courses to complement and broaden their professional skills. To complete the program, a student either both produces and defends a design project or thesis, or takes an additional three hours of course work.

Curriculum

The core curriculum includes course work in research and methods of analysis in technical and professional communication; technical, scientific and managerial discourse; technical editing, document design and software documentation; rhetorical analysis and style study; and language theory.

The core curriculum is enriched with elective course work. Master's students are encouraged to select elective sequences to pursue areas of particular research or professional interest.

Core Courses (15 credit hours)

COM 5000 Introduction to Technical and Professional Communication 3
COM 5050 Theories of Human Communication 3
COM 5102 Research Methods and Materials in Technical and Professional Communication 3
COM 5249 Document Design 3
COM 5345 Communicating in the Global Economy 3

Advanced Courses (12 credit hours)

At least four of the following courses

COM 5002 Writing for Specific Purposes 3
COM 5144 Science Journalism 3
COM 5247 Technical Editing 3
COM 5251 Oral Presentation for Business and Technical Audiences 3
COM 5252 Seminar in Marketing Communication 3
COM 5253 Customer Service and Communication 3
COM 5353 Advanced Managerial Report Writing 3
COM 5355 Seminar: Special Topics in Technical and Professional Communication 3
COM 5400 Independent Study 3
COM 5565 Technical and Professional Communication Internship 3–6
COM 5777 Technical and Professional Communication Design Project 3–6
COM 5999 Technical and Professional Communication Thesis 3
HUM 5020 The Roots of Rhetoric: Classical and Historical Perspectives 3
HUM 5021 Contemporary Rhetoric and Discourse Theory 3
LNG 5210 Aspects of Language 3

Electives (6 credit hours)—In addition, six credit hours of elective course work must be selected by students in the master's program. Students can pick up a copy of suggested electives from the program chair.

Nonthesis Option

A student may choose to complete 36 hours of course work without completing a thesis or design project. In that case, the student must take a final program examination no earlier than the last full semester in which the student is registered for courses.

Thesis/Design Project

In lieu of three hours of course work, the student may choose to complete either a traditional, research-based thesis or a design project (an extended problem-solving project exploring and resolving a designated situation in business, industry, government or education).

A thesis or design project proposal must be approved in advance by the student's committee. A defense of the thesis or the design project before the student's faculty committee is required. A unanimous vote of the student's committee is necessary for acceptance of the thesis or design project.

School of Aeronautics

Dean Michael K. Karim, Ph.D.

Bachelor of Science

Aeronautical Science
Aeronautical Science Flight Option
Aviation Computer Science
Aviation Management
Aviation Management Flight Option
Aviation Meteorology
Aviation Meteorology Flight Option

Master of Science in Aviation

Airport Development and Management
Applied Aviation Safety

Master of Science

Aviation Human Factors

Associate Dean and Director, Division of Aviation Studies
Kenneth E. Crooks, J.D.

Director, External Programs and Center for Airport Management and Development
Ballard M. Barker, Ph.D.

Program Chair, Aeronautical Science
John H. Cain, Ph.D.

Program Chair, Aviation Management
William R. Graves, M.B.A.

Program Chair, Graduate Studies
Nathaniel E. Villaire, Ed.D.

Associate Professors
Ballard M. Barker, Ph.D., *aviation systems management, aviation facility planning, aerial remote sensing applications.*

William M. Chepolis, D.Eng., *aerodynamics, aviation computer applications, avionics.*

John E. Deaton, Ph.D., *aviation human factors, applied aviation psychology.*

Ronald W. Hansrote, M.D., *aviation medicine, physiology, aeronautics, accident investigation.*

Michael K. Karim, Ph.D., *instructional technology systems, distance learning, project management.*

Tom Utley, Ph.D., *meteorology, environmental science.*

Nathaniel E. Villaire, Ed.D., *aviation safety, aviation physiology, airspace management, air traffic control.*

Assistant Professors
John H. Cain, Ph.D., *aeronautical science and technology applications, accident investigation, modern aircraft systems, flight deck avionics.*

Kenneth E. Crooks, J.D., *aviation law, labor relations, legal and ethical issues in aviation management.*

Paul B. Davis, M.B.A., *international business, crew resource management, multimodal transportation.*

William R. Graves, M.B.A., *aviation planning, airport design, aerodynamics, aviation computer applications, CAD for airports.*

Robert T. Schuster, M.A.S., *flight operations, turbine transition.*

David W. Smith, M.S., *airline operations, aviation education, air transportation management.*

Professors Emeriti
Alan L. Devereaux, M.B.A.; Edmund B. Everette, M.B.A.; N. Thomas Stephens, Ph.D.

Adjunct Professor
J. E. Faulk, J.D.

Lecturers
D.W. Beckwith, M.A.S.; E. Lindner, M.B.A.; W.W. Lowell, M.S.

Organization

The seven baccalaureate degree programs of the School of Aeronautics include aviation management, aeronautical science and aviation meteorology curricula, each with flight and nonflight options, and aviation computer science. The aviation management, aeronautical science and aviation computer science programs are fully accredited by the Council on Aviation Accreditation. The school offers a Master of Science in Aviation with options in airport development and management, and applied aviation safety; and a Master of Science in Aviation Human Factors.

Pilot training is an integral part of each flight option, and academic credit is awarded accordingly. Pilot training is conducted in conjunction with the normal academic programs, either as required or elective courses.

The School of Aeronautics is a member of the University Aviation Association and the Council on Aviation Accreditation. The school is recognized as a Federal Aviation Administration Airway Science Institution and an Aviation Education Resource Center. University flight training is conducted under the provisions of Federal Aviation Regulations Part 141.

Four aviation organizations for students are sponsored by the School of Aeronautics: Alpha Eta Rho, the national aviation fraternity; Women in Aviation International; the International Society of Air Safety Investigators; and the Falcons Intercollegiate Flight Team.

Facilities

The School of Aeronautics faculty and administrative offices, laboratories and academic classrooms are located in George M. Skurla Hall, at the corner of University Boulevard and Country Club Road on Florida Tech's main campus. Flight training is conducted by F.I.T. Aviation, L.L.C., a subsidiary of the university that maintains and operates a fleet of approximately 35 single- and multiengine training aircraft at nearby Melbourne International Airport. This towered airport hosts a mix of air carrier and general aviation traffic on its three runways, and with five separate terminal navigation facilities, an instrument landing system and a radar

approach control, it provides an excellent environment for professional flight training. Superb Florida weather allows efficiency of scheduling and continuity of training, and adds to the training experience. The many general aviation and commercial service airports in Central Florida also offer diversity and alternatives for flight training.

Admission

As a Freshman

A new freshman applicant is expected to have completed a high school college-preparatory curriculum, including mathematics courses—algebra, geometry and trigonometry. Applicants are evaluated on the basis of SAT/ACT scores, high school grade point averages, class standing and grades in foundation courses such as English, science and mathematics.

Tests administered to all entering freshmen during the week preceding the start of classes each semester determine appropriate placement in mathematics. Entering freshmen with previous flight training and at least the FAA Private Pilot Certificate will also be given the opportunity for advanced placement. Credit for certain flight and ground courses may be given for attainment of satisfactory scores on designated equivalency examinations and by logbook review and flight evaluation.

Students seeking admission to flight training must be examined by an FAA-designated aviation medical examiner and have an FAA medical certificate and student pilot certificate before the start of flight training. Applicants intending to seek a Commercial Pilot Certificate must have 20/20 vision in each eye, with or without correction. Medical examinations should be done far enough in advance of university admission to allow any potential problems or questions to be resolved.

As a Transfer Student

The School of Aeronautics welcomes transfer students from other colleges, and every effort is made to transfer the maximum number of credits. Transfer students may receive college credit for previous flight and ground training at the discretion of the division director. Transfer credit for flight training is normally granted only when the student is first enrolled, and after an evaluation, which may include a flight evaluation.

Dismissals

Dismissal policies for academic programs of the School of Aeronautics are the same as those stated in the *Undergraduate Information and Regulations* section of this catalog. However, due to the high-performance standards required for safety in flying, an added degree of commitment to meet those standards is required of the student pilot undergoing flight training. The dean of the School of Aeronautics retains the right to place on probation, suspend or administratively withdraw any flight student from any university flight training course, if such action is judged to be warranted by the student's behavior.

Flight Programs

Flight courses for academic credit are available to all interested Florida Tech students. Prospective students interested in any university flight training should be aware of weight and height limitations that may hinder or preclude safe and effective training. Training aircraft and many other aircraft in general use cannot accommodate persons with heights of less than 60 inches or greater than 77 inches, or body weights greater than 260 pounds (220 pounds for aerobatic training aircraft, which may be required for Flight Instructor training). Prospective students who may be affected by these limitations should make their situation known to admissions and the School of Aeronautics representatives at the earliest point in the application process for a case-by-case enrollment evaluation.

A summer program is offered to prospective students who have not yet started their flight training. This program gives high school graduates an opportunity to become acquainted with the flight environment by participating in an intensive two-month ground and flight training course. A student who is successful in the program will earn a Private Pilot Certificate and may enter the fall semester with advance credit for Flight 1 and Aeronautics 1 (a total of five semester credit hours). The credit will be applicable to all degrees offered by the School of Aeronautics, and may be used as elective credit in many other Florida Tech degree programs.

Professional, vocational and recreational flight training are also provided by arrangement at the aviation center, and qualified pilots may rent university aircraft. The aviation center offers training for FAA certificates for private, commercial and instructor pilot certificates, as well as training for the FAA ratings for instruments, multiengine, instrument instructor and multiengine instructor. An aerobatics course is also offered.

Degree Requirements

Candidates for School of Aeronautics degree programs must complete the minimum course requirements as outlined in the appropriate curriculum. Deviation from the recommended program may be made only with the approval of the division director or dean.

Flight Training Program

The flight training sequence for the aviation management flight option consists of four courses (AVF 1001 through AVF 2002), plus four additional flight credits, at least two credits of which must be earned in a multiengine course. This program is an integrated series of courses designed to qualify the student at the end of the first two academic years for the commercial pilot certificate and an instrument rating with a minimum of 190 hours of flight training. The aeronautical science flight option requires three upper-division flight courses in addition to the four-course lower division sequence. Students enrolled in the School of Aeronautics may not normally take flight training for credit outside the university's program.

A student seeking an FAA certificate or rating through the School of Aeronautics must complete courses pertinent to the desired certification at the university. To comply with FAA requirements, specific grades and attendance standards must be met in the following ground courses: Aeronautics 1 (AVT 1111), Aeronautics 2 (AVT 1112), Aeronautics 3 (AVT 2111) and Instructional Techniques (AVT 3101). FAA knowledge test fees are in addition to normal course fees.

Additional flight and ground training "add time," above the basic course program, may be required to achieve certification. Costs for all such add time are in addition to regular course fees. Most students require add time to complete private pilot certification.

Safety is a preeminent concern of the School of Aeronautics. All aircraft are modern, well equipped and maintained to the highest standards required by the FAA. Instructors and staff are particularly safety conscious and will insist students be physically and mentally fit to fly. All flight students are subject to random or "for cause" drug testing during enrollment as flight students. Any confirmed use of illegal drugs or chronic abuse of alcohol is cause for immediate dismissal from all flight training programs. Insurance coverage is automatically provided for all students operating aircraft under the university program.

All flight students seeking bachelor's degrees, regardless of experience or certificates, are required to take at least four credit hours of upper-division flight courses through the School of Aeronautics in addition to other degree requirements. Two of the upper-division credits must be in a multiengine flight course. All students applying for associate degrees in a flight option must have completed at least one two-credit flight course through the School of Aeronautics.

Aviation Management Internship Program

A six-credit aviation management internship program (AMIP) is offered to eligible senior students. The program consists of two courses, AVM 4600 and AVM 4603. This highly successful and popular program involves placement of students in entry-level management positions for a semester with air transportation, air commerce, aviation consulting, airports and governmental organizations throughout the United States and in selected foreign locations.

A management intern performs a variety of aviation management tasks under the supervision of working professionals, submits a series of graded written reports and presents a formal and written final report to selected students and faculty following the internship assignment.

To be eligible, a student must have completed all major requirements for the first three years of the curriculum, have a cumulative grade point average of at least 2.8 and be approved by a faculty committee.

Students enrolling in AMIP must have one full semester or summer term remaining after completion of AMIP. As a consequence, most students will enroll in AMIP during their last summer or the first semester of their senior year. The decision to enroll in AMIP must therefore be made and formalized with the student's adviser no later than early in the second semester of the junior year. Students planning to substitute AMIP credits for elective credit should make this decision early in their programs.

Electives

Electives are included to give the student reasonable flexibility and diversity within the constraints of total curriculum length and requirements of various accrediting and certification agencies.

Elective flight courses include all instructor ratings, advanced instrument proficiency, air-taxi training and aerobatics.

Nonflight-option students are encouraged to enroll in appropriate flight courses for personal and professional enhancement using elective credit.

Six credits of aviation management internship may be substituted for any free or AVx/BUS electives.

Aeronautical Science

Bachelor of Science

This curriculum prepares the graduate for a career in the global aviation science and technology industry and government regulatory agencies. The graduate is provided a strong foundation in mathematics, physics, aeronautical sciences, aeronautical technology and the regulated international aviation industry.

Freshman Year

FALL	CREDITS
AVS 1201 Aviation Meteorology	3
AVT 1111 Aeronautics 1	3
COM 1101 Composition and Rhetoric	3
CSE 1301 Introduction to Computer Applications	3
MTH 1001 Calculus 1	4
	16

SPRING	
COM 1102 Writing about Literature	3
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
PSY 1411 Introduction to Psychology	3
	15

Sophomore Year

FALL	CREDITS
AVS 1101 Aviation Chemical Science	3
AVS 2222 Aviation Physiology	3
BUS 1301 Basic Economics	3
HUM 2051 Civilization 1	3
PHY 2002 Physics 2	4
PHY 2092 Physics Lab 2	1
	17

SPRING	
AVS 2102 Aerodynamics	3
AVT 2201 National Airspace System	3
COM 2223 Scientific and Technical Communication	3
HUM 2052 Civilization 2	3
MTH 2401 Probability and Statistics	3
	15

Junior Year

FALL	CREDITS
AVM 2401 Aviation Fiscal Management	3
AVM 3201 Aviation Planning	3
BUS 2601 Legal and Social Environments of Business	3
BUS 3501 Management Principles	3
COM 3070 Professional Communication for Executives	3
Humanities Elective	3
	18

SPRING

AHF	3101	Introduction to Human Factors 3
AVM	3202	Airport Design 3
AVM	3302	Multimodal Transportation 3
AVS	3201	Meteorology 2 3
AVT	3203	Air Traffic Control 1 3
		Restricted Elective (Adviser Approval) 3
		18

Senior Year

FALL **CREDITS**

AVM	4201	Aviation Advanced Computer Applications 3
AVM	4301	Labor Relations and Employment Standards 3
AVM	4501	Air Transportation Management 3
AVT	4301	Aviation Safety 3
		Free Elective 3
		15

SPRING

AVM	4302	Aviation Law 3
AVM	4502	Aviation Business Simulation 3
AVM	4701	Airport Management 3
BUS	4502	Organizational Behavior and Theory 3
		Free Elective 3
		15

TOTAL CREDITS REQUIRED 129

Aeronautical Science Flight Option

Bachelor of Science

This curriculum prepares the graduate for a flight operations career in the global aviation science and technology industry and government regulatory agencies. The graduate is provided a strong foundation in mathematics, physics, aeronautical sciences, aeronautical technology, flight training and certification, and the regulated international aviation industry. On completion of the first two years of the curriculum with a cumulative GPA of 2.0 or higher, the student may petition for the award of the Associate of Science in Aeronautical Science Flight Option degree.

Freshman Year

FALL **CREDITS**

AVF	1001	Flight 1 2
AVS	1201	Aviation Meteorology 3
AVT	1111	Aeronautics 1 3
COM	1101	Composition and Rhetoric 3
MTH	1001	Calculus 1 4
		15

Private Pilot Written Examination
Private Pilot Flight Test

SPRING

AVF	1002	Flight 2 2
AVS	1101	Aviation Chemical Science 3
AVT	1112	Aeronautics 2 3
COM	1102	Writing about Literature 3
CSE	1301	Introduction to Computer Applications 3
MTH	1002	Calculus 2 4
		18

Instrument Rating Written Exam

Sophomore Year

FALL **CREDITS**

AVF	2001	Flight 3 2
AVS	2222	Aviation Physiology 3
AVT	2111	Aeronautics 3 3
HUM	2051	Civilization 1 3
PHY	1001	Physics 1 4
PHY	2091	Physics Lab 1 1
		16

Commercial Pilot Written Examination
Instrument Rating Flight Test

SPRING

AVF	2002	Flight 4 2
AVS	2102	Aerodynamics 3
HUM	2052	Civilization 2 3
PHY	2002	Physics 2 4
PHY	2092	Physics Lab 2 1
PSY	1411	Introduction to Psychology 3
		16

Commercial Pilot Flight Test

Junior Year

FALL **CREDITS**

AVF	4001	Multiengine Pilot 2
AVM	2401	Aviation Fiscal Management 3
AVM	3201	Aviation Planning 3
AVT	3101	Instructional Techniques 3
	or	
		Restricted Elective (Aviation) 3
MTH	2401	Probability and Statistics 3
		14

Multiengine Pilot Flight Test

SPRING

AHF	3101	Introduction to Human Factors 3
AVF	xxxx	Restricted Elective (Flight) 2
AVM	3202	Airport Design 3
AVS	3201	Aviation Meteorology 2 3
AVT	3203	Air Traffic Control 1 3
		Humanities Elective 3
		17

Senior Year

FALL **CREDITS**

AVF	xxxx	Restricted Elective (Flight) 2
AVM	4301	Aviation Labor Law and Employment Standards 3
AVT	4201	Advanced Aircraft Systems 3
AVT	4301	Aviation Safety 3
COM	3070	Professional Communications for Executives 3
		Restricted Elective (Aviation) 2
		16

SPRING

AVM	4302	Aviation Law 3
AVM	4501	Air Transport Management 3
AVT	4202	Advanced Aircraft Operations 3
AVT	4203	Airline Operations 3
		Free Elective 3
		15

TOTAL CREDITS REQUIRED 127

Aviation

Master of Science in Aviation
Options in:
Airport Development and Management
Applied Aviation Safety

The Master of Science in Aviation (M.S.A.) is designed to help meet the professional growth needs of persons interested in a wide range of aviation careers.

The degree is especially relevant for those who have earned baccalaureate degrees in aviation and those who have worked in the aviation field and now require more specialized knowledge. Generally, persons interested in careers in airport or airline management, airport consulting and governmental organizations involved in the management or regulation of airports should select the airport development and management option. Persons interested in aviation safety, accident investigation, technical aviation consulting and educational, regulatory or investigative positions in government or trade organizations would find the applied aviation safety option most appropriate.

Admission Requirements

The applicant to the Master of Science in Aviation program must have earned a bachelor's degree, or its equivalent, from an institution of acceptable academic standing. To be considered for admission, the student's academic and professional record must indicate a high probability the applicant will be able to pursue graduate work satisfactorily. Undergraduate degrees need not be in aviation; however, preparatory course work may be required in specific areas to assure successful pursuit of the M.S.A. degree. Such course work is determined by the School of Aeronautics before admission. The student is advised of any such requirements before final acceptance.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The Master of Science in Aviation degree is conferred on students who complete 33 (airport development and management option) or 37 (applied aviation safety option) graduate credits as listed on the student's approved Graduate Program Plan, in conformity with one of the curricula listed below. Each curriculum includes six credits of Thesis (AVM 5999), an in-depth study of a specific aviation issue. A non-thesis option is available for the airport development and management curriculum. The non-thesis option adds three credit hours for an aviation research project, and six hours of electives are completed in lieu of the thesis.

Curriculum

Airport Development and Management Option

The adviser assists the student in devising a program of study. Each student must complete a Graduate Program Plan (GPP) with a declared area of concentration by the end of the first semester of enrollment. The resulting GPP requires the approval of both the graduate program chair and the division director. Each student must complete and defend an appropriate thesis or take a total of 36 credit hours, including Advanced Aviation Research Project (AVM 5998) and a program examination. Thesis defense and examination policy and procedures are covered in the Graduate Policies of the School of Aeronautics.

Summary of Program Requirements

AVM	5101	Legal and Ethical Issues in Aviation	3
AVM	5102	Airport Development	3
AVM	5103	Airport Operations	3
		Additional Course Work (minimum)	15
		Graduate Statistics (Restricted Elective)	3
		Thesis (maximum)	6
		TOTAL CREDITS REQUIRED	33

Typical Graduate Program Plan

AVM	5101	Legal and Ethical Issues in Aviation	3
AVM	5102	Airport Development	3
AVM	5103	Airport Operations	3
AVM	5104	Aviation Economics and Fiscal Management	3
AVM	5105	Aviation Planning and Analysis Techniques	3
AVM	5999	Aviation Issue Analysis (Thesis)	6
BUS	5023	Management and Administration of Contracts	3
CVE	5040	Urban Planning	3
EDS	5070	Educational Statistics	3
ENM	5200	Project Engineering	3

Applied Aviation Safety Option

The adviser assists the student in devising a program of study. Each student must complete a Graduate Program Plan (GPP) appropriate for the declared area of concentration by the end of the first semester of enrollment. The resulting GPP requires the approval of both the graduate program chair and the division director. Each student must complete and defend an appropriate thesis.

Summary of Program Requirements

AVM	5101	Legal and Ethical Issues in Aviation	3
AVS	5204	Aviation Safety Analysis	3
AVT	4301	Aviation Safety	3
		Additional Course Work (minimum)	19
		Graduate Statistics (Restricted Elective)	3
		Thesis (maximum)	6
		TOTAL CREDITS REQUIRED	37

Typical Graduate Program Plan

AHF	5101	Human Factors in Man-Machine Systems	3
AHF	5201	Human Performance 1	3
AVM	5101	Legal and Ethical Issues in Aviation	3
AVS	5201	Aviation Meteorology Theory and Practice	3
AVS	5202	Advanced Aviation Meteorology Lab	1
AVS	5203	Impact of Aviation on Human Physiology	3
AVS	5204	Aviation Safety Analysis	3
AVS	5999	Thesis Research	6
AVT	4301	Aviation Safety	3
AVT	5301	Complex Aviation Systems	3
AVT	5302	Accident Investigation	3
EDS	5070	Educational Statistics	3

International Exchange

In cooperation with France's Ecole Nationale de l'Aviation Civile (ENAC), Florida Tech's School of Aeronautics conducts a special graduate program leading to the Master of Science in Aviation, Airport Development and Management option. For an ENAC student to qualify for this option, the student must have completed a predetermined program at ENAC before being accepted for graduate study. Once accepted,

the student enrolls at Florida Tech to take seven courses (list available upon request), including the three required courses listed above for this option. On completion of these courses and an internship, the Master of Science in Aviation is awarded.

Opportunities also exist for Florida Tech students to complete part of their M.S.A. degree requirements in Toulouse, France, by takings courses at ENAC. Additional information is available from the School of Aeronautics.

Aviation Computer Science

Bachelor of Science

This curriculum provides a strong background in computer science as related to several facets of the aviation industry, such as aircraft systems development, air traffic control, airspace management, information support systems and aviation planning. Program content complies with standards of the FAA Airway Science Program.

Freshman Year

FALL	CREDITS
AVS 1201 Aviation Meteorology	3
AVT 1111 Aeronautics 1	3
COM 1101 Composition and Rhetoric	3
CSE 1001 Fundamentals of Software Development 1	4
MTH 1001 Calculus 1	4
	17

SPRING	
COM 1102 Writing about Literature	3
CSE 1002 Fundamental of Software Development 2	4
MTH 1002 Calculus 2	4
PHY 1001 Physics 1	4
PHY 2091 Physics Lab 1	1
	16

Sophomore Year

FALL	CREDITS
CSE 1400 Applied Discrete Mathematics	3
CSE 2010 Algorithms and Data Structures	4
HUM 2051 Civilization 1	3
PHY 2002 Physics 2	4
PSY 1411 Introduction to Psychology	3
	17

SPRING	
AVT 2201 National Airspace System	3
COM 2223 Scientific and Technical Communication	3
CSE 2050 Programming in a Second Language	3
CSE 2410 Introduction to Software Engineering	3
HUM 2052 Civilization 2	3
	15

Junior Year

FALL	CREDITS
AVM 3201 Aviation Planning	3
AVT 3203 Air Traffic Control 1	3
BUS 3501 Management Principles	3
CSE 3101 Machine and Assembly Language	3
CSE 4250 Programming Language Concepts	3
MTH 2401 Probability and Statistics	3
	18

SPRING	
AVM 3202 Airport Design	3
COM 3070 Professional Communication for Executives	3
CSE 4232 Computer Network Programming	3
Restricted Elective (AVx, BUS, CSE)	3
Humanities Elective	3
	15

Senior Year

FALL	CREDITS
AVM 4201 Aviation Advanced Computer Applications	3
AVT 4301 Aviation Safety	3
CSE 4001 Operating Systems Concepts	3
Free Elective	3
Restricted Elective (CSE)	3
	15

SPRING	
AVM 4204 CAD for Airport Environments	3
AVM 4302 Aviation Law	3
AVM 4501 Air Transportation Management	3
or	
AVM 4701 Airport Management	3
BUS 3502 Human Relations in Management	3
Restricted Elective (CSE)	3

Aviation Human Factors

Master of Science

Human factors refers to the field of study that attempts to identify the principles of human/machine interaction, and applies these principles to the design and operation of engineered systems. Thus, the field is both a rigorous research domain rooted in cognitive, physiological and engineering theory, and an applied science with an intimate and direct connection to the operational world.

Although the range of engineered systems of interest in human factors is very wide, this degree concentrates on aviation-related human factors studies. Such studies range from aircraft cockpit design and aircraft maintenance methods and procedures to complex ground-based entities such as the National Airspace System. Human factors is now recognized as an indispensable component of systems design and evaluation, accident investigation and prevention, simulation, training, procedures development and system performance testing. Considerable research is being conducted in this field by government and private entities around the world.

In addition to its advantageous location on the Space Coast, Florida Tech has significant university assets that enhance its potential for aviation human factors research and education.

Admission Requirements

An applicant to the Master of Science in Aviation Human Factors program must have earned a bachelor's degree, or its equivalent, from an institution of acceptable academic standing. Undergraduate course work should include statistics and computer programming in at least one higher-level

language. Some aviation background or education is also required. Deficiencies in these areas may be made up through courses taken at the university concurrent with the aviation human factors program course work. Preference is given to candidates with special skills and experience in the fields of aviation software design, engineering, aeronautics, applied psychology or computer science.

General admission requirements and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Curriculum

The adviser assists the student in devising a program of study. Each student must complete a Graduate Program Plan (GPP) appropriate for the declared area of concentration by the end of the first semester of enrollment. The resulting GPP requires the approval of both the graduate program chair and the division director. Each student must complete and defend an appropriate thesis.

The Master of Science in Aviation Human Factors requires the satisfactory completion of a minimum of 36 credit hours of approved course work including six hours of Thesis (AHF 5999).

Summary of Program Requirements

AHF 5101 Human Factors in Man-Machine Systems	3
AHF 5991 Sensation and Perception	3
AVM 5101 Legal and Ethical Issues in Aviation	3
Additional Course Work (minimum)	18
Graduate Statistics (Restricted Elective)	3
Thesis (maximum)	6
TOTAL CREDITS REQUIRED	36

Typical Graduate Program Plan

AHF 5101 Human Factors in Man–Machine Systems	3
AHF 5201 Human Performance 1	3
AHF 5202 Human Performance 2	3
AHF 5302 Human-Computer Interaction	3
AHF 5991 Sensation and Perception	3
AHF 5999 Thesis Research	6
AVM 5101 Legal and Ethical Issues in Aviation	3
AVS 4000 Aviation Physiology Laboratory	1
AVS 4201 Flight Observation Laboratory	1
AVS 5201 Aviation Meteorology Theory and Practice	3
AVS 5202 Advanced Aviation Meteorology Lab	1
EDS 5070 Educational Statistics	3
EDS 5095 Essentials of Educational Research	3

Thesis Research

A thesis based on research conducted with the approval of the School of Aeronautics is required. The student selects a faculty member, with the approval of the option adviser and the graduate program chair, to serve as the thesis research adviser. With the assistance of the adviser, the student selects an advisory committee and defines a research topic. The committee must include at least one other member from the School of Aeronautics and one from another degree-granting department of the university. The adviser and the committee offer assistance and direction to the student and serve as a review board to ensure that thesis requirements are met. After completion of the thesis, the adviser and committee conduct the oral defense of the thesis as described under "Master's Degree Requirements" in the *Graduate Information and Regulations* section of this catalog. Three to six credits are awarded for successful completion of the thesis.

Aviation Management

Bachelor of Science

This program provides a comprehensive background in aviation studies, management and business, which is appropriate to careers in air transportation, air commerce, airport planning and management, and aircraft sales and insurance. An elective in this curriculum allows the student to take flight training for credit.

Freshman Year

FALL	CREDITS
AVS 1201 Aviation Meteorology	3
AVT 1111 Aeronautics 1	3
COM 1101 Composition and Rhetoric	3
CSE 1301 Introduction to Computer Applications	3
MTH 1000 Pre-Calculus	3
	15

SPRING	
AVS 1101 Aviation Chemical Science	3
AVT 2201 National Airspace System	3
COM 1102 Writing about Literature	3
MTH 1702 Applied Calculus	3
PSY 1411 Introduction to Psychology	3
	15

Sophomore Year

FALL	CREDITS
AVS 2101 Aviation Physical Science	3
BUS 2211 Introduction to Financial Accounting	3
BUS 2303 Macroeconomics	3
COM 2224 Business and Professional Writing	3
HUM 2051 Civilization 1	3
	15

SPRING	
BUS 2212 Introduction to Managerial Accounting	3
BUS 2304 Microeconomics	3
BUS 2601 Legal and Social Environments of Business	3
BUS 2703 Statistics for Business	3
HUM 2052 Civilization 2	3
	15

Junior Year

FALL	CREDITS
AVM 3201 Aviation Planning	3
BUS 3401 Corporate Finance	3
BUS 3501 Management Principles	3
BUS 3601 Marketing Principles	3
COM 3070 Professional Communication for Executives	3
Humanities Elective	3
	18

SPRING

AVM	3202	Airport Design 3
AVM	3302	Multimodal Transportation 3
BUS	3503	Human Resource Management 3
BUS	3504	Management Information Systems 3
		Restricted Elective (AVx or BUS) 3
		15

Senior Year

FALL **CREDITS**

AVM	4201	Aviation Advanced Computer Applications 3
AVM	4301	Aviation Labor Law and Employment Standards 3
AVM	4401	International Air Commerce 3
AVM	4501	Air Transportation Management 3
AVT	4301	Aviation Safety 3
		Restricted Elective (AVx or BUS) 3
		18

SPRING

AVM	4204	CAD for Airport Environments 3
AVM	4302	Aviation Law 3
AVM	4502	Aviation Business Simulation 3
AVM	4701	Airport Management 3
BUS	4502	Organizational Behavior and Theory 3
		15

TOTAL CREDITS REQUIRED 126

Aviation Management Flight Option

Bachelor of Science

This curriculum prepares the student to become a professional pilot with a strong business and management foundation appropriate for careers in air commerce, airport management and aircraft sales and insurance. After completing the first two years of the curriculum, as listed below, with a cumulative GPA of 2.0 or higher, a student may petition for the award of the Associate of Science in Aviation Management Flight Option degree.

Freshman Year

FALL **CREDITS**

AVF	1001	Flight 1 2
AVS	1201	Aviation Meteorology 3
AVT	1111	Aeronautics 1 3
COM	1101	Composition and Rhetoric 3
MTH	1000	Pre-Calculus 3
		14

Private Pilot Written Examination
Private Pilot Flight Test

SPRING

AVF	1002	Flight 2 2
AVS	1101	Aviation Chemical Science 3
AVT	1112	Aeronautics 2 3
BUS	1301	Basic Economics 3
COM	1102	Writing about Literature 3
MTH	1603	Applied Calculus and Statistics 3
		17

Sophomore Year

FALL **CREDITS**

AVF	2001	Flight 3 2
AVS	2101	Aviation Physical Science 3
AVT	2111	Aeronautics 3 3
BUS	2211	Introduction to Financial Accounting 3
CSE	1301	Introduction to Computer Applications 3
HUM	2051	Civilization 1 3
		17

Commercial Pilot Written Examination
Instrument Pilot Written Examination
Instrument Pilot Flight Test

SPRING

AVF	2002	Flight 4 2
AVS	2102	Aerodynamics 3
AVS	2222	Aviation Physiology 3
BUS	2212	Introduction to Managerial Accounting 3
HUM	2052	Civilization 2 3
PSY	1411	Introduction to Psychology 3
		17

Commercial Pilot Flight Test

Junior Year

FALL **CREDITS**

AVF	4001	Multiengine Pilot 2
AVM	3201	Aviation Planning 3
AVT	3101	Instructional Techniques 3
	or	
		Restricted Elective (Aviation) 3
BUS	3401	Corporate Finance 3
BUS	3501	Management Principles 3
COM	3070	Professional Communication for Executives 3
		17

Multiengine Pilot Flight Test

SPRING

AVM	3202	Airport Design 3
AVM	3302	Multimodal Transportation 3
BUS	2601	Legal and Social Environments of Business 3
BUS	3601	Marketing Principles 3
		Humanities Elective 3
		15

Senior Year

FALL **CREDITS**

AVF	xxxx	Restricted Elective (Flight) 2
AVM	4201	Aviation Advanced Computer Applications 3
AVM	4301	Aviation Labor Law and Employment Standards 3
AVM	4501	Air Transportation Management 3
AVT	4201	Advanced Aircraft Systems 3
AVT	4301	Aviation Safety 3
		17

SPRING

AVM	4302	Aviation Law 3
AVM	4701	Airport Management 3
AVT	4202	Advanced Aircraft Operations 3
BUS	3502	Human Relations in Management 3
		Free Elective 3
		15

TOTAL CREDITS REQUIRED 129

Aviation Meteorology

Bachelor of Science

This program provides a background in meteorology, aeronautical science and the appropriate physical sciences. A student completing the program meets the requirements of the U.S. Office of Personnel Management for employment by the federal government as a meteorologist. Graduates are prepared for careers with major airlines, corporate aviation and the FAA, as well as international organizations.

B.S. and M.S. degrees in meteorology are also offered as options in the environmental sciences program in the College of Engineering.

Freshman Year

FALL		CREDITS
AVS 1201	Aviation Meteorology	3
AVT 1111	Aeronautics 1	3
COM 1101	Composition and Rhetoric	3
CSE 1301	Introduction to Computer Applications	3
MTH 1001	Calculus 1	4
		16
SPRING		
AVS 1101	Aviation Chemical Science	3
AVT 2201	National Airspace Systems	3
COM 1102	Writing About Literature	3
MTH 1002	Calculus 2	4
PHY 1001	Physics 1	4
PHY 2091	Physics Lab 1	1
		18

Sophomore Year

FALL		CREDITS
HUM 2051	Civilization 1	3
MTH 2001	Calculus 3	4
MTH 2401	Probability and Statistics	3
PHY 2002	Physics 2	4
PHY 2092	Physics Lab 2	1
		15
SPRING		
AVS 2102	Aerodynamics	3
COM 2223	Scientific and Technical Communication	3
HUM 2052	Civilization 2	3
MTH 2201	Differential Equations/Linear Algebra	4
OCN 2407	Meteorology	3
		16

Junior Year

FALL		CREDITS
AVT 3203	Air Traffic Control	3
MET 3401	Synoptic Meteorology 1	3
OCN 3430	Fundamentals of Geophysical Fluids	3
PHY 3060	Thermodynamics	4
	Humanities Elective	3
		16
SPRING		
AVS 2222	Aviation Physiology	3
AVS 3201	Aviation Meteorology 2	3
MET 3402	Synoptic Meteorology 2	3
	Aviation Elective	3
	Restricted Elective (Adviser Approved)	3
		15

Senior Year

FALL		CREDITS
AVM 4501	Air Transportation Management	3
AVT 4301	Aviation Safety	3
MET 4305	Atmospheric Dynamics 1	3
	Social Science Elective	3
	Technical Elective	3
		15
SPRING		
AVM 4302	Aviation Law	3
MET 4233	Remote Sensing for Meteorology	3
MET 4306	Atmospheric Dynamics 2	3
MET 4310	Climatology	3
SPS 4030	Physics of the Atmosphere	3
		15

TOTAL CREDITS REQUIRED 126

Aviation Meteorology Flight Option

Bachelor of Science

This program prepares the student for a career as a professional pilot with a strong meteorological and physical science background. A student completing the program also meets the requirements of the U.S. Office of Personnel Management for employment by the federal government as a meteorologist. Students are afforded significant flexibility in career choices upon graduation. On completion of the first two years of the curriculum and satisfaction of the associate degree core requirements, with a cumulative grade point average of 2.0 or higher, the student may petition for the award of the Associate of Science in Aviation Meteorology Flight Option degree.

Freshman Year

FALL		CREDITS
AVF 1001	Flight 1	2
AVS 1201	Aviation Meteorology	3
AVT 1111	Aeronautics 1	3
COM 1101	Composition and Rhetoric	3
MTH 1001	Calculus 1	4
		15

Private Pilot Written Exam
Private Pilot Flight Test

SPRING		
AVF 1002	Flight 2	2
AVT 1112	Aeronautics 2	3
COM 1102	Writing About Literature	3
MTH 1002	Calculus 2	4
PHY 1001	Physics 1	4
PHY 2091	Physics Lab 1	1
		17

Instrument Rating Written Exam

Sophomore Year

FALL		CREDITS
AVF 2001	Flight 3	2
AVT 2111	Aeronautics 3	3
CSE 1301	Introduction to Computer Applications	3
MTH 2001	Calculus 3	4
PHY 2002	Physics 2	4
PHY 2092	Physics Lab 2	1
		17

Instrument Rating Flight Test
Commercial Pilot Written Exam

SPRING

AVF	2002	Flight 4 2
AVS	1101	Aviation Chemical Science 3
AVS	2102	Aerodynamics 3
MTH	2201	Differential Equations/Linear Algebra 4
OCN	2407	Meteorology 3
		15

Commercial Pilot Flight Test

Junior Year

FALL **CREDITS**

COM	2223	Scientific and Technical Communication 3
HUM	2051	Civilization 1 3
MET	3401	Synoptic Meteorology 1 3
OCN	3430	Fundamentals of Geophysical Fluids 3
PHY	3060	Thermodynamics, Kinetic Theory and Statistical Mechanics 4
		16

SPRING

AVF	xxxx	Restricted Elective (Flight) 2
AVS	2222	Aviation Physiology 3
AVS	3201	Aviation Meteorology 2 3
HUM	2052	Civilization 2 3
MET	3402	Synoptic Meteorology 2 3
MTH	2401	Probability and Statistics 3
		17

Senior Year

FALL **CREDITS**

AVF	4001	Multiengine Pilot 2
AVT	4201	Advanced Aircraft Systems 3
AVT	4301	Aviation Safety 3
MET	4305	Atmospheric Dynamics 1 3
		Humanities Elective 3
		Social Science Elective 3
		17

Multiengine Pilot Flight Test

SPRING

AVM	4302	Aviation Law 3
AVT	4202	Advanced Aircraft Operations 3
MET	4233	Remote Sensing for Meteorology 3
MET	4306	Atmospheric Dynamics 2 3
SPS	4030	Physics of the Atmosphere 3
		15

TOTAL CREDITS REQUIRED 129

School of Management

Dean A. Thomas Hollingsworth, Ph.D.

Bachelor of Science

Accounting
Business Administration
Business and Environmental Studies
Information Systems in Business
Management Information Systems

Master of Business Administration

Associate Dean
Barbara G. Pierce, Ph.D.

Professors
LuAnn G. Bean, Ph.D., *accounting choice decisions, financial reporting and valuation, internal auditing, information technology.*

Anthony J. Catanese, Ph.D., *real estate finance, architecture, urban planning.*

A. Thomas Hollingsworth, Ph.D., *enhancement of creativity in organizations, relating pay to performance, small business development, ethical behavior in organizations, health care management.*

T. Roger Manley, Ph.D., *behavior of individuals in work organizations, organizational effectiveness and productivity, work redesign, organizational change and development, measurement and management of work-related stress, measurement of organizational culture.*

Julie Siciliano, Ph.D., *strategic management, board of director involvement in strategy, relationship between planning and performance, strategy implementation issues.*

Associate Professors
Judith Barlow, Ph.D., *Web-based technologies, high performance database systems, telecommunications and networking, cross-curricular technology integration, distance education, technology innovation.*

Gerard A. Cahill, Ph.D., P.E., *corporate strategy and policy, financial management and planning, general corporate management.*

Karen Chambliss, Ph.D., *financial management, investments, financial institutions, financial services.*

Theresa A. Domagalski, Ph.D., *organizational behavior, human resources, employee rights and responsibilities, organizational justice, power and resistance to organizational change, emotions in organizations.*

David D. Hott, Ph.D., *management decisions, operations research quantitative methods for business, management information systems, E-commerce.*

John R. Patton, D.B.A., *international business.*

Barbara G. Pierce, Ph.D., *segmental disclosures and earning predictability, segment information, earnings forecasting, distance education, technology-supported curricula.*

Assistant Professors
Deborah S. Carstens, Ph.D., *human error, process and safety optimization, patient safety, human-computer interaction, usability.*

B. Andrew Cudmore, Ph.D., *quality perceptions, Internet marketing, persuasion knowledge, customer/salesperson interaction, store brand management, customer complaining behavior.*

Carolyn J. Fausnaugh, Ph.D., *strategic management, entrepreneurial studies.*

Michael H. Slotkin, Ph.D., *international economics, strategic trade policy, managerial economics, environmental and resource economics.*

Alexander R. Vamosi, Ph.D., *demographic and technological change in macroeconomics, monetary policy, trend movements in income distribution.*

Professors Emeriti
John P. Callahan, Ed.D.; Gerald F. Goldberg, Ph.D.; F. Robert Searle, D.B.A.

Adjunct Professors
D.F. Dement, Ph.D; W.R. Northcutt, J.D.; S.A. Villaire, Ed.D.; D.L. Wildman, J.D.

Lecturer
T.J. Stauffacher, M.S.

Curricula in the School of Management are designed to develop and expand a student's skills and capabilities in preparation for successful leadership in today's dynamic business environment. They provide exposure to the computer tools necessary to compete in the international marketplace, and more importantly, they focus on the use of these tools in the decision-making process, thereby providing a value-creating competency for the knowledge-based competitive environment.

Access to high-tech programs on campus, as well as proximity to the space industry's top innovative firms, creates an atmosphere of dynamic change and adaptation important in the rapid product and economic cycles of the 21st century. Due to relationships developed with firms in a variety of industries, the school has established an active participation program involving executives from both local companies and multinationals with locations in our area. These executives contribute to the programs in many ways, such as through membership on the school's board of overseers, whose charter is to assure the school is meeting the needs of employers; and in support of the internship program, where students obtain practical experience; and the mentor program, by which students have opportunities of one-on-one interaction with executives, in preparation for life in management.

The faculty are encouraged to stay on the cutting edge of their fields of expertise and are provided with the technical tools needed to accomplish this goal. They are also heavily involved in student activities and actively pursue opportunities to help each student reach his or her full potential.

The School of Management offers its M.B.A. program on the main campus and at the Spaceport Education Center. Students may enroll in classes offered in Melbourne or at either of the Spaceport Education Center sites, Patrick Air Force Base or John F. Kennedy Space Center. See our Web site: www.som.fit.edu.

Business Administration

Bachelor of Science Degree Programs

Accounting

The undergraduate program in accounting is a traditional four-year accounting program providing a solid business framework. This program includes the Business Practicum (focused on accounting) as well as access to the Corporate Mentor Program. Students planning to take the CPA examination in Florida receive a solid foundation preparing them for the M.B.A. accounting track, where they can earn sufficient credits to be eligible for this examination.

The first two years of the Bachelor of Science in Accounting program are the same as for the Bachelor of Science in Business Administration.

Junior Year

FALL		CREDITS
BUS 3211	Intermediate Accounting 1	3
BUS 3213	Cost and Managerial Accounting	3
BUS 3214	Accounting Information Systems	3
BUS 3501	Management Principles	3
	Humanities Elective	3
		15

SPRING		
BUS 3212	Intermediate Accounting 2	3
BUS 3601	Marketing Principles	3
BUS 3704	Quantitative Methods	3
BUS 4211	Internal Audit	3
	Humanities Elective	3
		15

Senior Year

FALL		CREDITS
BUS 3208	Federal Income Tax 1	3
BUS 3401	Corporate Finance	3
BUS 4501	Production/Operations Management	3
BUS 4502	Organizational Behavior and Theory	3
	Humanities Elective	3
		15

SPRING		
BUS 42xx	Restricted Elective (Accounting)	3
BUS 4284	Accounting Practicum	3
BUS 4702	Business Strategy and Policy	3
	Restricted Electives (Business)	6
		15

TOTAL CREDITS REQUIRED 120

Business Administration

The undergraduate program in business administration concentrates on a combination of basic and advanced courses in the various business disciplines. These are coordinated with courses covering current developments in the field, such as environmental aspects, quantitative techniques and computer applications. The emphasis of the business administration curriculum is on relevance, and the courses are continually updated with the objective of equipping each student with a background in the science of management. This will permit students to contribute significantly to their chosen occupations after graduation.

The curriculum is designed to permit the student to acquire a foundation in all areas of business administration: accounting, business law, information systems, economics, finance, marketing, management, quantitative methods and statistics. After graduation, the student has an excellent background in the business and management fields and can directly enter the job market, in commerce, industry, government or other areas. Many students may wish to continue into graduate school or enter one of the professional fields such as law, where they will have had an excellent undergraduate preparation.

Candidates for a Bachelor of Science in Business Administration must complete the minimum course requirements as outlined in the following curriculum. A minimum of 50 percent of the business courses must be completed at Florida Tech.

Freshman Year

FALL		CREDITS
BUS 1601	Computer Applications for Business	3
COM 1101	Composition and Rhetoric	3
MTH 1701	College Algebra	3
	Restricted Elective (Psychology)	3
	Restricted Elective (Science)	3
		15

SPRING		
BUS 2304	Microeconomics	3
COM 1102	Writing about Literature	3
MTH 1702	Applied Calculus	3
	Restricted Elective (Science)	3
	Free Elective	3
		15

Sophomore Year

FALL		CREDITS
BUS 2211	Introduction to Financial Accounting	3
BUS 2303	Macroeconomics	3
BUS 2703	Statistics for Business	3
COM 2224	Business and Professional Writing	3
HUM 2051	Civilization 1	3
		15

SPRING		
BUS 2212	Introduction to Managerial Accounting	3
BUS 2601	Legal and Social Environments of Business	3
COM 2370	Speech	3
HUM 2052	Civilization 2	3
	Free Elective	3
		15

Junior Year

FALL		CREDITS
BUS 3401	Corporate Finance	3
BUS 3501	Management Principles	3
BUS 3601	Marketing Principles	3
	Humanities Electives	6
		15

SPRING		
BUS 3503	Human Resource Management	3
BUS 3504	Management Information Systems	3
BUS 3704	Quantitative Methods	3
	Restricted Electives (Business)	3
	Humanities Elective	3
		15

Senior Year

FALL		CREDITS
BUS 4501	Production/Operations Management	3
BUS 4502	Organizational Behavior and Theory	3
BUS 4684	Senior Business Research	3
	Restricted Elective (Business)	6
		15

SPRING

BUS	4701	International Business 3
BUS	4702	Business Strategy and Policy 3
BUS	4784	Practicum in Business 3
		Restricted Electives (Business) 6
		15

TOTAL CREDITS REQUIRED 120

Business and Environmental Studies

This program emphasizes the application of economics to issues associated with the environment and the use of natural resources. It familiarizes students with both analytical and decision-making techniques used in assessing environmental concerns and the use of natural resources, and develops a balanced perspective on business and the environment.

Freshman Year

FALL **CREDITS**

BUS	1601	Computer Applications for Business 3
COM	1101	Composition and Rhetoric 3
MTH	1701	College Algebra 3
ENS	1001	The Whole Earth Course 3
		Restricted Elective (Psychology) 3
		15

SPRING

BUS	2304	Microeconomics 3
COM	1102	Writing about Literature 3
COM	2370	Speech 3
MTH	1702	Applied Calculus 3
OCN	1010	Oceanography 3
		15

Sophomore Year

FALL **CREDITS**

BIO	1010	Biological Discovery 1 4
BUS	2211	Introduction to Financial Accounting 3
BUS	2303	Macroeconomics 3
CHM	1101	General Chemistry 4
		14

SPRING

BIO	1020	Biological Discovery 2 4
BUS	2212	Introduction to Managerial Accounting 3
CHM	1102	General Chemistry 2 4
COM	2224	Business and Professional Writing 3
		Free Elective 3
		17

Junior Year

FALL **CREDITS**

BUS	2601	Legal and Social Environments of Business 3
BUS	2703	Statistics for Business 3
BUS	3501	Management Principles 3
ENS	3101	Atmospheric Environments 3
OCN	2602	Environmental Geology 3
		15

SPRING

BUS	3504	Management Information Systems 3
BUS	3601	Marketing Principles 3
BUS	3704	Quantitative Methods 3
ENS	4010	Geographic Information Systems 3
HUM	2051	Civilization 1 3
		15

Senior Year

FALL **CREDITS**

BUS	3401	Corporate Finance 3
BUS	4425	Environmental and Urban Planning 3
BUS	4426	Environmental and Resource Economics 3
BUS	4501	Production and Operations Management 3
BUS	4502	Organizational Behavior and Theory 3
HUM	2052	Civilization 2 3
		18

SPRING

BUS	4702	Business Strategy and Policy 3
BUS	4784	Business Practicum 3
		Restricted Electives (Environmental Science) 6
		Restricted Elective (Humanities) 3
		15

TOTAL CREDITS REQUIRED 124

Information Systems in Business

The information systems in business program offers an interdisciplinary approach that bridges information systems, computing, business and communication disciplines. The integration of information systems, computing technology, business and communication provide a solid foundation for effective management of today's complex systems. The study of information systems in business emphasizes strategic, managerial, operational and technical aspects of systems using appropriate decision tools, methods and technologies. Verbal and nonverbal communication modes are incorporated into the problem-solving process to promote the use of different information technologies, including multimedia, Web and distributed environments.

Candidates for the B.S. in Information Systems must complete the minimum course requirement as outlined in the following curriculum. Applicants interested in obtaining the Bachelor of Science degree in Computer Science with an information systems option should refer to the appropriate section of this catalog.

Freshman Year

FALL **CREDITS**

COM	1101	Composition and Rhetoric 3
CSE	1000	Introduction to Information Systems 3
MTH	1701	College Algebra 3
		Restricted Elective (Psychology) 3
		Restricted Elective (Science) 3
		15

SPRING

BUS	2304	Microeconomics 3
COM	1102	Writing about Literature 3
CSE	1001	Fundamentals of Software Development 1 4
MTH	1702	Applied Calculus 3
		Restricted Elective (Science) 3
		16

Sophomore Year

FALL **CREDITS**

BUS	2211	Introduction to Financial Accounting 3
BUS	2303	Macroeconomics 3
BUS	2703	Statistics for Business 3
COM	2012	Research Sources and Systems 1
COM	2501	Introduction to Visual Communication 3
CSE	1002	Fundamentals of Software Development 2 4
		17

SPRING

BUS	2212	Introduction to Managerial Accounting 3
BUS	2601	Legal and Social Environments of Business 3
COM	2224	Business and Professional Writing 3
CSE	2010	Algorithms and Data Structures 4
MTH	2051	Discrete Math 3
		16

Junior Year

FALL **CREDITS**

BUS	3401	Corporate Finance 3
BUS	3501	Management Principles 3
COM	3440	Public Relations 3
CSE	3030	Legal, Ethical and Social Issues in Computing 3
HUM	2051	Civilization 1 3
		15

SPRING

BUS	3504	Management Information Systems 3
BUS	3601	Marketing Principles 3
BUS	3704	Quantitative Methods 3
CSE	4020	Database Systems 3
HUM	2052	Civilization 2 3
		15

Senior Year

FALL		CREDITS
BUS	4501	Production/Operations Management 3
BUS	4502	Organizational Behavior and Theory 3
COM	3070	Professional Communication for Executives 3
COM	4026	Publishing and the Internet 3
CSE	4220	Systems Analysis and Design 3
		15

SPRING

BUS	4702	Business Strategy and Policy 3
BUS	4784	Business Practicum 3
COM	4424	Advanced Business and Professional Communication 3
CSE	4221	Systems Development Workshop 3
		Humanities Elective 3
		15

TOTAL CREDITS REQUIRED 124

Management Information Systems

The management information systems program provides an opportunity for students to gain valuable skills for use in a wide variety of organizations. As the liaison between information systems and management, graduates are able to provide significant, valuable contributions to the decision-making capabilities of an organization. The course work provides a solid understanding of the business core (management, accounting, finance, marketing and economics), supplemented by specialized knowledge of information systems and capabilities. The business practicum (focused on management information systems) provides students an opportunity to hone their skills in a real world environment, enabling them to confidently enter their future positions ready to make meaningful contributions.

Candidates for a Bachelor of Science in Management Information Systems must complete the minimum course requirements as outlined in the following curriculum. The first two years are the same as for the Bachelor of Science in Business Administration.

Junior Year

FALL		CREDITS
BUS	3501	Management Principles 3
BUS	3504	Management Information Systems 3
BUS	3510	Advanced Business Computer Applications 3
BUS	3601	Marketing Principles 3
COM	4026	Publishing and the Internet 3
		15

SPRING

BUS	3401	Corporate Finance 3
BUS	3512	System Design and Development for Business 3
BUS	3514	Introduction to Operating Systems and Networks for Business 3
BUS	3704	Quantitative Methods 3
		Humanities Elective 3
		15

Senior Year

FALL		CREDITS
BUS	4501	Production and Operations Management 3
BUS	4502	Organizational Behavior and Theory 3
BUS	4508	Web Technology for Business 3
BUS	4509	Management of Database Systems 3
		Humanities Elective 3
		15

SPRING

BUS	3503	Human Resource Management 3
BUS	4583	Senior Project 3
BUS	4584	MIS Practicum 3
BUS	4701	International Business 3
BUS	4702	Business Strategy and Policy 3
		15

TOTAL CREDITS REQUIRED 120

Master of Business Administration Degree Program

Admission Requirements

The applicant to the master of business administration program must have a bachelor's degree; however, the degree need not be in business administration. Applicants who are graduates of nonbusiness programs are encouraged to apply, but may be required to complete certain foundation courses to better prepare for some of the advanced business courses in the M.B.A. program. The number of needed foundation courses depends on the business courses completed by the applicant during his or her undergraduate studies. An applicant is assigned an adviser soon after acceptance into the M.B.A. program, and should meet with the adviser to prepare a program plan outlining the courses needed for the M.B.A. degree.

All applicants are required to take the Graduate Management Admissions Test (GMAT) and obtain a satisfactory score for admission to the M.B.A. program. The only exceptions to this policy are applicants who hold a master's degree at the time of application and Florida Tech School of Management graduates with a 3.25 GPA or better. In the United States, the GMAT is only available through Computer-Adaptive Testing (CAT) at specifically designated sites. Unofficial scores are available immediately after the test. Official scores are mailed within 10–15 days of the exam. Official scores should not be more than five years old.

In certain cases, a student may be admitted before receipt of an acceptable GMAT score, and in such a case, the unsatisfied requirement will be treated as a deficiency and will result in Provisional Student status. The student will be notified of the provisional status and of the GMAT score needed to remove the deficiency. Registration for more than a cumulative total of nine credits before removal of the deficiency is not permitted.

General admission requirements, student classifications and the process for applying are presented in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The Master of Business Administration degree is conferred on a student who has successfully completed 36 credit hours of core and elective courses as listed on the student's approved Graduate Program Plan. Additional foundation courses may be required depending on the applicant's undergraduate preparation.

Curriculum

Core Courses

The M.B.A. degree requires completion of a common set of nine core courses as shown below. These core courses are designed to prepare the student to respond to the complex business decisions that arise in today's rapidly changing environment. The student must complete the foundation requirements, if any, before registering for core courses or electives.

The following core courses are required of all M.B.A. students:

BUS 5411 Statistical Methods for Business 3
BUS 5421 Managerial Economics 3
BUS 5431 Managerial Accounting 3
BUS 5440 Financial Management 3
BUS 5450 Organizational Behavior 3
BUS 5460 Management Information Systems 3
BUS 5461 Production and Operations Management 3
BUS 5470 Marketing Management 3
BUS 5480 Strategic Management 3
TOTAL CORE CREDITS 27

Elective Courses

In addition to the nine core courses, students are also required to take three elective courses. Electives can be taken with the faculty adviser's approval from other graduate-level offerings in the School of Management or other schools or academic units.

Foundation Courses

Foundation courses are required of a student whose undergraduate major is outside the business area or who has not previously completed courses in these foundation areas. The exact number of needed foundation courses depends on courses previously completed by the student.

The following foundation courses are designed to better prepare a student for M.B.A. core courses:

BUS 5400 Legal, Ethical and Social Environment of Business
BUS 5410 Quantitative Methods for Business Decisions
BUS 5420 Macroeconomics
BUS 5430 Financial Accounting

Thesis Track

A thesis track exists for students with a strong business administration background. A maximum of six credit hours of thesis work, depending on the particular subject, may be taken in place of elective course work. The choice of thesis subject and the amount of thesis credit to be taken must be approved in advance by the student's adviser.

Accounting Track

Students with the required accounting prerequisites may elect to take the accounting track by completing four courses from the following list. These courses will substitute for Managerial Accounting (BUS 5431) and the three M.B.A. electives.

BUS 5432 Advanced Accounting
BUS 5433 Advanced Problems and Current Topics
BUS 5434 Advanced Auditing Theory and Application
BUS 5435 Tax and Financial Accounting Research
BUS 5436 Government and Nonprofit Accounting

Managing Information Technology Track

Students may elect to take the managing information technology track by completing the following courses as their M.B.A. electives.

BUS 5465 Managing Information
BUS 5466 Managing Systems
BUS 5467 Managing Electronic Commerce

School of Psychology

Dean Mary Beth Kenkel, Ph.D.

Bachelor of Arts
Psychology

Bachelor of Science
Forensic Psychology
Psychology

Master of Science
Applied Behavior Analysis
Industrial/Organizational Psychology

Doctor of Psychology
Clinical Psychology

Doctor of Philosophy
Industrial/Organizational Psychology

Professors
Arthur Gutman, Ph.D., *personnel law, program evaluation, applied statistics, personnel psychology, research design.*

Thomas H. Harrell, Ph.D., *psychometrics and computerized psychological assessment, use of MMPI-2 in clinical evaluation, cognitive-behavioral approaches to assessment and therapy, adaptation to aging.*

Mary Beth Kenkel, Ph.D., *clinical/community psychology, rural mental health, gender issues, telehealth, prevention, future of professional psychology.*

Thomas H. Peake, Ph.D., *brief psychotherapies, couples therapy, healthy aging, clinical training, neuropsychology, medical psychology.*

Frank M. Webbe, Ph.D., *sport psychology, neuropsychological correlates of athletic head trauma, neuropsychology and aging.*

Visiting Professor
Florence Kaslow, Ph.D., *marital/family-, divorce- and remarriage-dynamics and treatment, divorce mediation, sexual dysfunction, personality disorder.*

Associate Professors
Juanita N. Baker, Ph.D., *child sexual abuse, measurements of behavioral change (child misbehavior, grieving, depression, PTSD symptoms, eating disorders), evaluation of teaching, training and program effectiveness.*

Richard T. Elmore Jr., Ph.D., *marital and sex therapy, clinical hypnosis, traumatology, occupational health psychology.*

Philip D. Farber, Ph.D., *psychological assessment, clinical training issues, rural mental health issues.*

William K. Gabrenya Jr., Ph.D., *cross-cultural differences in group interaction, Chinese culture, social class and modernization, international student adjustment, indigenous psychologies.*

Radhika Krishnamurthy, Psy.D., *personality assessment with the MMPI-2/MMPI-A and Rorschach, therapeutic test feedback, gender and cultural factors in assessment and treatment.*

José Martinez-Diaz, Ph.D., i*n-home behavioral programs for children, teaching language to children with autism and related disabilities, antecedent strategies in behavior change, radical behaviorism, ethical and other professional issues.*

David A. Wilder, Ph.D., *organizational behavior management, functional assessment and intervention with developmentally disabled children and adults with schizophrenia.*

Assistant Professors
Richard L. Griffith, Ph.D., *response distortion on noncognitive selection procedures, advanced measurement issues, organizational innovation, cognitive processes of work teams.*

Monique Levermore, Ph.D., *multicultural approaches to psychotherapy, diversity issues in clinical training, risk and resilience, under-served populations, international consultation, forensic psychology.*

Matthew P. Norman, Ph.D., *accurate visual data analysis, experimental methodology to study verbal behavior, applied behavior analysis with disadvantaged populations.*

Lisa Steelman, Ph.D., *job performance feedback processes, performance appraisal, multirater feedback, organizational survey research, employee commitment and engagement.*

Instructor
M. Jones, M.S.

Professors Emerita
Carol L. Philpot, Psy.D.; Elizabeth B. Wolf, Ph.D.

Professor Emeritus
Charles D. Corman, Ph.D.

Adjunct Professors
P. Beighley, M.D.; D. Bersoff, Ph.D.; E.Q. Blakely, Ph.D.; V.J. Carbone, Ph.D.; E. Cipani, Ph.D.; W.E. Eyring, III, Psy.D.; E. Galluscio, Ph.D.; P.W. Gorman, Psy.D.; B.L. Hensel, Ph.D.; E.L. Levine, Ph.D.; C. Stevens, Psy.D.; M. Stoutimore, Ph.D.

Lecturers
J. Becker, M.A.; M. Jones, M.S.; J. Plowman, M.S.

Mission Statement

The mission of the School of Psychology is to enhance the human condition through education, research, scholarship, and the delivery of psychological services within an environment that develops, supports and rewards excellence in these endeavors. This mission is based on the following beliefs and values.

1. A healthy, participatory environment maximizes faculty and student potential. This environment is based on respect for individuality and diversity, is sensitive to individual and organizational needs and is receptive to change.

2. Our training program is based on integrity in all its components, and is responsible to the public at the university, local and national level for quality and excellence in training. We are committed to excellence in both process and product.

3. We have the opportunity to set a new standard and model for Schools of Psychology, one that combines the strong professional training model on which we have earned our reputation with a strong research/scholarly model through which we advance the frontiers of knowledge in professional psychology.

Accreditation

The doctor of psychology program in clinical psychology is fully accredited by the American Psychological Association and is listed as a designated doctoral program in psychology by the National Register of Health Service Providers in Psychology. For information on APA accreditation please contact: Office of Program Consultation and Accreditation, 750 First Street, NE, Washington D.C. 20002-4212; phone (202) 336 4212.

The School of Psychology is a member of the Council of Applied Masters Programs in Psychology, and its master of science program in industrial/organizational psychology has been certified as conforming to the standards of the council.

Organization

In addition to its undergraduate and graduate degree programs, the school administers and staffs the Counseling and Psychological Services Center (CAPS), Community Psychological Services of Florida Tech (CPS), the Center for Professional Services, the Center for Traumatology Studies, the East Central Florida Memory Disorder Clinic (MDC) and the Family Learning Program (FLP). CAPS provides counseling to the students, staff and faculty of the university; and CPS, to the local community. MDC provides memory screenings as well as neuropsychological assessment and counseling. The MDC and FLP programs are state supported.

Facilities

The Psychology Building, containing offices, classrooms, human research areas, observation and treatment rooms, computer facilities, a conference room, a faculty/staff/student lounge and a student reading room, is located on Florida Tech's main campus, as are CAPS and CPS. MDC is also located in Melbourne, near Holmes Regional Medical Center.

Financial Assistance

General financial assistance information including assistantships and veterans benefits are addressed in the *Expenses and General Information* section of this catalog.

Students may be eligible to work for remuneration with faculty members on their various research and service contracts. Information can be obtained from the department or the individual faculty member.

Students may wish to consider the various loan programs that are available to them and may wish to contact the Office of Financial Assistance at the university to investigate other possible support.

Forms for requesting graduate assistantships are included in all graduate application packets or can be obtained from the School of Psychology and must be submitted to that office before February 1 to be eligible for consideration for the next academic year.

A limited number of assistantships and scholarships are available to students in the psychology graduate program. These include:

General graduate assistantships—These assistantships may involve both stipends and tuition remission. General graduate assistants are expected to perform 5–20 hours of work per week in activities related to teaching, research or clinical services. Assistants are normally rotated through these types of activities during the various nonsummer semesters.

Graduate teaching assistantships—These assistantships involve both stipends and tuition remission. They involve the teaching of undergraduate courses and graduate assessment laboratories under supervision and are normally awarded to post-master's students.

Merit scholarships—Merit scholarships for undergraduate students are dependent on available funding. Please contact the School of Psychology.

Admission

As a Freshman

New freshman applicants usually complete a college-preparatory curriculum in high school and have taken four years of English, and three years each of mathematics, natural sciences and social sciences. Applicants are evaluated on the basis of their SAT/ACT scores, high school grade point averages and grades in specific courses, particularly English, social studies and science.

Tests administered to all entering freshmen during the week preceding the start of classes each fall semester are designed to determine appropriate placement in mathematics. Each student is placed according to degree program and mathematics background. Students in the B.A. program are typically placed in college algebra or precalculus. Students in the B.S. program are typically placed in precalculus or calculus.

As an Undergraduate Transfer Student

Admission decisions for transfer students are made on the basis of a combination of the criteria used for new freshmen, college grade point average and grades in specific courses applicable to the psychology major. Where one or more years of college-level course work have been completed, the admission decision will be predominantly based on accomplishment in these studies.

Undergraduate transfer credit may be granted for course work completed with a grade of C or above at other fully accredited two- and four-year colleges and universities in the United States or at recognized universities abroad. Transfer students who have majored in liberal arts (social science or humanities) at their former colleges will usually be able to transfer most of their course work to the university's psychology major, so that little or no time is lost in completing the degree. Transfer students from community colleges will also be able to transfer most of their course work.

For undergraduate courses only, students can request equivalency examinations if transfer credit is not awarded for a course passed at another institution. Successful completion

of an equivalency examination may be required if there is serious doubt about the equivalency of a course taken elsewhere.

As a Graduate Student

Graduate admission requirements are described separately for each graduate-level degree program in the sections that follow.

Graduate Student Agreement

The following statement is specific to the agreement assumed between a prospective psychology graduate student and the School of Psychology. A resolution adopted by the Council of Graduate Schools in the United States, and supported by 362 universities and colleges, reads as follows:

> *Acceptance of an offer of financial aid (such as graduate scholarship, fellowship, traineeship or assistantship) for the next academic year by an actual or prospective graduate student completes an agreement that both student and graduate school expect to honor. In those instances in which the student accepts the offer before April 15 and subsequently desires to withdraw, the student may submit in writing a resignation of the appointment at any time through April 15. However, an acceptance given or left in force after April 15 commits the student not to accept another offer without first obtaining a written release from the institution to which a commitment has been made. Similarly, an offer by an institution after April 15 is conditional on presentation by the student of the written release from any previously accepted offer. It is further agreed by the institutions and organizations subscribing to the above Resolution that a copy of this Resolution should accompany every scholarship, fellowship, traineeship and assistantship offer.*

The School of Psychology endorses the following resolution of the Council of Graduate Departments of Psychology regarding the offering and accepting of financial aid after April 15:

> *An acceptance given or left in force after April 15 commits the student not to solicit or accept another offer. Offers made after April 15 must include the provision that the offer is void if acceptance of a previous offer from a department accepting this Resolution is in force on that date. These rules are binding on all persons acting on the behalf of the offering institution.*

Psychology

Bachelor of Arts
Bachelor of Science

Program Chair
William K. Gabrenya Jr., Ph.D.

The bachelor's programs in psychology are designed to provide both a solid basis for graduate training in all areas of psychology, and a liberal arts and sciences education to students planning other careers or professions, such as law or business.

The B.A. and B.S. degrees in psychology differ broadly in their relative emphasis on traditional liberal arts and sciences course work. The B.A. degree is designed for students whose interests are primarily in the social sciences and humanities, while the B.S. degree is designed for students more oriented toward the natural sciences and mathematics. Students consult with their faculty advisers to select the degree program most appropriate to their interests and goals.

The undergraduate psychology degree programs are designed to allow students to customize their course work to meet their specific interests and needs. Course work within the psychology major includes a 27-hour psychology core and an additional 21-hour psychology concentration that includes courses in psychology and other areas that are deemed appropriate to the students' intellectual goals and interests in psychology. The concentration must be approved by the undergraduate program chair.

Courses are offered in the department to facilitate several concentrations: clinical/counseling psychology, industrial/organizational psychology and animal behavior. Students may also design concentrations appropriate to pursuing postgraduate education in law, medical fields, business and the experimental fields of psychology.

Bachelor of Arts Degree Program

Degree Requirements

Psychology Core (27 credit hours)

Psychology Concentration (21 credit hours)

Language and Communication (21 credit hours)

COM 1101	Composition and Rhetoric	3
COM 1102	Writing about Literature	3
COM 3070	Professional Communication for Executives	3
	Foreign Languages (two semesters)	6
	Communication Electives[1]	6

Humanities and Social Sciences (18 credit hours)

HUM 2051	Civilization 1	3
HUM 2052	Civilization 2	3
	Humanities Elective	3
	Social Science Electives[2]	9

Mathematics and Science (15 credit hours)

MTH 1701	College Algebra	3
	or	
MTH 1000	Precalculus	3
MTH 2401	Probability and Statistics	3
	or	
BUS 2703	Statistics for Business	3
	Physical Science Elective[3]	3
	Life Science Elective[4]	3
	Life Science or Physical Science Elective	3

Free Electives (18 credit hours)

Bachelor of Science Degree Program

Degree Requirements

Psychology Core (27 credit hours)

Psychology Concentration (21 credit hours)

Communication (9 credit hours)

COM 1101 Composition and Rhetoric 3
COM 1102 Writing about Literature 3
COM 2223 Scientific and Technical Communication 3

Humanities and Social Sciences (18 credit hours)
HUM 2051 Civilization 1 3
HUM 2052 Civilization 2 3
HUM 3351 History of Science and Technology 1 3
HUM 3352 History of Science and Technology 2 3
Humanities Elective 3
Social Science Elective[2] 3

Mathematics and Science (25 credit hours)
BIO 1010 Biological Discovery 1 4
BIO 1020 Biological Discovery 2 4
or
CHM 1101 Chemistry 1 4
CHM 1102 Chemistry 2 4
or
PHY 1001 Physics 1 4
PHY 2002 Physics 2 4
BUS 2703 Statistics for Business 3
or
MTH 2401 Probability and Statistics 3
MTH 1001 Calculus 1 4
MTH 1002 Calculus 2 4
Technical Electives[5] 6

Free Electives (20 credit hours)

Psychology Core
PSY 1400 Freshman Seminar 1
PSY 1411 Introduction to Psychology 3
PSY 2511 Introduction to Research Methods for Psychology 3
PSY 3400 Junior Seminar 1
Two of the following three courses 6
PSY 2441 Child and Adolescent Development 3
or
PSY 2442 Adult Development and Aging 3
PSY 3441 Social Psychology 3
PSY 3442 Psychology of Personality 3
Two of the following three courses 6
PSY 3421 Psychology of Learning and Motivation 3
PSY 3422 Cognitive and Perceptual Psychology 3
PSY 3423 Physiological Psychology 3
PSY 3511 Advanced Research Methods for Psychology 3
PSY 4400 Senior Seminar 1
PSY 4411 Internship 3
or
PSY 4415, 4416 Senior Thesis[6] 6

Suggested Concentrations
Clinical/counseling psychology—Students interested in pursuing postgraduate study in clinical, counseling or school psychology, or in obtaining employment in a mental health or social service agency after graduation should study in areas that will familiarize them with these occupations and build basic skills. Such areas of study include substance abuse, abnormal psychology, clinical psychology, professional ethics, assessment techniques and applied behavior analysis. Course work in behavior analysis can lead to certification as a board certified Associate Behavior Analyst in the state of Florida after completion of other requirements and a certification examination.

Industrial/organizational psychology—Students who plan to enter business directly after graduation, apply to an M.B.A. program or apply for graduate programs in personnel or industrial/organizational psychology should select courses in psychology and business that will help define their interests, prepare them for graduate school admission or develop skills. Some areas of study useful in this regard include industrial/organization psychology, business law, management, human resource management, organizational behavior and substance abuse.

Animal behavior—Students interested in seeking postgraduate training at an appropriate facility to pursue a career in animal behavior, such as training marine mammals, should take Biological Discovery 1 and 2, and a combination of psychology and biology courses in the areas of learning and behavior analysis, anatomy, zoology, ecology, and the biology of marine mammals and other vertebrates. Scuba and CPR certifications are recommended. An internship in an animal training facility should be performed. The bachelor of science degree program is recommended for students in this concentration.

[1] Communication Electives may be satisfied by any COM 3xxx or 4xxx courses, foreign languages, or linguistics.

[2] Social Science Electives exclude PSY courses except PSY 2444.

[3] Physical Science Electives include chemistry, geology, meteorology, physics, space sciences, and EDS 1032.

[4] Life Science Electives include biology, ecology and EDS 1031.

[5] Technical Electives exclude mathematics courses below the 2xxx level.

[6] For Thesis students, the required credits for Free Elective or Psychology Concentration are reduced by three.

Forensic Psychology

Bachelor of Arts

Program Chair
William K. Gabrenya, Jr., Ph.D.

Program Coordinator
Marshall A. Jones, M.S.

The B.A. in forensic psychology is a unique program designed to provide knowledge and skills in preparation for careers in several areas of criminal justice in the context of a firm foundation in basic psychology. Graduates of this program can pursue careers in criminal justice professions, such as crime analysts, police or probation officers and victim advocates, and in nonprofit and social service agencies that coordinate efforts with legal/justice systems, such as domestic violence shelters and victim's rights groups. Some graduates may choose to pursue graduate study in criminal justice, forensic psychology, criminology or law.

The forensic psychology program emphasizes skills in crime analysis (tracking patterns and social correlates of criminal activity), crime prevention, and community liaison work among legal, law enforcement and social service agencies. Statistical analysis, program development and program evaluation are some of the competencies students are expected to acquire. Students in this program perform two internships in criminal justice organizations.

Bachelor of Arts Degree Program

Degree Requirements

Psychology Foundation Courses (23 credit hours)

PSY	1400	Freshman Seminar 1
PSY	1411	Introduction to Psychology 3
PSY	2511	Introduction to Research Methods for Psychology 3
PSY	3400	Junior Seminar 1
PSY	3441	Social Psychology 3
PSY	3511	Advanced Research Methods for Psychology 3
		Restricted Electives[1] 9

Forensic Specialization Courses (33 credit hours)

PSF	2551	Survey of Forensic Psychology 3
PSF	3511	Introduction to Crime Analysis 3
PSF	3512	Forensic Behavior Investigation and Identification 3
PSF	3515	Special Topics in Forensic Psychology 3
PSF	3551	Integrated Theories of Crime 3
PSF	4515	Advanced Special Topics in Forensic Psychology 3
PSF	4551	Principles of Individual and Community Advocacy 3
PSY	3512	Interviewing and Assessment Techniques 3
PSY	4511	Principles of Program Development and Evaluation 3
SOC	1551	Introduction to American Criminal Justice 3
SOC	1552	Crime and Society 3
SOC	2541	Juvenile Delinquency 3

Communication and Languages (21 credit hours)

COM	1101	Composition and Rhetoric 3
COM	1102	Writing about Literature 3
COM	3070	Professional Communication for Executives 3
		Foreign Language (2 semesters of the same language) ... 6
		Communication Electives[2] 6

Humanities and Social Sciences (12 credit hours)

HUM	2051	Civilization 1 3
HUM	2052	Civilization 2 3
		Humanities Elective 3
		Social science Elective 3

Mathematics and Science (15 credit hours)

BUS	2703	Business Statistics 3
MTH	1701	College Algebra 3
		Life Science Elective[4] 3
		Physical Science Elective[5] 3
		Life Science or Physical Science Elective 3

Free Electives (10 credit hours)

Internship (6 credit hours)

PSY	4411	Internship 3
PSY	4422	Internship 3

[1] Restricted Electives must include:

one of the following courses in the social bases of psychology

Child and Adolescent Development (PSY 2441)
Adult Development and Aging (PSY 2442)
Psychology of Personality (PSY 3442)

and two of the following courses in the experimental bases of psychology

Psychology of Learning and Motivation (PSY 3421)
Cognitive and Perceptual Psychology (PSY 3422)
Physiological Psychology (PSY 3423).

[2] Communication Electives may be satisfied by any COM 3xxx or 4xxx courses, foreign languages, or linguistics.

[3] PSY courses other than PSY 2444 cannot be used as the Social Science Elective.

[4] Life Science Electives include biology, ecology and EDS 1031.

[5] Physical Science Electives include chemistry, geology, meteorology, physics, space sciences, and EDS 1032.

Industrial/Organizational Psychology

Master of Science *Doctor of Philosophy*

Program Chair
Richard L. Griffith, Ph.D.

Industrial/organizational (I/O) psychology is concerned with applying professional skills and focusing scientific research on problems people encounter at work.

The industrial/organizational programs at Florida Tech follow the scientist-practitioner model of graduate training, emphasizing the development of research skills, knowledge of I/O theory and techniques, and applied experiences. Through extensive course work, students receive great breadth in training, focusing on industrial psychology, organizational psychology and measurement/statistics. Florida Tech offers both M.S. and Ph.D. level training in industrial/organizational psychology. The goal of these programs is to train well-rounded I/O psychologists who have flexibility in their career paths and the skills to make a significant difference in society.

Master of Science Degree Program

The goal of the master's program is to offer a two-year terminal degree that prepares master's-level professionals to work within the broad human resource function in organizations. In addition, the program serves as a preparatory sequence for those graduate students who wish to continue their education in a doctoral program. To accomplish this goal, the master's program addresses the prediction and measurement systems necessary for making accurate personnel decisions with respect to the selection, placement, training and evaluation of employees. It covers the impact of group and other social influences on job-related behaviors, motivation, commitment and communication, and is also concerned with planned change within the organization.

The primary culminating experience that prepares the I/O psychology student for a career is the practicum. Practicum experiences reflect a wide variety of career opportunities within the business environment. Ideal career placements for graduates would include positions in employee selection and placement, performance appraisal, training and evaluation, organizational development, compensation and benefits, and employee relations.

Students who plan to continue on a traditional academic track may opt to complete the master's thesis. The thesis track allows a student to work with a faculty adviser on an independent research project. Students are mentored in areas such as research design, data collection, database management, statistical analysis and preparing a document for submission. Students are also encouraged to develop their computer literacy, critical evaluation and problem-solving skills.

Admission Requirements

A master's applicant should hold a bachelor's degree in psychology or business, although graduates from other fields are encouraged to apply. A student without a bachelor's degree in psychology may be required to complete up to nine credit hours of psychology course work at the undergraduate level before registering for graduate-level courses. These courses are in addition to the 45-credit degree requirement.

A master's applicant should have a grade point average of 3.0 (B) or higher, and should submit three letters of recommendation, a statement of career objectives, supplement form and GRE General Test scores. Official transcripts of all undergraduate and graduate courses attempted must be submitted. All applications should be submitted by February 1, but will be accepted throughout the year. Preadmission visits to the campus and conferences with faculty and students are strongly encouraged.

Degree Requirements

The Master of Science in Industrial/Organizational Psychology requires the satisfactory completion of a minimum of 45 credit hours of approved course work and the passing of a comprehensive examination administered in the semester of graduation, or successful defense of a master's thesis.

Curriculum

Foundations of Psychology (12 credit hours)

PSY 5101 Statistical Research Methods 1 3
PSY 5102 Statistical Research Methods 2 3
PSY 5402 Tests and Measurements 3
PSY 5403 Applied Research Methods 3

Industrial/Organizational Core (24 credit hours)

PSY 5401 Introduction to I/O Psychology 3
PSY 5411 Personnel Selection 3
PSY 5412 Performance Appraisal 3
PSY 5413 Personnel Law 3
PSY 5415 Organizational Psychology 3
PSY 5421 Industrial Training 3
PSY 5422 Group and Team Development 3
PSY 5492 Current Topics in I/O Psychology 3

Elective (3 credit hours)

Thesis (PSY 5999) (6 credit hours)

Typical Electives

BUS 5032 Personnel Management and Industrial Relations
BUS 5457 Negotiation and Conflict Resolution
BUS 5458 Leadership Theory and Effective Management
PSY 5113 Program Evaluation
PSY 5420 Organizational Change and Transformation
PSY 6402 Chaos Theory in Organizations
PSY 6408 Cultural Seminar in I/O Psychology
PSY 6410 Organizational Survey Methods

Typical Program Plan

Year 1

FALL **CREDITS**
PSY 5101 Statistical Research Methods 1 3
PSY 5401 Introduction to I/O Psychology 3
PSY 5415 Organizational Psychology 3
PSY 5492 Current Topics in I/O Psychology 1
10

SPRING
PSY 5102 Statistical Research Methods 2 3
PSY 5402 Tests and Measurements 3
PSY 5412 Performance Appraisal 3
PSY 5492 Current Topics in I/O Psychology 1
10

SUMMER
PSY 5422 Group and Team Development 3

Year 2

FALL **CREDITS**
PSY 5403 Applied Research Methods 3
PSY 5411 Personnel Selection 3
PSY 5492 Current Topics in I/O Psychology 1
Elective 3
10

SPRING
PSY 5413 Personnel Law 3
PSY 5421 Industrial Training 3
PSY 5496 Practicum in I/O Psychology 6
or
PSY 5999 Thesis 6
12

TOTAL CREDITS REQUIRED 45

Doctor of Philosophy Degree Program

Florida Tech's doctoral degree in industrial/organizational (I/O) psychology provides training and research opportunities in the complex issues associated with the management of human resources in the international business community. It is designed to provide a more advanced level of education as well as the opportunity to continue independent research. The program encourages graduate students to partner with outside organizations to address applied research problems and collect data that advances the field. The I/O program offers students rigorous quantitative and qualitative training, as well as advanced training in research design. Once the projects are completed, students are required to prepare the results for professional conferences and submission to academic journals. Throughout this process, graduate students work closely with their faculty advisers and other I/O faculty. The small class size of the Ph.D. program facilitates close interaction and augments the mentoring process. Although the Ph.D. degree is primarily a research degree, the skills acquired by graduates of the I/O psychology program are designed to translate to both external and internal consulting environments. Students are encouraged to pursue a practicum in the field. The I/O psychology program produces qualified professionals for teaching and research in academic settings, as well as internal and external consulting positions.

Admission Requirements

A doctoral applicant should hold a bachelor's or master's degree, with a grade point average of 3.2 (on a scale of 4.0) or higher, and should submit three letters of recommendation, a statement of career objectives, supplement form and GRE General Test scores. Official transcripts of all previous course work must be submitted. All applications should be submitted by February 1, but will be accepted throughout the year. Admission to the doctoral program is granted to a limited number of students. Preadmission contact with the faculty is highly encouraged.

Degree Requirements

The doctoral program requires 90 semester hours of credit beyond the bachelor's degree. Students entering with master's degrees in I/O psychology or related fields are evaluated on a case-by-case basis for possible award of transfer credit. Students are strongly encouraged to complete the requirements for the Ph.D. within four years.

The I/O doctoral program is designed to progress from general course work to courses that are more specific in content. In the first year, students receive intensive training in quantitative methods and computer applications, and study the foundations of general psychology. A student who has not previously carried out a master's thesis is required to do so, and should start in the first year. In the second year, students begin to take more specialized courses in I/O psychology, finish their fundamental requirements and enroll in an advanced research methods course. Most students who are required to carry out master's theses should complete them by the conclusion of the second year. The third year offers more specialized courses. During the third year, students are encouraged to complete an internship assignment in a corporate, government or consulting environment. Comprehensive examinations take place at the end of the third year.

The doctoral degree in I/O psychology is a research degree. Dissertation research is begun immediately after successful completion of the comprehensive examination. Typically, the fourth year is devoted to the completion of the doctoral dissertation. Before the award of the doctoral degree, the candidate must present the completed dissertation manuscript and defend the research results to the Dissertation Committee. Students may continue to enroll in special courses and advanced seminars.

Curriculum

Foundations of Psychology (6 credit hours)

PSY 5104 Learning and Memory 3
or
PSY 5105 Biological Foundations of Behavior 3
PSY 5120 Culture and Psychology 3

Industrial/Organizational Core (33 credit hours)

PSY 5401 Introduction to I/O Psychology 3
PSY 5411 Personnel Selection 3
PSY 5412 Performance Appraisal 3
PSY 5413 Personnel Law 3
PSY 5415 Organizational Psychology 3
PSY 5421 Industrial Training 3
PSY 5422 Group and Team Development 3
PSY 5492 Current Topics in I/O Psychology 3
PSY 6198 Doctoral Supervised Research 6
PSY 6492 Advanced Research Seminar in I/O Psychology 3

Electives (24–30 credit hours)

Thesis and Dissertation (21–27 credit hours)

PSY 5999 Thesis 6
PSY 6999 Dissertation 15–21

Typical Program Plan

Year 1

FALL	CREDITS
PSY 5101 Statistical Research Methods 1	3
PSY 5401 Introduction to I/O Psychology	3
PSY 5415 Organizational Psychology	3
PSY 5492 Current Topics in I/O Psychology	1
	10

SPRING	
PSY 5102 Statistical Research Methods 2	3
PSY 5402 Tests and Measurements	3
PSY 5412 Performance Appraisal	3
PSY 5492 Current Topics in I/O Psychology	1
	10

SUMMER	
PSY 5422 Group and Team Development	3
Elective	3
	6

Year 2

FALL	CREDITS
PSY 5403 Applied Research Methods	3
PSY 5411 Personnel Selection	3
PSY 5999 Thesis	3
Elective	3
	12

SPRING	
PSY 5413 Personnel Law	3
PSY 5421 Industrial Training	3
PSY 5492 Current Topics in I/O Psychology	1
PSY 5999 Thesis	3
	10

SUMMER	
PSY 5104 Learning and Memory	3
PSY 5120 Culture and Psychology	3
	6

Year 3

FALL	CREDITS
PSY 6198 Doctoral Supervised Research	3
PSY 6405 Multivariate Statistics	3
PSY 6492 Advanced Research Seminar	1
PSY xxxx Elective	3
	10

SPRING	
PSY 6198 Doctoral Supervised Research	3
PSY 6492 Advanced Research Seminar	1
PSY xxxx Elective	3
	7

Year 4

FALL	CREDITS
PSY 6492 Advanced Research Seminar	1
PSY 6999 Dissertation	6
Elective	3
	10

SPRING	
PSY 6999 Dissertation	9

Research Activities

Faculty and graduate students are actively engaged in a variety of research topics, including the use of personality measures in selection, structural equation modeling, cognitive processes of work teams, employment law, training evaluation, the role of feedback in organizational survey topics and differences in work attitudes across cultures.

Applied Behavior Analysis

Master of Science

Program Chair
José Martinez-Diaz, Ph.D.

Applied behavior analysis (ABA) is the design, implementation and evaluation of environmental modification to produce socially significant improvements in behavior. ABA includes the use of direct observation, measurement and functional analysis of the relations between environment and behavior. Based on the findings of descriptive and functional analyses, ABA uses antecedents and consequences to produce practical change. ABA is based on sound scientific principles and has a solid research foundation that proves its effectiveness. ABA is based on the belief that an individual's behavior is determined by past and current environmental events in conjunction with organic variables such as genetics. Thus, it focuses on explaining behavior in terms of external events (that can be manipulated) rather than internal constructs (that are beyond our control).

Behavior analysts may specialize in clinical applications (e.g., developmental disabilities, mental health, traumatic brain injury), educational applications (e.g., designing and evaluating instructional technology), organizational behavior management and other areas. They typically spend more time in the problem environment than in their offices; that is, behavior plans are implemented in the settings where behavior problems occur, rather than the client attending sessions at an office.

The Master of Science in Applied Behavior Analysis prepares graduates for employment as Board Certified Behavior Analysts™ (BCBA™) in private, community and state agencies. The Behavior Analyst Certification Board Inc. has approved the Florida Tech ABA course sequence as meeting the course work requirements for eligibility to take the Board Certified Behavior Analyst examination.

Mission

The mission of the ABA program is to produce competent behavior-analytic practitioners and consultants who are solidly grounded in basic principles derived from the Experimental Analysis of Behavior (EAB), who approach the world from a radical behaviorist perspective, who will continue to wisely consume and use current findings of ABA researchers, and who attain BCBA™ certification.

Admission Requirements

An applicant should hold a bachelor's degree in psychology, education, or other related fields, although graduates from other fields are encouraged to apply. A student without a bachelor's degree in psychology may be required to complete up to nine credit hours of psychology course work at the undergraduate level before registering for graduate-level courses, including an introduction to psychology, learning, and physiological psychology or the equivalent. These courses are in addition to the 48-credit degree requirement.

An applicant should have a grade point average of 3.0 (B) or higher, and should submit three letters of recommendation, a statement of career objectives and Graduate Record Examination General Test scores. Official transcripts of all undergraduate and graduate courses attempted must be submitted. All applications should be submitted by March 1 for the following fall, but will be accepted throughout the year. Preadmission visits to the campus and conferences with faculty and students are strongly encouraged.

Specialized Tracks

The program offers two different tracks: Clinical Behavior Analysis and Organizational Behavior Management. Both tracks provide a solid foundation in applied behavior analysis but allow further specialization. Both tracks benefit from small class sizes, presenting all students the opportunity for close supervision and mentoring from faculty members. Students may wait to choose a track after they begin the program. However, choosing before the first day of classes may obviate taking classes that would not be required for a particular track. Each of the two tracks may be completed within four semesters and the intervening summer. Students may complete both tracks by extending their residence in the program by one additional summer term and one semester, and taking additional credits.

Both clinical behavior analysis and organizational behavior management are applied, like traditional clinical or industrial/organizational (I/O) psychology, but are behavioral rather than cognitive. They are analytic in that we systematically manipulate environmental events and directly measure and graph behavior, rather than relying mostly on paper and pencil tests and interviews for our assessment and evaluation. They are technological in that we precisely describe our procedures in such a way that others can replicate them. Instead of treating clients in an office, we go to the real environment where the problem behaviors occur (e.g., homes and schools or the workplace).

The **clinical behavior analysis** track provides course work and practicum experience for persons who plan to work as behavior analytic clinicians or consultants in community-based and residential programs. Graduates will conduct functional assessments and develop, implement and monitor behavior programs in homes, foster-care agencies, residential programs, schools, adult day training programs and other settings. The clients served by our graduates will be children and adults with challenging behaviors and atypical skill deficits. Special emphasis is placed in populations who are given the following diagnoses: autism and other pervasive developmental disorders, mental retardation, learning disabilities, attention deficit and disruptive behavior disorders, feeding and eating disorders, schizophrenia, and neurobehavioral disorders. Sub-specialty areas include verbal behavior programs and programs to replace challenging behavior excesses.

Instead of directly treating the client within sessions, we work with parents, teachers, staff and others who implement behavior change procedures on an ongoing basis. In addition, there are other characteristics that differentiate clinical behavior analysis from traditional clinical psychology.

A minimum of 48 semester credit hours is required, nine of which are clinical behavior analysis practica. Students may complete the program on a full-time or part-time basis. Full-time students typically complete the program in four regular semesters plus the intervening summer.

The **organizational behavior management** track provides course work and practicum experience for persons who plan to work as "performance management" or organizational behavior management (OBM) consultants in business, industry, government, and human service organizations. Graduates are prepared to work in a variety of organizations helping management with training and staff development; improving staff performance, staff productivity and behavioral safety; reducing absenteeism and staff turnover; personnel selection and placement; and direct-line supervision of employees.

Instead of relying on psychometric testing and statistics, OBM relies on direct observation of work behavior in the real-life work environment and on visual inference based on graphed data. It manipulates antecedents and consequences to change staff behavior. OBM consultants train managers and supervisors to use behavioral technology to improve staff performance. In addition, OBM has other characteristics that differentiate it from traditional I/O psychology.

Some of our graduates in both tracks may apply and enroll in our Ph.D. program in I/O psychology, combining both degrees.

A minimum of 48 semester credit hours is required, nine of which are performance management practica. Students may complete the program on a full-time or part-time basis. Full-time students typically complete the program in four regular semesters plus the intervening summer.

Dual-Track. Students may complete both tracks by taking an additional six credits of course work and six additional credits of practica for a total of 60 credit hours. Full-time students typically complete both tracks of the program in five regular semesters plus the intervening two summers.

Degree Requirements

The Master of Science in Applied Behavior Analysis requires the satisfactory completion of a minimum of 48 semester credit hours (nine of which are behavior analysis practica) and the successful completion of a comprehensive examination administered during the semester of graduation. Students may complete the program on a full-time or part-time basis.

Applied Behavior Analysis Core

PSY 5231 Basic Concepts and Principles of Behavior Analysis 4
PSY 5232 Applied Behavior Analysis 1 4
PSY 5233 Applied Behavior Analysis 2 4
PSY 5234 Research Methods in Applied Behavior Analysis 4
PSY 5240 B.F. Skinner and Radical Behaviorism 2
PSY 5241 Legal Issues and Guidelines for the Ethical Practice of ABA 1

Clinical Behavior Analysis Curriculum

Applied Behavior Analysis Core (19 credit hours)

Clinical Analysis Track (22 credit hours)
PSY 5105 Biological Foundations of Behavior 3
PSY 5238 Advanced ABA Treatment and Planning 3
PSY 5242 Ethical and Professional Standards in Clinical Behavior Analysis 1
PSY 5296 Practicum in Clinical Behavior Analysis 9
PSY 5511 Clinical Psychopharmacology 3
PSY 5541 Clinical Skills and Techniques 3

Electives (7 credit hours)
(see the School of Psychology for approved electives and restrictions)

Typical Program Plan

Year 1

FALL	CREDITS
PSY 5231 Basic Concepts and Principles of Behavior Analysis	4
PSY 5232 Applied Behavior Analysis 1	4
PSY 5541 Clinical Skills and Techniques	3
	11
SPRING	
PSY 5105 Biological Foundations of Behavior	3
PSY 5233 Applied Behavior Analysis 2	4
PSY 5240 B.F. Skinner and Radical Behaviorism	2
PSY 5241 Legal Issues and Guidelines for the Ethical Practice of ABA	1
Elective	1
	11
SUMMER	
PSY 5296 Practicum in Clinical Behavior Analysis	3
	3

Year 2

FALL	CREDITS
PSY 5234 Research Methods in Applied Behavior Analysis	4
PSY 5296 Practicum in Clinical Behavior Analysis	3
PSY 5511 Clinical Psychopharmacology	3
Electives	2
	12
SPRING	
PSY 5238 Advanced ABA Treatment Planning	3
PSY 5242 Ethical and Professional Standards in Clinical Behavior Analysis	1
PSY 5264 Seminar in Clinical Behavior Analysis	1
PSY 5296 Practicum in Clinical Behavior Analysis	3
Electives	3
	11

Organizational Behavior Management Curriculum

Applied Behavior Analysis Core (19 credit hours)

Organizational Behavior Management Track (21 credit hours)
PSY 5250 Introduction to Organizational Behavior Management 3
PSY 5251 Advanced Organizational Behavior Management 3
PSY 5252 Techniques in Performance Management 3
PSY 5297 Practicum in Performance Management 9
PSY 5401 Introduction to Industrial/Organizational Psychology 3

Electives (8 credit hours)
(see the School of Psychology for approved electives and restrictions)

TOTAL CREDITS REQUIRED 48

Typical Program Plan

Year 1

FALL	CREDITS
PSY 5231 Basic Concepts and Principles of Behavior Analysis	4
PSY 5232 Applied Behavior Analysis 1	4
PSY 5401 Introduction to Industrial and Organizational Psychology	3
	11
SPRING	
PSY 5233 Applied Behavior Analysis 2	4
PSY 5240 B.F. Skinner and Radical Behaviorism	2
PSY 5241 Legal Issues and Guidelines for the Ethical Practice of ABA	1
PSY 5250 Introduction to Organizational Behavior Management	3
Elective	1
	11
SUMMER	
PSY 5297 Practicum in Performance Management	3
	3

Year 2

FALL		CREDITS
PSY	5234 Research Methods in Applied Behavior Analysis	4
PSY	5251 Advanced Organizational Behavior Management	3
PSY	5297 Practicum in Performance Management	3
	Elective	1
		11

SPRING		
PSY	5252 Techniques in Performance Management	3
PSY	5297 Practicum in Performance Management	3
	Electives	6
		12

Dual Track Typical Program Plan

Year 1

FALL		CREDITS
PSY	5231 Basic Concepts and Principles of Behavior Analysis	4
PSY	5232 Applied Behavior Analysis 1	4
PSY	5541 Clinical Skills and Techniques	3
		11

SPRING		
PSY	5105 Biological Foundations of Behavior	3
PSY	5233 Applied Behavior Analysis 2	4
PSY	5240 B.F. Skinner and Radical Behaviorism	2
PSY	5241 Legal Issues and Guidelines for the Ethical Practice of ABA	1
	Elective	1
		11

SUMMER		
PSY	5296 Practicum in Clinical Behavior Analysis	3
		3

Year 2

FALL		CREDITS
PSY	5234 Research Methods in Applied Behavior Analysis	4
PSY	5250 Introduction to Organizational Behavior Management	3
PSY	5296 Practicum in Clinical Behavior Analysis	3
PSY	5511 Clinical Psychopharmacology	3
		13

SPRING		
PSY	5238 Advanced ABA Treatment Planning	3
PSY	5242 Ethical and Professional Standards in Clinical Behavior Analysis	1
PSY	5251 Advanced Organizational Behavior Management	3
PSY	5252 Techniques in Performance Management	3
PSY	5296 Practicum in Performance Management	3
		13

SUMMER		
PSY	5297 Practicum in Performance Management	3
		3

Year 3

FALL		CREDITS
PSY	5297 Practicum in Performance Management	3
PSY	5401 Introduction to Industrial and Organizational Psychology	3
		6

TOTAL CREDITS REQUIRED 60

Clinical Psychology

Doctor of Psychology

Program Chair and Director of Clinical Training
Radhika Krishnamurthy, Psy.D.

Associate Director of Clinical Training
Richard T. Elmore, Ph.D.

School of Psychology doctoral candidates work toward the degree of Doctor of Psychology (Psy.D.)—a service-oriented degree emphasizing clinical skills. The program leading to the Psy.D. is based on a practitioner/scientist model. Florida Tech was the first university in the southeast to offer the Psy.D. and the model of training that it represents. In addition to classes and seminars, the training program in clinical psychology includes supervised experience in testing, diagnosis, counseling and therapy, and research projects related to special fields of interest. Before completing the doctorate, students complete one year of supervised internship training. Graduates are licensed throughout the United States and hold positions of responsibility in mental health clinics, hospitals, medical centers, HMOs, PPOs and independent practice.

Students are expected to be cognizant of various theories of human nature and of various treatment modalities. Students are encouraged to assess the problems of the clients, to select the procedures for behavioral change most appropriate to the problem, to assess the effectiveness of the procedure and, if necessary, to select alternate procedures. Every effort is made to emphasize the value and dignity of psychology as a profession. To this end, the importance of a problem-solving approach, as well as a knowledge of the results of scientific investigations in psychology and the other behavioral sciences, is stressed.

The program is designed with the view that the essence of professional psychology involves process and content. The process is the problem-solving approach and the content involves the knowledge of basic principles and professional skills. Both process and knowledge are in a continuous state of change but this state of change does not negate their significance. The model places greater emphasis on the quality and quantity of professional skills while placing somewhat less emphasis on research. Thus, the practicum and internship experiences are of special importance in our programs.

A combined program in which a student may obtain both the clinical psychology doctorate and a Master of Science in Industrial/Organizational Psychology is available to selected candidates. Interested students should contact the School of Psychology.

Professional Conduct of Students

The university's program in clinical psychology subscribes to the American Psychological Association Code of Ethics and all students are bound by the principles enumerated in that code.

Students who accept admission into the program are subject to the ethics, professional standards and laws relating to psychologists and the practice of psychology. For that reason, they may not engage in any psychological or mental health related work (for pay or otherwise) without the prior written approval of the director of clinical training. To disregard this need for approval or to engage in activities that seem either unethical or inappropriate to their level of training will be cause for dismissal from the program. It is further

understood that after graduation they will not engage in the independent or private practice of psychology until licensed or certified by the state in which they would practice.

Licensing/Certification

Licensing/certification laws vary for the various states. Although the curriculum is based on recommendations of the Board of Educational Affairs of the American Psychological Association, and the clinical psychology program is fully accredited by the American Psychological Association's Committee on Accreditation, completion of any program does not ensure admission to the licensing/certification examinations of any state. The applicant or admitted student should obtain and study the laws and regulations pertinent to licensing/certification in the state or states in which they plan to practice and should consider the educational demands on choosing both elective work and internship positions.

Admission Requirements

An applicant must possess a bachelor's degree from an accredited institution of higher learning. Although it is not necessary for the major area to have been psychology, it is expected that those entering without a previous degree in psychology will have completed at least 18 credit hours of psychology course work at the time of application. These courses must have been taken in a department of psychology, and should include statistics, personality theory, abnormal psychology, learning, physiological psychology and social psychology.

All application materials must be received by January 15. Application and application fee should be received by the university before receipt of reference letters and transcripts, so the applicant's file can be established. Applications cannot be acted on until all required materials have been received.

All applicants are required to submit:

1. the completed graduate school application form, together with the application fee (forms are available from the School of Psychology);
2. the School of Psychology's supplemental form (available from the School of Psychology);
3. a résumé of professional experience;
4. a statement of professional career objectives;
5. three letters of recommendation from psychologists familiar with the applicant's academic and/or clinical work, to be mailed directly by the recommenders (forms are available from the School of Psychology);
6. official undergraduate and graduate record transcripts, mailed directly from the degree-granting institutions; and
7. Graduate Record Examination General Test and Psychology Subject Test results. Please plan to take the GRE early enough to allow test results to be reported by January 15. Results may take up to six weeks to be reported by the Educational Testing Service.

Attendance at the scheduled interview is recommended but not required. After acceptance, a signed statement that, if admitted, the student will comply with the professional conduct requirements of the School of Psychology must also be submitted.

Degree Requirements

To receive the doctoral degree, the candidate must have been a matriculated student in full-time residence at the school for a minimum of three years (six semesters and two summer terms). This period represents the minimum of attendance to complete the course requirements. In addition to these years of course work, the internship requires an additional year for completion. To obtain an approved internship, students must make application and be accepted at one of the many APA-accredited internship training facilities located throughout the country.

A student admitted to the doctoral program without a master's degree is awarded the master of science degree when the following 36 credits are successfully completed:

PSY	5101 Statistical Research Methods 1	3
PSY	5102 Statistical Research Methods 2	3
PSY	5105 Biological Foundations of Behavior	3
PSY	5120 Culture and Psychology	3
PSY	5501 Personality and Psychotherapy	3
PSY	5502 Psychopathology	3
PSY	5521 Assessment of Intelligence	3
PSY	5522 Laboratory in Assessment of Intelligence	1
PSY	5524 Laboratory in Assessment of Personality	1
PSY	5527 Objective Personality Assessment	3
PSY	5528 Projective Personality Assessment	3
PSY	5591 Seminar in Professional Standards and Ethical Principles in Psychology	1
PSY	5999 Thesis (minimum)	6

The requirements for the master's degree, including the final defense of the thesis, must be completed by the end of the fall semester of the third year. No more than nine credit hours of PSY 5999 may be counted toward the master's or doctoral degree. All requirements for the doctoral degree must be completed no later than seven years from the date of first attendance.

A student who completed graduate work at another accredited university can petition for transfer of a maximum of 18 semester credits. Beyond the 18 credits, students can also petition for substitution of elective courses for required courses taken previously. Such requests are normally evaluated by the director of clinical training. Transfers and elective substitutions are not granted for the core clinical specialization courses listed in the curriculum description.

A student receiving a grade of C in a required course may be required to repeat the course and attain a grade of B or better. All grades will enter into the grade point average, but only credit hours from the final repeat will be credited toward the minimum credit hour requirement.

Requirements for the Psy.D. degree include:

1. A minimum of 104 semester hours of credit beyond the bachelors degree, including the required courses described in the curriculum section below.
2. A minimum of three years of full-time residency: six semesters and two summer terms. Full-time status is defined as nine or more credits. Although the curriculum is arranged to allow for its completion within a three-year time frame, students are encouraged to consider a fourth year of study to take additional electives, practica and specialty tracks.

3. Admission to candidacy requires the successful completion of the following five components:
   a. Clinical qualification examination (CQE). At the completion of 300 clock hours of practica, the clinical faculty of the School of Psychology makes an assessment of student progress in clinical skill development. This CQE contains numerous components, including a written conceptualization and treatment plan of the videotaped case and an oral presentation and defense of the case.
   b. Written comprehensive examination. At the end of the second year of study, all students are required to take and pass a written comprehensive examination. The examination includes both in-class and take-home components, and covers the core academic and clinical areas of psychology.
   c. Second year student review. At the end of the second year, the clinical faculty reviews all students across a number of personal and interpersonal dimensions, which are directly tied to their ability to function as professional psychologists.
   d. Completion of a master's thesis or research project.
   e. Satisfactory academic progress. A 3.2 grade point average, computed on the basis of all university course work applied to the doctoral program, is required for admission to candidacy.
4. An internship consisting of 2,000 clock hours of supervised experience in an internship facility accredited by the American Psychological Association to offer clinical training. This placement provides the trainee with the opportunity to take substantial responsibility for carrying out the major professional functions with appropriate supervisory support. Liaison between the Office of Clinical Training and the internship facility is maintained.

Curriculum

The curriculum for the doctor of psychology program consists of three or four levels of training, as summarized below.

Basic science, research and assessment course work occupy the early terms of residence and flow into intervention and practicum work that occupies the later terms of residence.

Level I (Beginning)

This level corresponds to the first year of training following the bachelor's degree. It consists of basic science courses designed to develop a broad conceptual understanding of the theoretical foundations for clinical practice and entry-level assessment and intervention skills. Basic assessment skills are developed and the master's thesis proposal is generated. Students entering with a master's degree begin practicum placements.

Level II (Intermediate)

This level corresponds to the second residence year in the program. Didactic work consists of more advanced examinations of broad-based conceptual foundations, further development of assessment and intervention strategies, and beginning and intermediate practica placements. The master's thesis is completed and defended during this year.

Level III (Advanced)

This level corresponds to the third residence year in the program. Assessment and intervention skills are fine-tuned during this year and are put into practical use in advanced practicum assignments. Systems of case conceptualization are reviewed and related to assessment and intervention strategies.

Level IV (Advanced Specialty)

This level corresponds to the optional fourth year in the program. During this year, students may take advantage of our specialty tracks, obtain more field experience in advanced practica and take more electives.

The Doctor of Psychology program includes the following required courses:

Foundations of Psychology

Bases of Behavior (15 credit hours)

PSY 5104 Learning and Memory 3
PSY 5105 Biological Foundations of Behavior 3
PSY 5120 Culture and Psychology 3
PSY 5511 Clinical Psychopharmacology 3
PSY 5570 Multicultural Psychotherapy 3

Individual Differences (6 credit hours)

PSY 5502 Psychopathology 3
PSY 5106 Life Span Development 3
or
PSY 6514 Clinical Aging and Development 3

Research Methods (12–15 credit hours)

PSY 5101 Statistical Research Methods 1 3
PSY 5102 Statistical Research Methods 2 3
PSY 5999 Thesis (or PSY 5990 Research Project) 6–9

Seminars in Professional Standards and Ethics (3 credit hours)

Biological Bases (6 credit hours)

PSY 5105 Biological Foundations of Behavior 3
PSY 5511 Clinical Psychopharmacology 3

Cognitive/Affective Bases of Behavior (3 credit hours)

PSY 5104 Learning and Memory 3

Social Bases of Behavior (6 credit hours)

PSY 5120 Culture and Psychology 3
PSY 5570 Multicultural Psychotherapy 3

Individual Differences (6 credit hours)

PSY 5502 Psychopathology 3
PSY 5106 Life Span Development 3
or
PSY 6514 Clinical Aging and Development 3

Research Methods (12–15 credit hours)

PSY 5101 Statistical Research Methods 1 3
PSY 5102 Statistical Research Methods 2 3
PSY 5999 Thesis (or PSY 5990 Research Project) 6–9

Professional Standards and Ethics (3 credit hours)

PSY 5591 Seminar in Professional Standards and Ethical Principles 1 1
PSY 5592 Seminar in Professional Standards and Ethical Principles 2 1
PSY 5593 Seminar in Professional Standards and Ethical Principles 3 1

Clinical Specialization

Psychological Assessment (14 credit hours)

PSY 5521 Assessment of Intelligence 3
PSY 5522 Laboratory in Assessment of Intelligence 1
PSY 5524 Laboratory in Assessment of Personality 1
PSY 5527 Objective Personality Assessment 3
PSY 5528 Projective Personality Assessment 3
PSY 6521 Psychodiagnostics 3

Relationship and Interpersonal Skills (6 credit hours)

PSY 5541 Clinical Skills and Techniques 1 3
PSY 5542 Clinical Skills and Techniques 2 3

Intervention (12 credit hours)

PSY 5501 Personality and Psychotherapy 3
PSY 5549 Psychotherapy Techniques 3
PSY 5xxx Approved Intervention Courses* 6

Professional Issues (6 credit hours from the following)

PSY 5113 Program Evaluation 3
PSY 5506 Administration of Mental Health Services 3
PSY 6580 Consultation 3
PSY 6583 Supervision in Psychotherapy Training 3

Supervised Practical Experience (21–24 credit hours)

PSY 5000 Clinical Colloquium 0
PSY 5001 Pre-practicum 0
PSY 5595 Practicum 21–24

**A list of approved intervention courses is available on request.*

Internship (2,000 clock hours)

Students register for nine hours of internship credit (PSY 6595) in each of three semesters. Grading is on a satisfactory/unsatisfactory basis, and credits do not count toward the minimum 104 credit hours of course work necessary for the doctor of psychology degree.

Typical Program Plan

Year 1

FALL **14–17 CREDITS**

PSY 5000 Clinical Colloquium 0
PSY 5001 Pre-practicum 0
PSY 5101 Statistical Research Methods 3
PSY 5501 Personality and Psychotherapy 3
PSY 5521 Assessment of Intelligence 3
PSY 5522 Lab in Assessment of Intelligence 1
PSY 5541 Clinical Skills and Techniques 1 3
PSY 5591 Seminar in Professional Standards and Ethical Principles in Psychology 1 1
Electives 0–3

SPRING **12–17 CREDITS**

PSY 5000 Clinical Colloquium 0
PSY 5001 Pre-practicum 0
PSY 5102 Statistical Research Methods 2 3
PSY 5502 Psychopathology 3
PSY 5527 Objective Personality Assessment 3
PSY 5542 Clinical Skills and Techniques 2 3
PSY 5595 Practicum
Electives

SUMMER **13–17 CREDITS**

PSY 5120 Culture and Psychology 3
PSY 5524 Laboratory in Assessment of Personality 1
PSY 5528 Projective Personality Assessment 3
PSY 5549 Psychotherapy Techniques 3
PSY 5595 Practicum
PSY 5999 Thesis 3

Year 2

FALL **9–17 CREDITS**

PSY 5000 Clinical Colloquium 0
PSY 5595 Practicum
PSY 5999 Thesis 3
PSY 5570 Multicultural Psychotherapy 3
Intervention Elective 3
Electives

SPRING **13–17 CREDITS**

PSY 5000 Clinical Colloquium 0
PSY 5105 Biological Foundations of Behavior 3
PSY 6521 Psychodiagnostics 3
PSY 5592 Seminar in Professional Standards and Ethical Principles in Psychology 2 1
PSY 5595 Practicum
PSY 5999 Thesis 3
Intervention Elective 3
Electives

SUMMER **6–12 CREDITS**

PSY 5104 Learning and Memory 3
or
Intervention Elective 3
PSY 5113 Program Evaluation 3
or
PSY 5506 Administration of Mental Health Services 3
PSY 5595 Practicum
Electives

Year 3

FALL **9–17 CREDITS**

PSY 5000 Clinical Colloquium 0
PSY 5104 Learning and Memory 3
or
Intervention Elective 3
PSY 5106 Life Span Development 3
or
PSY 6514 Aging and Development 3
PSY 5511 Clinical Psychopharmacology 3
PSY 5595 Practicum
Electives

SPRING **10–17 CREDITS**

PSY 5000 Clinical Colloquium 0
PSY 5593 Seminar in Professional Standards and Ethical Principles in Psychology 3 1
PSY 5595 Practicum
PSY 6583 Supervision in Psychotherapy Training 3
or
PSY 6580 Consultation 3
Electives

SUMMER

PSY 5595 Practicum
Electives

Year 4

Internship (2,000 clock hours)

The Multicultural Commitment

The School of Psychology is committed to providing students with information and training that is not restricted to one cultural or national tradition. Exposure to information on the theory and practice of psychology in different cultures and with different ethnic and cultural minorities make graduates sensitive to cultural, national and ethnic differences, whether encountered at home or abroad.

Specialty Tracks

The majority of students complete the program without pursuing a specific specialty track. However, specialty tracks have been developed in marriage and family psychology, child psychology, neuropsychology-behavioral medicine and industrial/organizational psychology. Most tracks can be completed within the three years of required residence by selecting the appropriate electives and practicum sites. The industrial/organizational psychology track does require an additional year of residence.

Intensive Classroom Courses

These courses are usually one credit hour and are taught by nationally known members of our visiting and adjunct faculty. The format of an intensive course is as follows. Each registered student is given a syllabus that includes reading and report assignments. Several weeks into the term, the class meets formally with the professor for one, two or three days. Papers or tests can be given during this time, and papers and projects are usually assigned for the remaining weeks of the term. All assignments are due by the end of the semester. This format allows our students to gain exposure to distinguished psychologists from throughout the world. Generally, one of these courses is available each semester.

Academic Dismissal

Students will be dismissed from further graduate study under the following circumstances:

1. A grade point average below 3.0 at any stage of the doctoral program.
2. Two or more grades of D or F.
3. Unsatisfactory grades for nine credits of internship.
4. Nonadmission to doctoral candidacy as defined under Degree Requirements.
5. Failure to abide by the Mental Health practice standards as specified in Policy 3.4.
6. Failure to abide by the Ethical Principles of Psychologists and Code of Ethics of the American Psychological Association.
7. Hampering the academic efforts of other students.
8. Failure to maintain satisfactory progress in course work and/or research, regardless of grade point average.
9. Violation of the legal and ethical standards of the university, including, but not limited to, cheating, plagiarism, knowingly furnishing false information to the university, or forging, altering or misusing university documents or academic credentials.
10. Failure to demonstrate adequately those personal and interpersonal skills and attributes deemed suitable for the profession, as delineated in the School of Psychology graduate student handbook.

The *Graduate Information and Regulations* section of this catalog presents information concerning dismissal and the rights of the student to appeal dismissal decisions.

School of Extended Graduate Studies

Dean Ronald L. Marshall, Ph.D.

Master of Science

Acquisition and Contract Management
Aerospace Engineering
Computer Information Systems
Computer Science
Electrical Engineering
Engineering Management
Human Resources Management
Logistics Management
Management
- *Acquisition and Contract Management*
- *eBusiness*
- *Human Resources Management*
- *Information Systems*
- *Logistics Management*
- *Transportation Management*

Materiel Acquisition Management
Mechanical Engineering
Operations Research
Project Management
- *Information Systems*
- *Operations Research*

Space Systems
Space Systems Management
Systems Management
- *Information Systems*
- *Operations Research*

Professional Master of Business Administration

Acquisition and Contract Management
eBusiness
Human Resources Management
Information Systems
Master of Public Administration

Directors of Graduate Studies
Aberdeen Graduate Center
Atefeh S. McCampbell, D.B.A.

Fort Lee Graduate Center
Barbara L. Peery, Ph.D.

Hampton Roads Graduate Center
Catherine A. Elder, Ph.D.

National Capital Region Center
Lloyd H. Muller, Ed.D.

Northeast Graduate Center
Richard O. Blalack, D.B.A.

Orlando Graduate Center
David E. Clapp, Ph.D.

Patuxent Graduate Center
Norman W. Chlosta, M.P.A.

Redstone Graduate Center
William C. Wall, Jr., Ph.D.

Spaceport Graduate Center
Ronald L. Marshall, Ph.D.

Virtual Graduate Center
Mary S. Bonhomme, Ph.D.

Professors
Richard O. Blalack, D.B.A., Northeast Graduate Center, *Management*

John F. Clark, Ph.D., P.E., Spaceport Graduate Center, *Space Systems*

Kermit C. Zieg Jr., Ph.D., National Capital Region Graduate Center, *Management*

Associate Professors
David E. Clapp, Ph.D., Orlando Graduate Center, *Management*

Vernon C. Gordon, Ph.D., Patuxent Graduate Center, *Aerospace Engineering*

George W. Masters, Ph.D., Patuxent Graduate Center, *Electrical Engineering*

Atefeh S. McCampbell, Ph.D., Aberdeen Graduate Center, *Management*

Jeffrey C. Mitchell, M.S., Spaceport Graduate Center, *Space Systems*

Barbara L. Peery, Ph.D., Fort Lee Graduate Center, *Management*

Daniel B. Weddle, Ph.D., Patuxent Graduate Center, *Computer Science*

Assistant Professors
Barry A. Bodt, Ph.D., Aberdeen Graduate Center, *Management*

Norman W. Chlosta, M.P.A., Patuxent Graduate Center, *Management*

Catherine A. Elder, Ph.D., Hampton Roads Graduate Center, *Management*

John B. Foulkes, Ph.D., National Capital Region Graduate Center, *Management*

Robert B. Kirby, J.D., Orlando Professional Development Center, *Financial Planning*

Jennifer M. Long, Ph.D., Patuxent Graduate Center, *Electrical Engineering*

Lloyd H. Muller, Ed.D., National Capital Region Graduate Center, *Management*

David W. Mutschler, Ph.D., Patuxent Graduate Center, *Computer Information Systems*

William C. Wall, Jr., Ph.D., Northeast Graduate Center, *Management*

Professor Emeritus
Arthur L. Holt, Ph.D.

Organization

The School of Extended Graduate Studies offers master's degree programs at 10 graduate centers in five states. The programs are conducted in a traditional manner with admission and graduation standards the same as those required on the main campus.

Inquiries about extended graduate studies programs should be addressed to:

Florida Institute of Technology
Dean, School of Extended Graduate Studies
150 West University Boulevard
Melbourne, FL 32901-6975
(321) 674-8880
Fax (800) 676-9245
www.segs.fit.edu

Degree Programs

The procedures for admission, specific degree requirements and curriculum offerings are published separately in the official catalog for each graduate center. A summary chart of degrees offered by graduate center locations appears at the end of this section. Management courses used to support the School of Extended Graduate Studies' master's programs are identified by the prefix MGT, and listed in the *Course Descriptions* section of the School of Extended Graduate Studies catalog.

Distance Learning

The professional M.B.A., and all of the M.S., Management programs, are available in a complete online distance learning mode. Visit the Web site at www.segs.fit.edu for current course offerings and enrollment information. Courses may be completed for graduate credit toward a master's degree, or for non-credit continuing education. Also, ten graduate certificate programs are available via online distance learning. A graduate certificate program requires completion of five courses, for a total of 15 graduate credit hours. Enrollment information and further details about the graduate certificate programs may be obtained from any of the 10 graduate centers or in the published school catalog.

Graduate certificate programs currently available online:

- Business Management
- Contract Management
- eBusiness
- Information Systems Management
- Logistics Management
- Materiel Acquisition Management
- Program Management
- Systems Management
- Quality Management
- Transportation Management

Acquisition and Contract Management

Master of Science

The Master of Science program in Acquisition and Contract Management is designed for adult working professionals in the public and private sectors of acquisition and contract management. The curriculum provides coverage of federal procurement practices, current issues in contracting and contract administration, legal and financial aspects of government contracting and policy issues associated with acquisition and contract management. Individuals without current experience in acquisition and contract management may be accepted into this program; however, all program prerequisite courses must be fulfilled.

Admission Requirements

The applicant to the Master of Science in Acquisition and Contract Management program must have a bachelor's degree; however, the degree need not be in business administration. Students with undergraduate business degrees or courses may be able to waive the program prerequisites based on evaluations of their undergraduate academic transcripts.

The Graduate Record Examination (GRE) or Graduate Management Admissions Test (GMAT) may be required for admission evaluation purposes. General admission requirements and the process for applying are discussed in the *Graduate Information and Regulations* section of this catalog.

Degree Requirements

The degree of Master of Science in Acquisition and Contract Management is conferred on students who have successfully completed 33 credit hours of graduate course work plus other course requirements as listed on the student's approved Graduate Program Plan. Students without adequate undergraduate business courses are required to complete the program prerequisites.

Program Prerequisites 6
MGT 5000 Financial Accounting 3
MGT 5132 Basic Economics 3
In addition, computer literacy is required as a prerequisite. It can be demonstrated by the applicant's undergraduate course work or passing a proficiency examination offered by the School of Extended Graduate Studies, or completing a suitable computer course.

Required Courses (9 courses) 27
MGT 5001 Managerial Accounting 3
MGT 5002 Corporate Finance 3
MGT 5013 Organizational Behavior 3
MGT 5211 Procurement and Contract Management 3
MGT 5213 Contract Changes, Terminations and Disputes 3
MGT 5214 Cost Principles, Effectiveness and Control 3
MGT 5217 Contract and Subcontract Formulation 3
MGT 5218 Contract Negotiations and Incentive Contracts 3
MGT 5220 Contract Management Research Seminar 3

Electives (2 courses) 6
MGT 5017 Program Management 3
MGT 5023 Management and Administration of Contracts 3
MGT 5064 Cost and Economic Analysis 3
MGT 5138 Business Ethics 3
MGT 5240 Business and Legal Aspects of Intellectual Property 3
MGT 5270 Special Topics in Contracts Management 3
MGT 5084 Materiel Acquisition Management 3
MGT 5231 Government Contract Law 3
TOTAL CREDITS REQUIRED 33

Electives may be taken with the approval of both the faculty adviser and the program head from other graduate-level offerings in the School of Extended Graduate Studies, or other schools or academic units.

SEGS Programs and Locations

Note: For DL = Distance Learning program information, visit our Web site www.segs.fit.edu.

DEGREES OFFERED	LOCATIONS									
Legend: R = Resident Classes, On site DL = Distance Learning (Online) Classes NA = Not Available (this location)	Aberdeen Proving Ground, MD	Fort Lee, VA	Hampton Rds., Fort Eustis/ Norfolk, VA	NCR, Alexandria, VA	Northeast NJ/PA	Orlando, FL	Patuxent River, MD	Redstone Arsenal, AL	Spaceport/ PAFB, FL KSC, FL	Virtual Center
PROFESSIONAL MASTER OF BUSINESS										
ADMINISTRATION (PMBA)	R-DL	DL	R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL
ACQUISITION AND CONTRACT MANAGEMENT	R-DL	DL	DL	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL
EBUSINESS	R-DL	DL	R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL
HUMAN RESOURCES MANAGEMENT	R-DL		DL	DL	R-DL	R-DL	R-DL	R-DL	DL	DL
INFORMATION SYSTEMS	R-DL	DL	DL	DL	R-DL	R-DL	R-DL	R-DL	DL	DL
MASTER OF PUBLIC ADMINISTRATION (MPA)	DL		DL	DL	R-DL	DL	R-DL	R-DL	DL	DL
MASTER OF SCIENCE (MS)										
ACQUISITION AND CONTRACT MANAGEMENT	R-DL		R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL
AEROSPACE ENGINEERING	NA	NA	NA	NA	NA	NA	R	NA	NA	NA
COMPUTER INFORMATION SYSTEMS	NA		NA	NA	NA	R	R	R	R	NA
COMPUTER SCIENCE	NA	NA	NA	NA	NA	R	R	NA	R	NA
ELECTRICAL ENGINEERING	NA		NA	NA	NA	R	R	NA	NA	NA
ENGINEERING MANAGEMENT	R	NA	NA	NA	R	R	R	R	NA	NA
HUMAN RESOURCES MANAGEMENT	R-DL		DL	DL	R-DL	R-DL	R-DL	R-DL	DL	DL
LOGISTICS MANAGEMENT	DL	R-DL	DL	DL	R-DL	DL	DL	R-DL	DL	DL
MANAGEMENT	R-DL		R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL
ACQUISITION AND CONTRACT MANAGEMENT	R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL
EBUSINESS	R-DL		R-DL	DL	R-DL	R-DL	DL	DL	DL	DL
HUMAN RESOURCES MANAGEMENT	DL	DL	R-DL	DL	R-DL	R-DL	R-DL	R-DL	DL	DL
INFORMATION SYSTEMS	R-DL		DL	DL	R-DL	R-DL	R-DL	R-DL	DL	DL
LOGISTICS MANAGEMENT	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL	R-DL	DL	DL
TRANSPORTATION MANAGEMENT	DL		R-DL	DL	R-DL	DL	DL	DL	DL	DL
MATERIEL ACQUISITION MANAGEMENT	DL	R-DL	DL	R-DL	R-DL	DL	DL	R-DL	DL	DL
MECHANICAL ENGINEERING	NA		NA	NA	NA	NA	R	NA	NA	NA
OPERATIONS RESEARCH	R-DL	R-DL	DL	DL	DL	DL	DL	DL	DL	DL
PROJECT MANAGEMENT	R-DL		R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL
INFORMATION SYSTEMS	R-DL	DL	R-DL	R-DL	R-DL	R-DL	R-DL	R-DL	DL	DL
OPERATIONS RESEARCH	R-DL		DL	DL	R-DL	R-DL	R-DL	R-DL	DL	DL
SOFTWARE ENGINEERING	NA	NA	NA	NA	NA	NA	NA	NA	R	NA
SPACE SYSTEMS	NA		NA	NA	NA	NA	NA	NA	R	NA
SPACE SYSTEMS MANAGEMENT	NA	NA	NA	NA	NA	NA	NA	NA	R	NA
SYSTEMS MANAGEMENT	R-DL		R-DL	R-DL	R-DL	R-DL	DL	R-DL	DL	DL
INFORMATION SYSTEMS	R-DL	DL	R-DL	R-DL	R-DL	R-DL	DL	R-DL	DL	DL
OPERATIONS RESEARCH	R-DL		DL	DL	R-DL	R-DL	DL	R-DL	DL	DL

Nondegree Programs

General Studies

Freshman Year Curriculum

The general studies program provides a common freshman-year curriculum for students planning to major in communication, humanities, psychology or business, but are uncertain about which major to choose. Courses representative of these majors are taken during the freshman year, allowing students to obtain a general understanding of each area of study. All courses listed below are applicable toward degrees in all of these majors.

Students are encouraged to choose a degree program before registering for the third semester of full-time course work, and must do so within the first 45 credit hours. These criteria are adjusted for transfer students. General studies' students are advised by faculty in each of the programs noted above, and are assigned a new adviser in the appropriate academic unit when they choose a degree program. No degree is awarded in general studies.

Nondegree freshman-year programs in general engineering and general science are also offered, and are described in the corresponding sections of this catalog.

Admission

Criteria for admission are based on those established for the majors listed above. Details are provided in the sections of this catalog that describe these majors. Transfer students with more than 45 credit hours are normally required to choose a degree program rather than general studies before admission.

Admission to the general studies curriculum allows selection of any of the participating degree programs at any time before completion of 45 credit hours, unless the student has been academically dismissed. No additional admission procedures are required to declare a degree program, except for processing a Change of Major form (available from the Office of the Registrar).

Freshman Year

FALL			CREDITS
BUS	1301	Basic Economics	3
COM	1101	Composition and Rhetoric	3
EDS	1031	Survey of Science 1	3
BUS	1701	Introduction to Business	3
PSY	1400	Freshman Seminar	1
PSY	1411	Introduction to Psychology	3
			16

SPRING			
BUS	1401	Personal Finance and Investments	3
COM	1102	Writing About Literature	3
EDS	1032	Survey of Science 2	3
MTH	1702	Applied Calculus	3
PSY	1462	Substance Abuse	3
			15

Languages and Linguistics

Department Head
Nabil I. Matar, Ph.D.

Chair
Randall L. Alford, Ph.D.

Associate Professor
Randall L. Alford, Ph.D., *general linguistics, language education, German, English as a second language.*

Assistant Professor
Peter-Otto Uhr, Ph.D., *foreign languages, literature, history.*

Professor Emerita
Grace S. Wylie, M.A.

Instructors
P. Bernard, M.S.; A. Burkhart, M.A.; C.A. Gibbons, M.A.; D. Russell, M.S.

Organization

Florida Tech's Division of Languages and Linguistics is operated by the Department of Humanities and Communication. It provides training in English for students whose first language is not English and who have been admitted into a Florida Tech degree program.

For all academic students (foreign or native-born) whose first language is not English and whose command of the English language is insufficient to meet the requirements of their academic programs, English courses at two levels of advanced proficiency are available each semester. These courses are listed in the *Course Descriptions* section of this catalog under "English as a Second Language (ESL)." An institutional TOEFL, given at the beginning of each semester as a placement instrument, permits the division's staff to determine the incoming student's competence in English and establish the most beneficial program of study. Both undergraduate and graduate international students who score below 450 on the institutional TOEFL are referred to the ELS Center on campus where lower-level English as a Second Language courses are taught. Students with scores from 450 through 549 are required to take ESL courses as specified by the Division of Languages and Linguistics.

Students are permitted to begin their academic course work in conjunction with ESL 3xxx and 4xxx courses. Although these courses are credit bearing (3 credit hours per course), they cannot be applied toward completion of a degree.

Students who are not native speakers of English are considered to have demonstrated English language proficiency if they have done any of the following:

1. taken a TOEFL and earned an official score of at least 550, or a computer-based TOEFL-CBT score of at least 213, no more than two years before the planned date of first attendance at Florida Tech; or
2. successfully completed ELS 109 taken at an ELS Language Center, either at Florida Tech or elsewhere, and successfully completed LNE 1040 and LNE 1050 at Florida Tech concurrently with the beginning of their academic courses; or
3. successfully completed a total of 20 semester hours at an accredited, mainland U.S. university or college where English is the language of instruction, including three semester hours of English that qualify as transfer credit for Florida Tech's Composition and Rhetoric (COM 1101) course; or
4. earned a bachelor's or higher degree from an accredited, mainland U.S. university or college where English is the language of instruction; or
5. attended for three consecutive years, and graduated from, an accredited, mainland U.S. high school where English is the language of instruction; or
6. obtained an official score of 4 or higher on either the International Baccalaureate Higher Level Language A examination in English, or the College Board Advanced Placement Program (AP) examination in English Language and Composition.

Military Science

General

The mission of the Army Reserve Officers' Training Corps (ROTC) is to commission the future officer leadership of the United States Army. Through Army ROTC, a student can earn a commission as a second lieutenant in the active Army, Army Reserve or Army National Guard. The program is open to both male and female full-time students enrolled in four-year baccalaureate or two-year master's degree programs.

The Army ROTC program at Florida Tech is a general military science curriculum. Instruction covers military fundamentals common to all branches of the service. The program of instruction is designed to complement the student's academic goals of acquiring a baccalaureate degree in a course of study of his or her own choosing. The curriculum stresses leadership development and management principles. Emphasis is placed on the development of leadership traits and skills that are essential to the student's success in the Army, or as a civilian in his or her chosen profession. As such, the ROTC program of instruction cuts across conventional subject boundaries and involves elements of various disciplines that are designed to encourage students to interrelate their learning and to apply that knowledge in reflective thinking, goal seeking and problem solving.

The program is divided into the basic course (Military Science 1 and 2) and the advanced course (Military Science 3 and 4). All military science course grades are included in the student's grade point average. A student wishing to use a military science course to satisfy a degree requirement should consult the "Course Substitutions Authorized for ROTC" section on the following page.

Florida Tech offers both four-year and two-year ROTC programs. The two-year program is particularly beneficial for students who have transferred to Florida Tech from junior colleges where military science training was not available. Such students are required to complete a basic ROTC course at the five-week Army National Leaders Training Course at Fort Knox, Kentucky. Students may then be enrolled in the advanced course. While attending Camp Challenge, a student receives approximately $700 plus travel expenses to and from camp.

The four-year military science curriculum described below is applicable to both male and female students who meet the required age and physical standards. Students with prior military service or students who were enrolled in a high school ROTC program may be eligible to receive credit for the basic course (MSC 1 and 2) and directly enter the advanced program, as determined by the professor of military science.

Army ROTC Scholarships

The Army ROTC program awards four-, three- and two-year merit-based scholarships to qualified applicants on a competitive basis. These scholarships are offered at a monetary level of $17,000 annually, providing for college tuition and educational fees. An additional scholarship benefit is a designated book allowance of $650. Army scholarship winners and all advanced course cadets receive a tax-free subsistence allowance ranging from $250–400 a month for up to ten months for each year the scholarship is in effect. Scholarships do not pay flight fees.

A student who enrolls at Florida Tech under contract with the U.S. Army as an ROTC scholarship student receives incentives from the university in addition to the benefits paid by the Army. Four-year scholarship winners receive a room and board scholarship from the university and a grant for tuition not covered by the Army. Three-year advanced designees receive 50 percent tuition assistance for the freshman year. Beginning in the sophomore year, three-year advanced designees receive a room and board scholarship, plus tuition balance not covered by the ROTC scholarship from the university. Three- and two-year on-campus scholarship recipients will receive incentive packages similar to the above for all years the scholarship is in effect.

A student who transfers from another university to Florida Tech may be eligible for these incentive benefits as determined on a case-by-case basis by the professor of military science.

Military Science Curriculum

Military Science 1 covers the history, mission and organization of ROTC and the U.S. Army; basic customs, marksmanship, navigation and small-unit infantry tactics; and leadership development through practical exercises. Academic classes meet one hour per week. Leadership laboratory meets 1.5 hours per week. ROTC credit, four hours (2 hr/sem). Optional activities: Ranger Company, Drill Team, Color Guard, weekend field exercises and physical training (mandatory for scholarship winners).

Military Science 2 offers a more advanced study of map reading and small-unit infantry tactics, and continued leadership development by placement in leader positions within the cadet organization. Academic classes meet two hours per week. Leadership laboratory meets 1.5 hours per week. ROTC credit, two hours/semester. Optional activities: Ranger Company, Color Guard, Drill Team, additional weekend field exercises and physical training (mandatory for scholarship winners).

Military Science 3 covers operation orders and platoon tactics; weapons, land navigation, military skills, communications and instructional techniques; and the development of leadership through tactical exercises. Academic classes meet three hours per week. Leadership laboratory meets 1.5 hours per week. Physical training meets three hours per week. Attendance is required. ROTC credit, six hours (3 hrs/sem). Optional activities: Ranger Company and Drill Team.

Military Science 4 covers the conduct of training, ethics, military law and history. Cadet leaders gain practical experience in staff organization and planning while executing the unit's training program. Academic classes meet three hours per week. Leadership laboratory meets 1.5 hours per week and physical training meets three hours per week (attendance required). ROTC credit, six hours (3 hrs/sem). Optional activities: Ranger Company and Drill Team.

Course Substitutions Authorized for ROTC

Academic credit is permitted for military science classes as follows.

Aeronautical Science
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Electives 6
9

Aeronautical Science Flight Option
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Elective 3
6

Applied Mathematics
MSC 4002 Military Science (for Liberal Arts Elective) 3
Free Electives 6
Technical Elective 3
12

Aviation Computer Science
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Elective 6
9

Aviation Management Flight Option and Aviation Management
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Electives 0–3
3–6

Aviation Meteorology Flight Option and Aviation Meteorology
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3

Biochemistry and Biological Sciences
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Liberal Arts Electives 3–6
Free Elective 3
9–12

Business (except Information Systems)
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Business Restricted Electives 6
9

Chemistry
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Elective 3
Technical Electives 3–6
9–12

Communication and Humanities
Substitute any three MSC credits for HUM 3385 3
Free Electives 12
15

Computer Science (except Information Systems)
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Electives 4
7

Engineering Programs and Oceanography
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Elective 3
6

Environmental Sciences
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free or Restricted Elective 3
6

Information Systems Options in Business and Computer Sciences
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3

Interdisciplinary Science
Free Electives 6
Interdisciplinary Science 9
15

Physics
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Elective 0–12
Technical Elective 3
6–18

Psychology
Free Electives 17–18

Science and Mathematics Education
Free Elective 3
Liberal Arts Elective 0–3
3–6

Space Sciences
MSC 4002 Military Science (for Humanities/ Social Science Elective) 3
Free Electives 6
Technical Elective 3
12

Research: Institutes, Centers and Major Laboratories

Florida Institute of Technology has made, over the past decade, major additions and improvements to facilities that enhance the research component of nearly all aspects of undergraduate and graduate education. Along with these facility improvements, a number of research centers have been established to focus on particular areas of study and in many cases encourage interdisciplinary collaboration. These centers, and the facilities where they are located, represent a significant research capability that supplements the various department- and program-related activities and facilities described in previous sections of this catalog.

Particularly noteworthy is the multidisciplinary Applied Research Laboratory (ARL) facility that is situated less than two miles from the main campus. ARL houses research in ocean engineering, advanced materials, polymer flammability, lasers and electrooptics, psychology, parallel computing, neural networks and software engineering.

In addition, two teaching/research buildings were completed in 1999 on the main campus: the F.W. Olin Engineering Complex and the F.W. Olin Life Sciences Building. The engineering complex is a 68,500-square-foot facility housing 26 specialized research laboratories. The 37,000-square-foot life sciences building houses 12 research laboratories designed with a flex-space to meet the needs of specific activities.

The university engages in more than $22 million in research annually in its six colleges and schools. At any given time, the research faculty have almost $10 million in pending proposals to government agencies and private corporations.

Brief descriptions of Florida Tech's research centers and institutes follow. Not included here is research within the various degree-granting academic units, described in the preceding sections of this catalog.

Oak Ridge Associated Universities (ORAU)

Since 1989, students and faculty of Florida Tech have benefited from its membership in Oak Ridge Associated Universities. ORAU is a consortium of 88 colleges and universities and a management and operating contractor for the U.S. Department of Energy (DOE) located in Oak Ridge, Tenn. ORAU works with its member institutions to help their students and faculty gain access to federal research facilities throughout the country; to keep its members informed about opportunities for fellowship, scholarship and research appointments; and to organize research alliances among its members.

Through the Oak Ridge Institute for Science and Education (ORISE), the DOE facility that ORAU manages, undergraduates, graduates and postgraduates, as well as faculty enjoy access to a multitude of opportunities for study and research. Students can participate in programs covering a wide variety of disciplines, including business, earth sciences, epidemiology, engineering, physics, geological sciences, pharmacology, ocean sciences, biomedical sciences, nuclear chemistry and mathematics. Appointment and program length range from one month to four years. Many of these programs are especially designed to increase the numbers of underrepresented minority students pursuing degrees in science- and engineering-related disciplines. A comprehensive listing of these programs and other opportunities, their disciplines and details on locations and benefits can be found in the ORISE *Catalog of Education and Training Programs*, which is available online at www.orau.gov/orise/educ.htm, or by calling either of the contacts below.

ORAU's Office of Partnership Development seeks opportunities for partnerships and alliances among ORAU's members, private industry and major federal facilities. Activities include faculty development programs, such as the Junior Faculty Enhancement Awards, the Visiting Industrial Scientist Program and various services to chief research officers.

For more information about ORAU and its programs, contact Dr. Robert L. Sullivan, ORAU Council member, at (321) 674-8960; or Monnie E. Champion, ORAU Corporate Secretary, at (865) 576-3306; or online at www.orau.org.

Aquaculture Laboratory

Director
Junda Lin, Ph.D., Professor, Biological Sciences

The indoor aquaculture facilities at Florida Tech's main campus total approximately 2,500 square feet, most of which is wet laboratory space. Recirculating systems ranging from small glass aquaria through 720-gallon tanks harbor a wide variety of aquatic species. Controlled environmental factors such as temperature, salinity and photoperiod can be imposed on any of these systems, providing outstanding capabilities for studies of reproduction, early life history, growout, nutrition, behavior and related areas of virtually any aquatic species. A phytoplankton and live food culture system is available for nutritional support for planktivorous organisms.

Support equipment for providing aeration, refrigeration, filtration, water quality testing and particle counting is available.

Bioenergy and Technology Laboratory

Director
John J. Thomas, Ph.D., Research Professor, Biological Sciences

Laboratory research is concerned with investigations of biomass-derived hydrogen sulfide, methane and hydrogen, principally from municipal landfills and sewage treatment plants. Performance and emission characteristics of liquid fuels derived from hydrogen and methane are also studied. The laboratory is equipped with advanced engine analysis equipment, including a computerized state-of-the-art dynamometer, 168-sq.-ft. cold cell, exhaust analyzer and many engine performance measuring devices.

Center for Airport Management and Development (CAMD)

Director
Ballard M. Barker, Ph.D., A.A.E.,
Director, External Programs, School of Aeronautics

CAMD conducts applied research, contractual consultation and specialized training for industry and governmental organizations in airport planning, design, development, operations, management and system performance. The center includes dedicated computer applications laboratories for supporting the full scope of design, planning, modeling and management activities. It draws on the specific and multidisciplinary strengths of university faculty and graduate students in airport management and development. Recent major activities have included training development, management training, airport system studies and automated airport planning technology sponsored by The Boeing Company, the Federal Aviation Administration and the Florida Department of Transportation.

Center for Applied Business Research

Director
Dudley Gordon, M.S., Director of Industry Education Programs, School of Management

This center serves to consolidate the School of Management programs that interact directly with local business, to provide focus and establish responsibility and accountability for activities and relationships with local businesses, to establish a forum for local businesses to interact with the School of Management, to establish and maintain a database of activities involving local businesses for tracking and research purposes, and to support faculty research activities.

Working in close cooperation with the School of Management faculty, the center oversees the following programs: the Local Business Assistance Program, which offers research assistance to businesses (both for-profit and not-for-profit) in marketing, finance, organizational behavior and general management; Internship Practicum Program; Mentor Program; Classroom Guest Speaker Program; Industry Visitation Program; and Faculty Externship Program. The center also maintains a repository of longitudinal data for business research and analysis.

Students are involved in all aspects of the center's activities and have significant opportunities for experiential learning as a result of their interaction with local businesses and professional organizations.

Center for Distance Learning

Director
Mary S. Bonhomme, Ph.D.

This center is the focus for the identification, development and marketing of courses and programs (undergraduate, graduate and professional development) for delivery using distance learning technologies. Primary functions of the center include administering the learning management system and providing assistance to faculty using the learning management system for distance education. The center's staff informs the faculty of requests by outside audiences for courses and programs, works with the staff of Instructional Technology to provide the pedagogy and technology to ensure their high-quality presentation, and works with the faculty to implement marketing plans. Through its advisory board, the center's staff works with faculty to develop and promulgate policies and procedures to assure the excellence and continued improvement of Florida Tech's distance learning programs, monitor advances in educational delivery technology, and investigate new approaches with the goal of continuously improving the effectiveness of the distance learning experience.

Center for Environmental Education

Co-Directors
Robert Fronk, Ph.D., Professor, Science Education

Thomas Marcinkowski, Ph.D., Acopian Associate Professor of Environmental Education

Founded in 1993, this center supports ongoing activities in teacher education and professional development opportunities; regional, national and international outreach; curriculum, program and educational materials development; and research, assessment and evaluation. Recent projects include validation and subsequent use of the Secondary School Environmental Literacy Instrument; development and field testing of the Everglades Case Study and development of an accompanying Teachers Guide and Web site; statewide surveys of environmental education service-learning programs in grades 9–16 and of statewide environmental grant recipients; and involvement in Florida Tech's Peace Corps Fellows Program. Research, assessment and evaluation activities address three prominent needs: organization, synthesis, interpretation and application of research studies in environmental education at national and state levels; development of sound assessment and evaluation strategies for use in environmental education; and assisting professionals in the field to apply these strategies to their own and others' programs.

Center for Remote Sensing

Director
Charles R. Bostater, Ph.D., Associate Professor, Environmental Sciences and Physical Oceanography

The center's purpose is to encourage excellence in the development and application of remote sensing technology. It is structured as a joint effort among the College of Engineering, the College of Science and Liberal Arts and the School of Aeronautics. Under the authority of the Space Grant Act of 1988, Florida Tech is a member of the Southeastern Space Consortium and the Florida Space Grant Colleges Consortium. Accordingly, the center is not only an interdisciplinary

facility within the university, but also is allied with local industry; government agencies such as the NASA Kennedy Space Center, the Air Force's 45th Weather Squadron, the NOAA National Weather Service and the Florida Solar Energy Center; and other institutions.

Facilities for remote sensing teaching and research include the ERDAS Image Analysis System, Evans Library, the Geographical Information Systems Laboratory, the Marine and Environmental Optics Laboratory and the Synoptic Meteorological Laboratory. Various laboratories and facilities in Academic and Research Computing; Computer Science; Aerospace, Computer, Electrical and Mechanical Engineering; Physics and Space Sciences; and Space Systems are also available. Field studies can be conducted through the School of Aeronautics' fleet of aircraft, the flotilla of small watercraft at Florida Tech's Evinrude Marine Center and the R/V *Delphinus* (the university's 20-meter research vessel).

Center faculty offer a wide variety of courses at the graduate and undergraduate level, including Environmental Satellite Systems and Data, Hydroacoustics, Digital Image Processing and Environmental Optics for Remote Sensing.

Claude Pepper Institute for Aging and Therapeutic Research

Director
Joshua Rokach, Ph.D., Professor, Chemistry

The institute is interested in improving the understanding of some of the most serious and yet misunderstood diseases such as arthritis, atherosclerosis and Alzheimer's Disease. A fundamental premise of the institute's work is that free radical oxidative processes play an important role in these chronic degenerative diseases. This process initiates a reaction with polyunsaturated fatty acids on cell membranes to produce a family of products called isoprostanes. These isoprostanes are therefore the products of oxidative cellular damage and can also cause distortions of the membranes, leading to cell death. Knowledge of the amounts of isoprostanes formed may give us an indication of the severity of oxidative damage in degenerative diseases.

The institute's focus is on the chemistry of these isoprostanes and it has started a program for the total synthesis of some of them. Institute researchers have used these synthetic standards to develop sensitive assays to measure the isoprostanes in biological fluids such as urine, blood, etc. The level of these compounds in patients with atherosclerosis, for example, have been found to be highly elevated, implying oxidative damage to the coronary artery.

The Claude Pepper Institute for Aging and Therapeutic Research provides training and educational opportunities in chemical, biochemical and bioanalytical areas for students who want careers in industrial or academic settings.

Dynamic Systems and Controls Laboratory (DSC)

Co-Directors
Hector Gutierrez, Ph.D., P.E., Assistant Professor, Mechanical Engineering

Y.I. Sharaf-Eldeen, Ph.D., P.E., Associate Professor, Mechanical Engineering

DSC supports a variety of research and teaching activities in dynamic systems, including machinery monitoring and fault diagnosis, real-time control, computer-based instrumentation and mechatronics. Current research activities include real-time, on-line vibration and angular motion measurements and analyses to develop condition monitoring and maintenance information systems for power generation and transmission systems and components in rotating machinery; frequency response of model structures to low frequency (earthquake) vibrations; and system identification and control of magnetic suspension systems for positioning systems with nanometer resolution. State-of-the-art sensors and data acquisition systems are used in remote, wireless monitoring and control applications using the Internet.

Real-time control and mechatronics activities include nonlinear control of magnetic suspension systems, hybrid control of seismically-excited nonlinear buildings using distributed tuned mass dampers, microprocessor based control systems and automation.

A 2-D magnetically levitated stage for photolithography is being developed with National Science Foundation support.

Geospace Physics Laboratory (GPL)

Director
Hamid K. Rassoul, Ph.D., Associate Professor, Physics and Space Sciences

The laboratory hosts the space physics research activities of Florida Tech's space sciences program. Space physicists, and graduate and undergraduate students study the interaction of the Sun on Earth's magnetosphere and ionosphere, as manifested in such phenomena as the aurora. Current research projects include the study of plasma wave activity within the magnetosphere, solar/interplanetary energetic particle measurements, and cosmic-ray propagation modeling. GPL operates a 10-site meridional array of magnetometers along the east coast of the United States (the MEASURE array). The array observations, and particle and field measurements from various satellites (CRRES, LANL, IMP) are used for studying magnetic wave energy propagation within the geospace environment and the dynamics of Earth's plasmasphere and the storm-time radiation belt. Research at GPL also includes the study of energetic particle acceleration and propagation within the heliosphere and in interstellar space, using energetic particle measurements from the Ulysses, ACE, Wind and CRRES spacecraft as well as numerical modeling of particle transport processes. A space shuttle Get Away Special Canister (GAS Can) payload to study upward propagating lightning from space is being developed with a student team in charge of the hardware assembly and integration of the radio, optical and gamma ray experiments. Please see www.pss.fit.edu/Space-Physics/gpl.html for more details.

Infectious Diseases Laboratory

Director
Arvind M. Dhople, Ph.D., Research Professor, Biological Sciences

Current research in this laboratory is aimed at the successful *in vitro* growth of *Mycobacterium leprae*, the causative agent of human leprosy. Partial success in this area has led to a model for *in vitro* screening of potential anti-leprosy drugs and evaluation of potential compounds for their *in vitro* and *in vivo* (mice) activities against *M. leprae*.

The techniques developed and knowledge gained from the labratory's previous and ongoing studies are being extended to identify new drugs against human tuberculosis, and also to develop new methods to determine compliance of tuberculosis patients to chemotherapy. Similar studies are being carried out with *Mycobacterium ulcerans* infection (Buruli ulcer), which is rapidly becoming prevalent in many African countries. Drug evaluation studies with three bacteria are being carried out in collaboration with pharmaceutical companies in the United States and Japan.

This laboratory is also working in some areas of food microbiology, especially on prevention of food contamination with *Escherichia coli* O157:H7, a causative agent of enterohemorrhagic gastroenteritis, which is also becoming more and more prevalent worldwide, and has undertaken a study of the role of Chlamydia pneumonia and smoking in the pathogenesis of atherosclerosis.

Joint Center for Advanced Therapeutics and Research

Director
Mary Beth Kenkel, Ph.D., Professor and Dean, School of Psychology

The Holmes Regional Medical Center/Florida Tech Joint Center for Advanced Therapeutics and Research was created to encourage interdisciplinary clinical, scientific and engineering research to foster the development and application of novel diagnostic and therapeutic methods in medicine otherwise unobtainable in each institution individually. The center provides a means by which the faculty of Florida Tech and the medical staff of Holmes Regional Medical Center/ Health First (HRMC) have mutual access to the facilities and services of each institution for the purpose of both basic and clinical research. The Joint Center also houses the East Central Florida Memory Disorder Clinic, administered by HRMC. The Memory Disorder Clinic provides a variety of services to patients and their families.

Laser, Optics and Instrumentation Laboratory (LOI)

Co-Directors
Kunal Mitra, Ph.D., Associate Professor, Mechanical Engineering

Chelakara Subramanian, Ph.D., P.Eng, Associate Professor, Aerospace Engineering

LOI exploits current technologies in continuous wave and short-pulse lasers and optics to develop new techniques for measuring and characterizing material properties. Faculty and graduate students are involved in analyzing the interaction of these lasers with different materials for various applications. Biomedical applications focus on detecting and irradiating tumors and inhomogeneities in tissues. Material characterization/processing applications involve detection of defects in materials such as debonding of thermal protection tile systems and thermal response of materials subjected to high-energy radiation. Remote sensing applications focus on lightning detection in cloud media and landmines in shallow waters. The challenge of integrating laser sources, system optics, instrumentation, measurement schemes and data acquisition provides students with new learning experiences in these areas. Equipment currently in use includes a mode-locked short-pulse laser, high power continuous wave lasers, a modulator, an ultrafast photodetector, a sampling head oscilloscope, a streak camera, miscellaneous optics and optical accessories, a thermal camera and an image processing system.

Maglev Laboratory

Director
Laszlo Baksay, Ph.D., Professor and Head,
Physics and Space Sciences

The primary goal of this laboratory is the development of a new space launch system for manned and unmanned missions based on electromagnetic acceleration and levitation, in cooperation with NASA, the Florida Space Institutes, and the Advanced Magnet Laboratory, a high-tech industry partner. It houses a 43-foot magnetic levitation and propulsion demonstration track, one of a handful of such devices in the country, and the only one at an academic institution. Physics, space science and engineering students and faculty, together with researchers from the other institutions, are performing investigations in topics such as controls, aerodynamics, mechanical stability, superconducting technology and electromagnetic acceleration and levitation, to study the feasibility of maglev launch assist for future spacecraft.

Some of the work is also related to maglev based transportation systems. The laboratory also houses a 20-foot maglev track model built by Florida Tech students.

Microelectronics Laboratory

Director
Susan Earles, Assistant Professor, Electrical and Computer Engineering

This microelectronics facility is designed to be a teaching laboratory, as well as an advanced research laboratory. A microelectronics fabrication course is taught to graduate and undergraduate students. In this course, students complete, fabricate and test state-of-the-art integrated circuits. Research conducted in the facility includes advanced microelectronic packaging and processes for new metalization techniques and dielectrics.

The facility is a 3,800-sq.-ft. structure with all support services needed for modern semiconductor research, including a 3,000-sq.-ft. cleanroom, as well as areas dedicated to integrated-circuit testing and equipment maintenance. Equipment in the teaching laboratory includes photolithographic aligners, diffusion furnaces, a thin film evaporator, wet chemistry benches and significant measurement and inspection equipment. The advanced research laboratory presently features a scanning electron microscope, rapid thermal annealer, chemical vapor deposition, reliability test equipment and several lasers for teaching and research.

Research Center for Waste Utilization (RCWU)

Director
Iver Duedall, Ph.D., Professor, Oceanography and Environmental Sciences

The RCWU provides government organizations and the private sector with development facilities and personnel to design advanced techniques for waste management and use of solid and hazardous waste products. The research is directed toward developing technically and economically sound processes and procedures to manage waste materials to protect the environment, promote optimum use and recover the energy value in wastes.

The center works in partnership with other universities; local, state and federal agencies; and industry to provide utilitarian solutions to waste management problems. Current research has included the use of combustion ash in cement block for construction of artificial reefs, conversion of waste to fuel and improved methods for recycling. Future efforts are planned to increase the efficiency of the resource recovery process, improve use of the ash by-products and improve the useful recycling of both plastics and paper waste products.

Robotics and Spatial Systems Laboratory (RASSL)

Director
Pierre Larochelle, Ph.D., Associate Professor, Mechanical Engineering

RASSL is dedicated to the development of mechanical systems that generate spatial motion and force transmission. Research focuses on achieving advances in design methodologies for these systems as well as the techniques for using them in industrial and consumer applications. A mutually beneficial relationship has been achieved with local industry (e.g. NASA-KSC, GSMA, AMTI, RWT and ICS) that has resulted in motivating K–12 youth toward engineering, science and technology through active involvement in the FIRST Robot Competitions. Equipment includes an AdeptOne SCARA robot, a Zevatech CT2000 Cartesian robot and a Motoman SV3x, as well as the computer capabilities needed for computer-aided synthesis, analysis and design of robots and spatial systems.

Southeastern Association for Research in Astronomy (SARA)

Director
Terry Oswalt, Ph.D., Professor, Physics and Space Sciences

SARA is a consortium of six universities led by Florida Tech that operates a one-meter-class automated telescope at Kitt Peak National Observatory near Tucson, Arizona. The SARA members are Florida Tech, East Tennessee State University, the University of Georgia, Valdosta State University, Florida International University and Clemson University. Using an innovative, computer-controlled operating system, the observatory can operate interactively with an astronomer on-site as well as remotely from SARA institutions' home campuses. Observational data are transferred to SARA institutions via a high-speed link to the Internet and are also made available to other astronomers around the world. In addition to faculty research activities in a wide variety of areas such as stellar evolution, active galaxy dynamics and origins of the universe, SARA operates a unique, multi-institution Research Experiences for Undergraduates (REU) program funded by the National Science Foundation. Each year, this program provides summer internships to about a dozen students selected from around the country and offers an opportunity for these students to work one-on-one with faculty on research projects. The SARA REU program is one of the largest astronomy internship programs in the United States.

Southeastern Center for Advanced Transportation Research (SCATR)

Director
John J. Thomas, Ph.D., Research Professor, Biological Sciences

SCATR responds to advanced transportation concepts with an emphasis on development, demonstration and impact studies of alternative fuels. SCATR builds on the strengths and facilities of existing programs, while also developing partnerships with industry and cooperative efforts with national research organizations.

Alternative transportation fuels have potential for reducing dependence on petroleum. Substitution by any one option or group of options will impact the economics and technology of vehicular performance, fuel handling techniques, safety, material requirements, primary energy sources, air quality, fuel-cycle infrastructure and public response. The center has the existing personnel, resources and facilities to conduct research on the petroleum replacement issue and focus on the use of alternative fuels for transportation.

Sportfish Research Institute (SRI)

Director
Jonathan M. Shenker, Ph.D., Associate Professor, Biological Sciences

SRI is dedicated to studies of the sport fishery species that are tremendously important to Florida. Research currently focuses on the use of the Indian River Lagoon as a nursery habitat for juvenile tarpon, the basic biology and ecology of these juveniles, the genetic structure of tarpon populations and the role of offshore artificial reefs in creating habitat for diverse sport fish species. In addition to field and laboratory research, SRI personnel present talks and provide information to local and regional sport fishing organizations and publications. Funded in part by state and local grants, SRI also seeks funding and participation from corporations associated with the fishing industry and from private individuals.

University Center for Information Assurance

Director
James A. Whittaker, Ph.D., Professor, Computer Sciences

The center is funded by both industry and government sponsors and concentrates on all aspects of computer hardware and software security. Faculty participants are internationally recognized for their technical contributions, especially in the areas of hardware and software security testing. License agreements in place with a number of industry leaders enable the implementation of research results in commercial quality hardware and software products, focusing on assuring the integrity of computer hardware and software applications from malicious intrusion. The center performs funded

hardware and software testing, vulnerability testing, security assessments and basic research in computer security and software development testing.

Vero Beach Marine Laboratory (VBML)

Director
Junda Lin, Ph.D., Professor, Biological Sciences

Deputy Director
Elizabeth A. Irlandi, Ph.D., Assistant Professor, Oceanography

VBML is located on four acres of oceanfront property in nearby Vero Beach. This facility serves as a field station for the university in support of research and teaching in the marine sciences. The beachfront location of VBML provides ready access to field study sites for work on the biology of coastal organisms and for studies of physical and geological processes of the coastal zone. Major research efforts at the laboratory are related to mariculture, the ecology of seagrass. The center has a seawater system and extensive holding tanks for mariculture work. A two-story laboratory building, equipped with seawater tables and flow-through seawater, supports research on mariculture, ecology and toxicology of marine organisms. Classroom and seminar areas, offices and dry laboratory facilities are provided in the main laboratory building.

Wind and Hurricane Impacts Research Laboratory (WHIRL)

Director
Jean-Paul Pinelli, Ph.D., Associate Professor, Civil Engineering

WHIRL is dedicated to the study of the effects and impacts of windstorms, including hurricanes, tornadoes and thunderstorms, and other related meteorological hazards (e.g., flooding and tidal surges) on the natural environment and man-made structures. The laboratory involves a multidisciplinary team of engineers, scientists and business experts. It takes advantage of a geographic location in the heart of Florida's Space Coast to serve the needs of industry, government and the public in wind hazard mitigation. The laboratory's activities include research on mitigation of losses of life, property and the environment; education of the public through dissemination of information; and the development of a multidisciplinary program of study focused on wind engineering and wind-related socioeconomic studies and analyses.

Research topics in the laboratory include action of strong winds and storm surges on structures; evaluation of codes, standards and retrofitting techniques for buildings and infrastructure systems; risk assessment for existing structures, coastal erosion, sediment transport and environmental damage due to storm surges and floods; development of remote sensing tools for assessing and monitoring hurricane damage, wind speed and flood levels; fundamental wind and meteorological research; wind tunnel modeling and testing; and statistical studies, analysis of economic impacts and development of potential damage maps for hurricane hazards in Florida.

Wireless Center of Excellence (WiCE)

Director
Chang Wen Chen, Ph.D., Henry Professor of Electrical and Computer Engineering

Technical Director
Ivica Kostanic, Ph.D., Assistant Professor, Electrical and Computer Engineering

WiCE is a center devoted to creating a new generation of wireless engineering professionals through education and research. Driven by its academic program, WiCE considers wireless to be any system or device that relies on electromagnetic-wave propagation to perform one or more of its functions. This context includes such diverse applications as radar, global positioning, location, sensing, etc., as well as the broader class of communications systems such as satellites, point-to-point/multi-point, WLAN, wireless WAN, etc. In partnership with industry, WiCE offers the opportunity for faculty and both undergraduate and graduate students to engage in research and to study wireless concepts in a variety of courses. It is focused on two strongly related disciplines, wireless systems and microwave engineering, and is supported by significant laboratory facilities as described under "Electrical Engineering" in the *College of Engineering* section of this catalog.

Course Descriptions

Courses are listed alphanumerically. The 1000, 2000, 3000 and 4000 series are undergraduate courses. The 5000 series are graduate courses that can also be taken by undergraduates with cumulative grade point averages of 2.75 or higher, who have satisfied all listed prerequisites and whose registration is approved by the department head or program chair responsible for the course. The 6000 series courses are restricted to graduate students only.

Courses that may be taken in fulfillment of Undergraduate Core Requirements are designated as follows: CL: computer literacy requirement, COM: communication elective, HU: humanities elective, SS: social science elective. These designations follow the course descriptions. Other courses that satisfy Undergraduate Core Requirements are identified by the course prefix: any MTH course can be used toward meeting the mathematics requirement; and any AVS, BIO, CHM or PHY course, or EDS 1031 or 1032, toward meeting the physical/life sciences requirement.

AVIATION HUMAN FACTORS

AHF 3101 INTRODUCTION TO HUMAN FACTORS (3 credits). Introduces the field of engineering psychology (ergonomics) that examines the interaction of humans and machines. The course analyzes aircraft accidents and industrial safety concepts, and the design of aircraft, computers and other products. *(Prerequisite: Junior standing.)*

AHF 5101 HUMAN FACTORS IN MAN-MACHINE SYSTEMS (3 credits). Provides an introduction to the range of human factors topics and introduces the principles and knowledge that underpin the aviation human factors specialist's approach. Employment opportunities and an insight into the systems approach methodology of the aviation human factors specialist are discussed.

AHF 5191 SEMINAR IN AVIATION HUMAN FACTORS (0 credit). Reports and discussions on current research and contemporary topics in the field of aviation human factors are conducted. Mandatory for all AHF students.

AHF 5201 HUMAN PERFORMANCE 1 (3 credits). Classical and naturalistic decision making. The study of human performance in complex systems with an examination of stress, anxiety, fatigue and organizational stress and error. Automation and human performance in aviation are explored. *(Prerequisite: AHF 5101.)*

AHF 5202 HUMAN PERFORMANCE 2 (3 credits). An examination of information processing models; learning and memory, mental models and schema theory; signal-detection theory; human error; language and warnings; and knowledge elicitation for expert system development. *(Prerequisite: AHF 5201.)*

AHF 5302 HUMAN-COMPUTER INTERACTION (3 credits). An examination of human performance issues in the design of human-computer interfaces. Emphasis is given to human performance research relevant to aviation computer and aviation information systems. The course is structured around comparative readings in human-computer interaction using multiple sources.

AHF 5990 DIRECTED RESEARCH (3 credits). This option permits students to conduct independent research or participate in ongoing research or other projects under faculty supervision. A written proposal containing performance expectations and evaluation criteria must be submitted to the division director for approval. *(Prerequisite: Division director approval.)*

AHF 5991 SENSATION AND PERCEPTION (3 credits). The philosophical underpinnings of scientific views of sensation and perception. Hypothesized psychophysiological mechanisms of sensation. Subsequently, the nature of human perceptual processes, distortion and illusion are covered with response to real-world aviation human factors considerations. *(Prerequisite: Program chair approval.)*

AHF 5999 THESIS RESEARCH (0–3 credits). Preparation and submission of a research thesis on a selected topic in aviation human factors, under the direction of the graduate faculty. *(Prerequisite: Program chair approval.)*

ACADEMIC SUPPORT CENTER

ASC 1000 UNIVERSITY EXPERIENCE (1 credit). Helps first-year students adjust to the university and acquire essential academic survival skills (classroom behavior, academic honesty, study skills, etc.) that will enhance academic and social integration into college.

ASC 1005 STRATEGIES FOR SUCCESS AT FLORIDA TECH (1 credit). Helps first-time freshmen recover and improve academically during their second semester, particularly those who are on academic probation because of poor first semester performance.

ASC 1051 CHEMISTRY REVIEW (1 credit). This course is designed to increase proficiency in understanding chemistry through one-on-one instruction.

AEROSPACE ENGINEERING

See Mechanical/Aerospace Engineering (MAE).

AVIATION FLIGHT

AVF 1001 FLIGHT 1 (2 credits). Dual flight instruction, takeoffs and landings, solo flight and cross-country flight, flight maneuvers, navigation and emergency operations. Prepares the student for the FAA Private Pilot Certificate. *(Prerequisites: Student Pilot Certificate, Class III or higher medical certificate; corequisites: AVS 1201, AVT 1111.)*

AVF 1002 FLIGHT 2 (2 credits). Advanced dual-flight instruction, solo and advanced cross-country navigation; and introductory instrument instruction in aircraft and simulators (flight training devices) in preparation for the FAA Commercial Pilot and Instrument Ratings. *(Prerequisites: AVF 1001, FAA Private Pilot Certificate, Class II or higher medical certificate.)*

AVF 2001 FLIGHT 3 (2 credits). Advanced flight instruction and cross-country navigation. Preparation for the FAA Commercial Pilot and Instrument Ratings. Continuation of AVF 1002. Award of the FAA instrument rating upon successful completion of this course and the FAA knowledge test. *(Prerequisites: AVF 1002, FAA Private Pilot Certificate, Class II or higher medical certificate; corequisite: AVT 2111.)*

AVF 2002 FLIGHT 4 (2 credits). Introduces complex aircraft flight and covers commercial flight maneuvers. The student is awarded the FAA Commercial Certificate after successfully completing this course and the required FAA knowledge test. *(Prerequisites: AVF 2001, successful completion of FAA written examination for Commercial Pilot Certificate.)*

AVF 2006 INSTRUMENT PILOT (2 credits). Aircraft and simulator (flight training device) instrument flight procedures in preparation for the FAA instrument rating. Taken in lieu of portions of AVF 1002 and AVF 2001 for those students with previous flight experience. *(Prerequisites: FAA Private Pilot Certificate, 50 flight hours of PIC cross-country experience.)*

AVF 3001 FLIGHT INSTRUCTOR-AIRPLANE (2 credits). Training for commercial- and instrument-rated pilots to qualify for the FAA Certified Flight Instructor Certificate. Upon successful completion of this course and the required FAA knowledge tests, the student is awarded the Certificate. *(Prerequisites: AVT 3101, FAA Commercial Pilot Certificate with Instrument Rating.)*

AVF 3002 FLIGHT INSTRUCTOR-INSTRUMENT (2 credits). Prepares certified flight instructors to become instrument flight instructors. Ground instruction and flight in the instructor's seat to develop skill in analyzing student procedures and maneuvers in all instrument flight procedures. Students must pass the FAA knowledge test and flight test. *(Prerequisite: FAA Flight Instructor-Airplane Certificate.)*

AVF 3003 STUDENT TEACHING FOR FLIGHT INSTRUCTORS (2 credits). Practical application of flight training skills. Students plan and conduct flight training under the supervision of a senior instructor. The course includes the use of audiovisual aids, flight training devices and aircraft. *(Prerequisites: Associate degree, FAA Flight Instructor Certificate and program chair approval.)*

AVF 3004 COMPLEX INSTRUMENT FLIGHT TRAINING (2 credits). Training in complex instrument aircraft using a combination of dual flight and pilot-in-command instrument cross-country flights. Experience in instrument flight and operations into busy air terminals. Review of basic instrument flying, air-traffic control procedures and instrument approaches. *(Prerequisite: FAA Instrument Rating.)*

AVF 3008 AEROBATIC FLIGHT (1 credit). Ground and flight training in basic acrobatic flight maneuvers, recovery from unusual flight attitudes and familiarity with conventional landing-gear aircraft. *(Prerequisites: FAA Private Pilot Certificate and 100 flight hours or program chair approval.)*

AVF 4001 MULTIENGINE PILOT (2 credits). Designed to qualify single-engine-rated pilots to fly multiengine airplanes. The course provides a combination of multiengine flight, multiengine flight training device and ground training. Upon successful completion of this course, the student is awarded the FAA Multiengine Airplane Rating. *(Prerequisites: AVF 2001, AVF 2002.)*

AVF 4002 FLIGHT INSTRUCTOR-MULTIENGINE (2 credits). Prepares multi-engine-rated pilots to become multiengine flight instructors. Emphasis is in ground instruction and flight in the instructor's seat to develop skill in analyzing student procedures and maneuvers. *(Prerequisites: AVF 4001 or FAA Commercial Pilot Certificate with Multiengine Rating and FAA Flight Instructor Certificate.)*

AVF 4003 AIRTAXI FLIGHT TRAINING (2 credits). Teaches the duties of pilot-in-command and second-in-command in airtaxi flight operations and provides multiengine instrument flight training for airtaxi competency. Encompasses ground instruction and training in multiengine flight simulators and light twin-engine airplanes. *(Prerequisites: AVF 4001 or FAA Commercial Pilot Certificate, Instrument and Multiengine Ratings.)*

AVF 4005 EXECUTIVE TRANSPORT FLIGHT TRAINING (2 credits). A continuation of AVF 4003 and includes ground instruction, flight simulator and flight instruction. Emphasizes the duties and responsibilities of pilot-in-command during commercial and corporate operations in cabin-class multi-engine aircraft. *(Prerequisites: AVF 4001 or FAA Commercial Pilot Certificate, Instrument and Multiengine Ratings.)*

AVF 4090 SPECIAL TOPICS IN FLIGHT TRAINING (1 credit). Topics will vary by semester and could include Advanced Instrument Flight, Advanced Aerobatics and Advanced Crew Resource Management. Flight fees will vary depending on topic and flight hours required. The course may be repeated for credit. *(Prerequisite: Program chair approval.)*

AVIATION MANAGEMENT

AVM 2401 AVIATION FISCAL MANAGEMENT (3 credits). A study of the fiscal management of airports, airlines, and other aviation enterprises. Students become familiar with operating and capital budgets, and the management and budgeting of debt and equity capital in the airline and airport markets.

AVM 3201 AVIATION PLANNING (3 credits). Introduces the student to the requirements, issues and processes involved in aviation planning. Sources of aviation data, forecasting methods, the airport master planning process and environmental issues and requirements are studied in depth. *(Prerequisite: Junior standing.)*

AVM 3202 AIRPORT DESIGN (3 credits). An analysis and application of FAA standards for airport design. Emphasis is on the airside components. Topics include airport capacity calculations; movement area geometry; pavement, runway, and taxiway design; (FAR Part 77), approach and departure gradients, terminal building concepts and heliports. *(Prerequisite: AVM 3201.)*

AVM 3302 MULTIMODAL TRANSPORTATION (3 credits). A survey of the development and operation of land, water and air transportation systems. Principles of logistics, transportation economics and intermodal traffic management are discussed, with emphasis on air traffic. Transportation management in both the private and public sectors is included.

AVM 3501 SPECIAL TOPICS IN AVIATION MANAGEMENT (3 credits). Topics of special interest are offered when student interest and staffing permit. Current topic will be announced prior to registration. *(Prerequisite: Division director approval.)*

AVM 4201 AVIATION ADVANCED COMPUTER APPLICATIONS (3 credits). This course teaches the application of specialized software packages used in the aviation industry. Included are land-use management, airport and airway simulations and geographical information systems. *(Prerequisites: AVM 3202 and a CSE course.)* (CL)

AVM 4204 CAD FOR AIRPORT ENVIRONMENTS (3 credits). This course teaches the application of AutoCAD, its interfaces, the essential AutoCAD concepts and terminology, and specialized conflict analysis software packages used in the aviation industry. Included are three-dimensional airspace analysis and airspace coordination systems. *(Prerequisite: AVM 3202.)* (CL)

AVM 4301 AVIATION LABOR LAW AND EMPLOYMENT STANDARDS (3 credits). A study of government regulation of aviation employment standards and labor-management practices in negotiating and administering collective bargaining agreements. Private and public sector labor relations are examined with specific application of labor law to the varied aspects of the aviation industry.

AVM 4302 AVIATION LAW (3 credits). Provides the student with an overview of the fundamentals of aviation law. Emphasis is placed on factors guiding operational decision making by aviation managers and professional pilots to minimize exposure to legal liability.

AVM 4401 INTERNATIONAL AIR COMMERCE (3 credits). A study of the geographic, economic, social and political environment of international air commerce. Issues include the trend to globalization, technology transfer, legal environments and the effect of geography on business and politics.

AVM 4501 AIR TRANSPORTATION MANAGEMENT (3 credits). A survey of the development of the air transportation system leading to the modern organization and functions of airlines and general aviation business. Route structure, scheduling, pricing and fleet selection strategies are studied in the solution of typical operational problems. *(Prerequisite: Senior standing.)*

AVM 4502 AVIATION BUSINESS SIMULATION (3 credits). This course applies business management concepts and techniques to the decision-making and problem-solving processes and situations in an aviation business. Operations research techniques, process analysis, forecasting and computer and mathematical modeling are used as tools. *(Prerequisite: AVM 4501.)*

AVM 4600 AVIATION MANAGEMENT INTERNSHIP (5 credits). Management training within the aviation industry. Minimum of a full academic term during the senior year. For credit, this internship must be followed by AVM 4603. *(Prerequisites: Completion of junior year major requirements, cumulative GPA of 2.8 or higher and faculty committee approval.)*

AVM 4602 INDEPENDENT STUDY IN AVIATION MANAGEMENT (3 credits). Provides outstanding students an opportunity to pursue independent study on selected subjects to a depth not otherwise available in the curriculum. It requires the student to prepare a formal written paper and undergo an oral examination. *(Prerequisites: 2.8 cumulative GPA and division director approval, senior standing.)*

AVM 4603 AVIATION MANAGEMENT SEMINAR (1 credit). Students present formal oral and written reports on their management internship to students and faculty for comment and critique. This course is mandatory in the first semester after completion of AVM 4600.

AVM 4701 AIRPORT MANAGEMENT (3 credits). A study of modern airports, including their roles, functions and status in the national air transportation system; sponsorship and management alternatives; management of airport development, operations and business matters; and discussion of current and emerging public airport issues. *(Prerequisites: AVM 3202, senior standing.)*

AVM 5000 FUNDAMENTALS OF AVIATION PLANNING AND DESIGN (3 credits). Introduces issues, requirements and processes involved in aviation planning, design and software applications. Sources of aviation data, forecasting methods, the airport master planning process and environmental issues and requirements are studied. (Foundation course, does not meet graduate degree requirements.) *(Prerequisite: Division director approval.)*

AVM 5101 LEGAL AND ETHICAL ISSUES IN AVIATION (3 credits). Current issues are used as vehicles for study of the legal and moral concepts that influence developments in both national and international air law. Legal and ethical considerations directly confronting the aviation professional are addressed through case studies. *(Prerequisite: AVM 4302.)*

AVM 5102 AIRPORT DEVELOPMENT (3 credits). Addresses capital project development issues at airports with emphasis on project definition, funding, project administration and coordination, marketing and property management of airside and land-side facilities. *(Prerequisite: AVM 4701.)*

AVM 5103 AIRPORT OPERATIONS (3 credits). Addresses requirements, responsibilities, and methods of major U.S. and international airports. Both FAA and ICAO standards regarding air- and land-side operations, operational safety, maintenance and construction, security and emergency preparedness are studied. A case study or research paper is required. *(Prerequisite: AVM 4701.)*

AVM 5104 AVIATION ECONOMICS AND FISCAL MANAGEMENT (3 credits). This course uses the case-study method of teaching Aviation Economics and Management. It covers topics such as the role of government, union-management relations, airline integration and computer reservation systems. *(Prerequisite: Undergraduate economics course.)*

AVM 5105 AVIATION PLANNING AND ANALYSIS TECHNIQUES (3 credits). Teaches use of special software to evaluate compliance of airports with FAA safety, efficiency and land-use compatibility guidelines. Topics include noise compatibility, imaginary surface design, airport and airway simulations and geographical information systems. *(Prerequisite: AVM 4201 or AVM 5000.)*

AVM 5199 ADVANCED AVIATION MANAGEMENT INTERNSHIP (3 credits). Advanced management of, or research in, aviation-related operations or enterprises with approved industrial or governmental organizations. A detailed written professional analysis of the experience is required. *(Prerequisite: Program chair approval.)*

AVM 5501 CASE STUDIES AND SPECIAL TOPICS IN AVIATION MANAGEMENT (1–3 credits). An in-depth study of a specific case or topic in the field of aviation management. *(Prerequisite: Program chair approval.)*

AVM 5998 ADVANCED AVIATION RESEARCH PROJECT (3 credits). This is a capstone course requiring individual research into an aviation-related topic, issue or problem appropriate to the student's area of concentration. It is conducted under the supervision of a graduate faculty member and culminates in a formal written and oral report. *(Prerequisite: Program chair approval.)*

AVM 5999 THESIS (0–6 credits). In-depth study of a specific aviation issue. Oral presentation to faculty required prior to formal defense of thesis. *(Prerequisite: Program chair approval.)*

AVIATION SCIENCE

AVS 1101 AVIATION CHEMICAL SCIENCE (3 credits). An introduction to the basic principles of general chemistry to include elements, compounds, states of matter, chemical bonds, the periodic table and applications to aviation.

AVS 1201 AVIATION METEOROLOGY (3 credits). A study of atmospheric composition, circulation, stability and convection, forms of moisture, air masses and fronts, energy cycles, weather hazards to flying; and aviation weather observation, forecasting and report interpretation.

AVS 2101 AVIATION PHYSICAL SCIENCE (3 credits). An introduction to the basic principles of physics directly applicable to aviation, including properties of matter, mechanics, vibration, wave motion, heat, sound, electricity, magnetism and optics. *(Prerequisite: MTH 1000 or MTH 1001.)*

AVS 2102 AERODYNAMICS (3 credits). Principles of aerodynamics for non-engineering aviation professionals. The theory of flight, including concepts of airfoils, lift, drag and thrust, is applied to specific characteristics of aircraft performance, stability and control, weight and balance, load factors, fuel consumption and structural limitations. *(Prerequisite: AVS 2101 or PHY 1001.)*

AVS 2222 AVIATION PHYSIOLOGY (3 credits). An introductory course that covers the effects of flight on human functional capability. Hypoxia, hyperventilation, self-imposed stress, disorientation and other physical consequences of flight are explored.

AVS 3201 AVIATION METEOROLOGY 2 (3 credits). Emphasis is on synoptic meteorology (meteorological data analysis and basic forecasting). Other topics include regional weather patterns and seasonal variations, as well as flight planning. *(Prerequisite: AVS 1201 or OCN 2407.)*

AVS 4000 AVIATION PHYSIOLOGY LABORATORY (1 credit). This course allows the student to experience the biophysical and biochemical reactions of the body to loss of pressurization in flight. Students experience the personal effects of hypoxic hypoxia and trapped gas expansions in a certified hypobaric chamber following FAA approved flight profiles. *(Prerequisite: Current FAA Airman Medical Certificate; corequisite: AVS 2222 or AVS 5203.)*

AVS 4201 FLIGHT OBSERVATION LABORATORY (1 credit). Nonflight students are provided experience in the flight operations environment. The course includes observation of preflight and postflight briefings, participation as an observer on training flights and related activities with emphasis on human factors and safety. *(Prerequisite: Program chair approval.)*

AVS 5201 AVIATION METEOROLOGY THEORY AND PRACTICE (3 credits). In-depth coverage of selected aviation meteorology topics, including stability, causes and manifestations of turbulence and mesoscale convective complexes. Wind shear and microbursts, and their impact on aviation are covered. *(Prerequisite: AVS 1201 or AVS 3201 or OCN 2407.)*

AVS 5202 ADVANCED AVIATION METEOROLOGY LABORATORY (1 credit). This course focuses on the integration of all-weather data using the Kavouras Trimets and METPAC weather data systems. The student learns to operate the equipment and interpret synoptic situations. Short-term weather forecasting is practiced and students make detailed presentations supporting their forecasts. *(Corequisite: AVS 5201.)*

AVS 5203 IMPACT OF AVIATION ON HUMAN PHYSIOLOGY (3 credits). Explores the biophysical and biochemical, blood gas chemistry and neurological and pulmonary reactions to flight. A special analysis of human reactions to many of the extremes of flight. *(Prerequisite: AVS 2222 or instructor approval.)*

AVS 5204 AVIATION SAFETY ANALYSIS (3 credits). This course provides aviation and selected non-aviation professionals with a strong background in aviation safety analysis. The material and methods studied, including a variety of safety databases, provide a foundation for safety management, safety program development, team performance analysis and personnel resource management. *(Prerequisite: AVT 4301.)*

AVS 5500 CASE STUDIES AND SPECIAL TOPICS IN AVIATION SCIENCE (1–3 credits). An in-depth study of a specific case or topic in the field of aviation science. *(Prerequisite: Program chair approval.)*

AVS 5999 THESIS RESEARCH (0–3 credits). Preparation and submission of a research thesis on a selected topic in Aviation Science under the direction of the graduate faculty. *(Prerequisite: Program chair approval.)*

AVIATION TECHNOLOGY

AVT 1111 AERONAUTICS 1 (3 credits). Academic training for a Private Pilot certificate. Topics include principles of flight, FAA regulations, visual flight rules, aircraft systems and performance, meteorology, navigation, aviation physiology and flight planning. Student must obtain a score of 70 percent or higher on the FAA course completion examination.

AVT 1112 AERONAUTICS 2 (3 credits). Academic instruction for an instrument rating. Principles of instrument flight, air traffic control, IFR procedures, analyses of weather information, IFR planning, emergency procedures and pilot decisions. Student must obtain a score of 70 percent or higher on the FAA course completion examination. *(Prerequisites: AVF 1001, AVT 1111.)*

AVT 2111 AERONAUTICS 3 (3 credits). Academic training for a Commercial Pilot certificate. Topics include airplane performance, VFR cross-country planning, FARs applicable to commercial pilot operations, advanced aircraft systems and aircrew physiology. Student must obtain a score of 70 percent or higher on the FAA course completion examination. *(Prerequisite: AVT 1112.)*

AVT 2201 NATIONAL AIRSPACE SYSTEM (3 credits). An intensive study of the National Airspace System to include its political, geographical and operational structures. Covers ATC responsibilities, airfield operations and special-use airspace management.

AVT 3101 INSTRUCTIONAL TECHNIQUES (3 credits). Academic training for a Certified Flight Instructor certificate. Topics include the principles of learning and communication, instructional methods, techniques and media. Oral communication skills are emphasized. Student must obtain a score of 70 percent or higher on the FAA course completion examination. *(Prerequisites: AVF 2002, AVT 2111.)*

AVT 3203 AIR TRAFFIC CONTROL 1 (3 credits). An introductory course to Air Traffic Control (ATC) and its use of NAVAIDS and airspace to effect positive separation and control of IFR aircraft.

AVT 3501 SPECIAL TOPICS IN AVIATION TECHNOLOGY (3 credits). Topics of special interest are offered when student interest and staffing permit. Current topics are announced prior to registration. *(Prerequisite: Division director approval.)*

AVT 4201 ADVANCED AIRCRAFT SYSTEMS (3 credits). Theory and operating characteristics of modern transport aircraft systems, including engine, fuel, electric, hydraulic, pneumatic, flight control, environmental and computer systems and displays. *(Prerequisites: AVF 2002, AVT 2111 or instructor approval.)*

AVT 4202 ADVANCED AIRCRAFT OPERATIONS (3 credits). Designed to provide an understanding of advanced aircraft performance, systems integrations and crew management. *(Prerequisite: AVF 4001 or instructor approval.)*

AVT 4203 AIRLINE OPERATIONS (3 credits). Covers federal U.S. air carrier regulation. Functions and relationships between the various major divisions of a typical air carrier. Prepares the student to take the FAA written exam for aircraft dispatcher and the FAA practical exam to receive an FAA Aircraft Dispatcher Certificate. *(Prerequisites: AVF 2002, AVT 2111 or instructor approval.)*

AVT 4205 TURBINE TRANSITION AND LINE OPERATIONS (3 credits). Provides classroom and simulator instruction in turboprop aircraft systems and airline-type operations in line-oriented flight training (LOFT) scenarios. Prepares students with multiengine instrument ratings for more complex aircraft systems and advanced cockpit procedures. *(Prerequisite: Multiengine certificate with instrument rating.)*

AVT 4301 AVIATION SAFETY (3 credits). Exploration of the historical roots of modern safety organizations and the safety responsibilities and operations of the FAA and the NTSB. Aviation safety planning, icing and human-centered accidents are examined closely. *(Prerequisite: Junior standing.)*

AVT 5301 COMPLEX AVIATION SYSTEMS (3 credits). Conceptional and operational avionics systems in air-transport aircraft. Communications, navigation, flight control, flight management and engine instrumentation systems, and various electronic displays are covered. Focus is on the pilot's perspective for effective use of the entire suite of avionics in improved decision making and safety.

AVT 5302 AVIATION ACCIDENT INVESTIGATION (3 credits). A study of aviation accident investigation as performed by NTSB, FAA and ICAO. Includes field investigation techniques and laboratory methods for accident reconstruction, and analysis of flight mishaps using time and events correlation of cockpit voice recorders, flight data recorders and ATC radar tapes. *(Prerequisite: AVT 4301.)*

BIOCHEMISTRY

BCM 4991, 4992 SENIOR THESIS IN BIOCHEMISTRY 1, 2 (3, 3 credits). This course offers biochemical research under the supervision of a faculty committee that leads to the preparation of an undergraduate thesis. Prior acceptance as a thesis student and approval of a thesis proposal are required for registration. *(Corequisite: COM 2012.)*

BIOLOGICAL SCIENCES

Note: Graduate standing is a prerequisite for all 5000-level and higher biological sciences courses.

BIO 1010 BIOLOGICAL DISCOVERY 1 (4 credits). The first of a two-semester sequence on the scientific approach to biology. Emphasis is placed on the scientific method, analytical techniques, utilization of original source materials, ethical questions in biology, historical perspectives of the development of biological theory and profiles of prominent figures in biology. *(Prerequisites: High school biology and chemistry.)*

BIO 1020 BIOLOGICAL DISCOVERY 2 (4 credits). The second of a two-semester sequence on the scientific approach to biology. A continuation of an integrated approach to the study of the hierarchal structure and function of living systems, including the origin and history of life on earth. *(Prerequisites: High school biology and chemistry.)*

BIO 1200 INTRODUCTION TO THE HEALTH PROFESSIONS (1 credit). An introduction to careers in the health profession, including diverse medical fields and allied health professions. Strategies for preparing for professional schools, getting volunteer experience, taking professional admission exams and applying to a professional school will be discussed.

BIO 1500 INTRODUCTION TO AQUACULTURE (1 credit). An introduction to the basic concepts of aquaculture including examination of algal, invertebrate and fish systems. Several field trips to local aquaculture operations will be conducted.

BIO 2010 MICROBIOLOGY (4 credits). Lecture and laboratory course covering the fundamentals of microbiology. Structure, classification, metabolism and pathogenicity of prokaryotes, eukaryotic microorganisms and viruses are examined. Laboratories cover aspects of isolation, culture, enumeration, identification and control of microorganisms. *(Prerequisites: BIO 1020, CHM 1102.)*

BIO 2110 GENERAL GENETICS (4 credits). A course in the fundamentals of genetics from Mendel to modern day. Lecture and laboratory topics emphasize the transmission of genetic material, the molecular nature of heredity and the heredity of populations. In the laboratory, students will perform genetic analysis with *Drosophila* (fruit flies), as well as with a variety of microbial systems. *(Prerequisite: BIO 1010.)*

BIO 2801 BIOMETRY (4 credits). Experimental design and hypothesis testing in the biological sciences, and the analysis of biological data using descriptive statistics and applying parametric and non-parametric tests. Computer applications will include statistical packages, spreadsheets, graphics preparation, and word processing in the development of reports on modules of field-, clinic-, and laboratory-based studies. *(Prerequisite: BIO 1020.)* (CL)

BIO 2925 FIELD BIOLOGY AND ECOLOGY/AFRICA (3 credits). Field biology and ecology methodology are discussed, demonstrated and applied in the field to collect data for analysis. Field studies are conducted in Africa. *(Prerequisite: BIO 1020.)*

BIO 2935 FIELD BIOLOGY AND ECOLOGY/SMOKY MOUNTAINS (3 credits). Field biology and ecology methodology are discussed, demonstrated and applied in the field to collect data for analysis. Field studies are conducted in the Smoky Mountains. *(Prerequisite: BIO 1020.)*

BIO 2945 FIELD BIOLOGY AND ECOLOGY/ROCKIES AND THE DESERT SOUTHWEST (3 credits). Field biology and ecology methodology are discussed, demonstrated and applied in the field to collect data for analysis. Field studies are conducted in the Rocky Mountains and the desert southwest. *(Prerequisite: BIO 1020.)*

BIO 2955 FIELD BIOLOGY AND ECOLOGY/CORAL REEFS (3 credits). Field biology and ecology methodology are discussed, demonstrated and applied in the field to collect data for analysis. Field studies are conducted in the Bahamas. *(Prerequisite: BIO 1020.)*

BIO 3010 MICROBES AND SOCIETY (3 credits). A lecture and lab course to introduce nonscience majors to the discipline of science using microbiology as a medium. It will enable students to think about how microbes affect our everyday lives with respect to disease, the food we eat, how microbes have changed and are changing the way we live. Noncredit for biological sciences and biochemistry majors, except as free elective.

BIO 3210 MAMMALIAN PHYSIOLOGY (4 credits). An introduction to the study of bodily functions. Emphasis is placed on biophysical principles and control systems to explain organ system function and the maintenance of homeostasis. *(Prerequisites: BIO 1020, CHM 2001.)*

BIO 3220 DEVELOPMENTAL BIOLOGY (4 credits). An overview of developmental processes, including contemporary themes of molecular, cellular and multicellular aspects of embryonic and postnatal development. The issues of induction, regulation, differentiation and senescence are discussed. *(Prerequisite: BIO 2110.)*

BIO 3410 GENERAL ECOLOGY (4 credits). The study of the distribution and abundance of organisms, with emphasis at the level of biological populations. Interaction of populations with the abiotic environment; energetics, population growth, reproduction, competition, predation, adaptation and evolution. Modular laboratory exercises stress experimental design, conduct and data analysis. *(Prerequisite: BIO 2801.)*

BIO 3510 INVERTEBRATE ZOOLOGY (4 credits). Lectures and laboratories on the origins and adaptive radiation of the kingdom Metazoa, including comparative structure and function of living and extinct animal phyla, evolution of organ system, and comparative physiology and ecology. *(Prerequisite: BIO 1020.)*

BIO 3550 APPLICATIONS OF AQUACULTURE TECHNOLOGY (3 credits). A course focusing on the technical aspects of aquaculture. Students will use the Aquaculture Research Center to gain hands-on experience in the design and operation of aquaculture systems. *(Prerequisite: BIO 1500.)*

BIO 3625 MOLLUSCAN AQUACULTURE (3 credits). A study of the basic biology, life history and culture techniques of the major commercially important molluscs. Culture procedures for microalgae will also be covered. Laboratory work will culture selected microalgal species, spawning and larviculture of selected bivalve species. *(Prerequisite: BIO 3510.)*

BIO 3701 EVOLUTION (3 credits). A lecture course describing the processes resulting in evolutionary change and the factors affecting those processes. Evolution is discussed at all levels from cell and molecular evolution to local populations to major groups, and covers time frames drawing on knowledge of many biological fields. *(Prerequisites: BIO 1020, BIO 2110.)*

BIO 3935 ECOLOGY OF TROPICAL ECOSYSTEMS (3 credits). A three-week course that examines aspects of population and community ecology of tropical rain forest systems in Belize or Costa Rica, Central America. The course is designed to familiarize the student with the ecological principles governing the abundance and distribution of species in different rain forest ecosystems. *(Prerequisite: BIO 1020.)*

BIO 3940 TROPICAL MARINE ECOLOGY (3 credits). An intensive field-oriented course focusing on tropical marine ecosystems and their biological communities, with emphasis on biodiversity, the ecology of dominant taxa, interactions between physical and biological processes, and the structure and function of representative communities. *(Prerequisite: BIO 1020.)*

BIO 4010 BIOCHEMISTRY 1 (4 credits). An introduction to the structure and properties of proteins, carbohydrates, lipids and nucleic acids. Lectures and laboratories involving intermediary metabolism, properties of enzymes, bioenergetics including oxidative phosphorylation and photosynthesis are presented. *(Prerequisite: CHM 2002.)*

BIO 4101 MOLECULAR BIOLOGY (3 credits). The structure, function and regulation of genetic information. Nucleic acid replication, transcription and translation are discussed in detail. Uses and applications of nucleic acids in current research are introduced. *(Prerequisite: BIO 4010.)*

BIO 4110 BIOCHEMISTRY 2 (4 credits). Lectures and laboratories involving the metabolism of carbohydrates, lipids and nitrogenous compounds, including amino acids, proteins and nucleic acids. The regulation of metabolism, biosynthesis of macromolecules and control of gene expression are discussed in detail. *(Prerequisite: BIO 4010.)*

BIO 4120 GENETIC ENGINEERING TECHNIQUES (4 credits). Lectures and laboratories on the theory and practice of gene splicing and manipulation, the use of restriction enzymes, plasmid and phage vectors and the cloning of genes. Additional topics include nick translation, random primer labeling, colony hybridization and southern blotting. *(Prerequisites: BIO 4101, BIO 4110.)*

BIO 4130 NUCLEIC ACID ANALYSIS (4 credits). Lectures and laboratories involving the theory and practice of current methods of nucleic acid manipulation. Techniques studied include restriction site mapping, end-labeling, sequencing, mRNA isolation, cDNA synthesis, DNA:DNA and DNA:RNA hybridization, PCR technology and DNA fingerprinting. *(Prerequisite: BIO 4120.)*

BIO 4201 IMMUNOLOGY (3 credits). A lecture course covering basic immunology and the fundamental principles relating to clinical immunology. The two functional divisions of the immune system, the innate and the adaptive immune system, are studied, along with the cells and the soluble factors responsible for the immune response. *(Prerequisite: BIO 4010.)*

BIO 4210 PLANT PHYSIOLOGY (4 credits). A presentation of the physiological processes of plants and their interactions with their environment. Specific topics covered include water relations, plant biochemistry, plant development and environmental physiology. *(Prerequisites: BIO 1020, CHM 2002.)*

BIO 4301 CELL BIOLOGY (3 credits). Emphasis is on the interdependence of three systems: a membrane-cytoskeletal system, a system that directs genetic information into synthesis of cell constituents; and a system integrated into membranes that converts energy, supplied to cells as nutrients or light, into cell function and cell synthesis. *(Prerequisite: BIO 4010.)*

BIO 4310 FOOD MICROBIOLOGY (3 credits). Lectures and laboratories examining the sources and types of microorganisms in food and their role in food spoilage. The microbiology of food products, ways of controlling and preventing spoilage, methods of isolation and enumeration, quality control, safety practices and food-borne diseases caused by these organisms are discussed. *(Prerequisite: BIO 2010.)*

BIO 4410 COMMUNITY ECOLOGY (4 credits). The study of the composition and distribution of biological communities and the community responses to climatic and other abiotic factors. Ecosystems, biogeography, biodiversity, successions, paleoecology, pollution, conservation. Modular laboratory exercises will stress the experimental design, conduct, and data analysis of community studies. *(Prerequisites: BIO 2801, BIO 3410.)*

BIO 4515 ECOLOGY OF CORAL REEFS (3 credits). A broad-spectrum examination of coral reefs, from reef geology and geomorphology to conservation and management, including the physical environment, corals and symbiosis, reproduction, demography, community dynamics, diversity and function, biogeography and evolution, and natural and anthropogenic disturbances. *(Prerequisites: BIO 3410, BIO 4410.)*

BIO 4517 AN INTRODUCTION TO MODELING FOR ECOLOGY AND BIOLOGY (4 credits). Subjects include allometric principles, biological processes within organisms, population and metapopulation models, competition and symbiosis, predator-prey relations, community and diversity, and models in evolution, biogeography, ecosystems and conservation. *(Prerequisite: BIO 3410.)*

BIO 4530 BIOLOGY OF FISHES (4 credits). An introduction to the structure, evolution, behavior and ecology of freshwater and marine fishes. The laboratory examines the anatomy, physiology and ecology of fishes. Field collection trips to local marine and freshwater habitats are conducted. *(Prerequisite: BIO 1020.)*

BIO 4550 COMPARATIVE VERTEBRATE ANATOMY (4 credits). A lecture and laboratory course that examines the comparative anatomy of higher animals. Special emphasis is placed on the evolutionary trends of the vertebrates. *(Prerequisite: Junior standing.)*

BIO 4601 CORAL REEF FISH ECOLOGY (3 credits). An introduction to the structure of coral reefs and the behavior, ecology and evolution of reef fish communities. *(Prerequisite: BIO 4530.)*

BIO 4620 FISH AQUACULTURE AND MANAGEMENT (4 credits). An in-depth survey of culture methods of freshwater and saltwater fish species, including an introduction to the theory and techniques necessary for managing wild fisheries stocks. Laboratory work focuses on fish culturing methodology and analysis of wild fish populations. Several field studies are included. *(Prerequisite: BIO 1020.)*

BIO 4625 CRUSTACEAN AQUACULTURE (3 credits). A study of the basic biology, life history and culturing techniques of the major commercially important crustaceans. Laboratory work will culture selected decapod species. *(Prerequisite: BIO 3510.)*

BIO 4641 BIOLOGY OF MARINE MAMMALS (3 credits). A study of the evolution, classification, ecology and general life history of marine mammals. *(Prerequisite: BIO 1020.)*

BIO 4710 MARINE BIOLOGY (4 credits). Lectures and labs on the nature of life in the ocean and in coastal environments. Taxonomic diversity, ecological roles and adaptations of the five kingdoms are reviewed. Topics include physiological mechanisms, locomotion and migrations, defenses against predation, sensory reception, productivity, feeding, reproduction and symbiosis. *(Prerequisite: BIO 3510.)*

BIO 4720 MARINE ECOLOGY (4 credits). Structure and function of marine biotic systems from the organism (life histories) to community and ecosystem. *(Prerequisites: BIO 2801, BIO 3410, senior standing.)*

BIO 4905 OCEAN AND REEF ECOLOGY OF AUSTRALIA (3 credits). A field course examining the biodiversity and ecology of temperate and tropical marine habitats in Australia. Comparative analysis of the phycological, invertebrate and vertebrate biota, and the physical components of marine ecosystems of southeast Australia and the Great Barrier Reef are studied. *(Corequisite: BIO 4915.)*

BIO 4915 EVOLUTION AND ECOLOGY OF AUSTRALIAN ECOSYSTEMS (3 credits). An examination of the origins and adaptations of the unique flora and fauna of Australia. Emphasis is on climatic and geological shaping of modern communities. The influence of continental drift, glacial cycles, nutrient availability and human impact on populations are discussed. *(Prerequisite: BIO 1020; corequisite: BIO 4905.)*

BIO 4990 BIOLOGY FORUM (1 credit). Critical analysis of primary literature and review articles in the biological sciences by oral presentation and small group discussion. *(Prerequisite: Instructor approval.)*

BIO 4991, 4992, 4993 UNDERGRADUATE RESEARCH 1, 2, 3 (3, 3, 3 credits). Research experience under the direction and supervision of a member of the biological sciences faculty. *(Prerequisite: Instructor approval.)*

BIO 5005 COMPARATIVE BIOLOGY OF INVERTEBRATES (3 credits). An introductory, graduate-level course on the methods by which invertebrate metazoans perform life functions, as well as the similarity underlying these methods. The course draws on the rich diversity of invertebrate body forms, and compares major and minor phyla.

BIO 5010 ICHTHYOLOGY (4 credits). This course provides graduate students a background in ichthyology and fish biology. The first part follows a classical ichthyology course by covering systematics and evolution of fishes. The second part focuses on biological and ecological adaptation of fishes to different environments.

BIO 5013 ELASMOBIOLOGY (3 credits). The study of the evolution, taxonomy, ecology, behavior and physiology of sharks, skates and rays. Laboratory is supplement lecture material.

BIO 5015 POPULATION ECOLOGY (3 credits). A lecture course to examine factors responsible for variations in population structure, and strategies employed for within and among population interactions. Emphasis is placed on evolutionary ecology.

BIO 5017 TROPICAL PLANT COMMUNITY ECOLOGY (3 credits). Investigations of the origins and functions of tropical plant communities. Topics include soils, climate, distribution of biodiversity, niche structure, animal/plant interactions and conservation. Emphasis is placed on the effect of global climate change on the communities.

BIO 5020 FIELD ECOLOGY 1 (3 credits). A field course designed to identify the plant communities characteristic of the southern Appalachian Mountains. The factors responsible for the control and dynamics of these community types are examined in the field. The field trip is conducted in the Great Smoky Mountains National Park. A field fee is required.

BIO 5021 FIELD ECOLOGY 2 (3 credits). An intensive four-week field course designed to identify the plant communities in the central and southern Rocky Mountains and the plateaus and deserts of the southwestern United States. A field fee is required.

BIO 5022 CORAL REEF ECOLOGY (3 credits). A two-week course conducted in the Bahamas, designed to familiarize the student with patterns of abundance and distribution of the common species of coral reef fishes. Emphasis is on species identification and on field methods of investigating reef fish ecology. A field fee is required.

BIO 5023 FIELD ECOLOGY 3 (3 credits). A field course that examines the structure and function of selected tropical rain forest ecosystems. A field fee is required.

BIO 5024 FIELD ECOLOGY 4 (3 credits). A three-week course, two weeks of which are conducted in Kenya, designed to familiarize the student with patterns of abundance, distribution, habitat requirements and behavior common to vertebrate species of African savanna ecosystems. A field fee is required.

BIO 5025 ECOLOGY OF SALT MARSH AND MANGROVE (3 credits). Lectures and discussions on the ecology of salt marsh and mangrove systems. Emphasis is on how organisms adapt to the alternating inundation and exposed environment, and how physical and biological factors interact to determine the population and community structures.

BIO 5028 DESIGN AND ANALYSIS OF ECOLOGICAL STUDIES (4 credits). A comprehensive review of experimental and observational methods and analysis tools commonly encountered in ecology. The practical application of research designs to ecological problems and different fields of ecology is emphasized.

BIO 5030 CONSERVATION BIOLOGY (3 credits). A lecture course to demonstrate the synthetic nature of conservation biology drawing from the disciplines of genetics, population biology, biogeography, ecology, wildlife management, human ecology and natural resource management. Conservation issues are illustrated using case studies from a wide variety of global ecosystems.

BIO 5033 PALEOECOLOGY (4 credits). A lecture/seminar/laboratory course investigating how ecosystems have changed during the Quaternary period. Topics include evolution of species and communities, factors driving climate change, effect of climate change from high to low altitudes, ecological impacts of human evolution and dispersal, isotopic dating and analysis.

BIO 5036 EXPLORATION OF ANIMAL BEHAVIOR (3 credits). This lecture/lab course will emphasize laboratory analysis of behavior in animals. Students will perform ethological observations and design and conduct experiments testing mechanisms underlying specific behavior.

BIO 5037 NAVIGATION AND ORIENTATION OF MARINE ANIMALS (3 credits). Introduction to the behaviors, mechanisms, and cues used by marine organisms for navigation and orientation. Functional significance and evolution of orientation behaviors will be stressed.

BIO 5038 BEHAVIOR AND SENSORY BIOLOGY OF FISHES (3 credits). The investigation of the behavior of fishes as it relates to their ecology, reproductive biology and social systems. The role of fish sensory systems is integrated with the expression of these adaptive behaviors.

BIO 5040 MARINE MAMMALOGY (4 credits). A lecture and laboratory course on the evolution, classification, zoogeography, anatomy and general life history of marine mammals.

BIO 5042 FEEDING ECOLOGY OF FISHES (3 credits). Addresses the feeding biology of fishes, with emphasis on the interplay between theoretical and practical aspects of fish foraging research. It involves lectures and discussions on foraging theory, ecological and functional morphology of feeding in fishes, effects of disturbance on fish foraging and influences of exotic species on fish ecology.

BIO 5045 REPRODUCTION AND RECRUITMENT OF MARINE FISHES (4 credits). The processes of reproduction and recruitment of marine fishery species are discussed. Topics range from the physiological and behavioral characteristics of reproduction, to the molecular events of fertilization, to the influences of oceanographic processes on larval and juvenile life stages.

BIO 5047 ECOLOGICAL PHYSIOLOGY OF FISHES (3 credits). Fishes inhabit a vast range of habitats that vary with respect to biotic and abiotic factors. Successful maintenance of populations in challenging environments requires responsive adjustments in physiology. This course addresses how the physiology of fishes is affected and regulated in response to environmental changes.

BIO 5050 MOLLUSCAN BIOLOGY (3 credits). Lectures on the biology of a well-studied and dominant marine, freshwater and terrestrial invertebrate phylum, including comparative biology and taxonomy.

BIO 5055 ECHINODERM BIOLOGY (4 credits). A study of the anatomy, physiology, ecology, evolution and systematics of the marine phylum *Echinodermata*. Emphasis is placed on recent advances in knowledge of echinoderms. There is also individual and group laboratory study.

BIO 5060 BIOLOGY AND ECOLOGY OF SEAGRASSES (3 credits). Lectures, discussions of recent literature, and independent or group laboratory study of the truly marine angiosperms. The systematics, anatomy, physiology and reproduction of seagrasses are covered, along with autecology and community ecology of tropical and temperate seagrass meadows.

BIO 5065 NATURAL HISTORY OF THE INDIAN RIVER LAGOON (4 credits). A field course on the flora, fauna and descriptive ecology of the Indian River system along the east coast of Florida. Emphasis is placed on understanding natural history in relation to geologic history, biogeography, human society and recent problems in resource management.

BIO 5070 PHYSIOLOGICAL ECOLOGY (3 credits). Lectures and discussions on the physiological adaptation of organisms to environment.

BIO 5075 MULTIVARIATE ANALYSIS IN BIOLOGY (3 credits). A hands-on, problem-solving course designed to teach graduate students how to apply various multivariate techniques in analyzing biological data. Topics include principal component analysis, cluster analysis and discriminate function analysis.

BIO 5080 MECHANISMS OF BIOLOGICAL CLOCKS (3 credits). A survey of primary literature of processes underlying rhythmicity, including neural, cellular, and molecular mechanisms. Focus will be on circadian rhythms in vertebrate and invertebrate animals.

BIO 5085 BIOLOGICAL IMAGING (3 credits). An introduction to the applications of image processing techniques to biological problems. Topics include the acquisition, enhancement and quantification of 2-D images, motion analysis and processing in 3-D.

BIO 5120 ECOLOGY OF TROPICAL MARINE COMMUNITIES (3 credits). A lecture and field course that examines aspects of the population and community ecology of tropical marine systems, especially coral reefs and mangroves. Factors influencing community structure and the relationships between representative populations are emphasized.

BIO 5140 CORAL ECOLOGY (3 credits). The focus is on both theoretical and practical aspects of coral ecology, including hands-on taxonomy and assessment of the functional response of coral reefs to environmental factors, including thermal stress at a global scale. Emphasis tends toward identification of processes and regulatory phenomena driving the dynamics of coral communities.

BIO 5501 CELL AND MOLECULAR BIOLOGY (3 credits). An overview of molecular mechanisms used to regulate fundamental cellular processes. Emphasis is placed on gene expression, cell growth, replication and differentiation, and on intercellular communications.

BIO 5502 MOLECULAR BIOLOGY OF SIGNAL TRANSDUCTION (3 credits). An introduction to current concepts of cellular signal transduction. Hands-on experience in essential techniques including production of fusion proteins and quantitative microinjection.

BIO 5505 HISTOTECHNIQUES FOR LIGHT MICROSCOPY (3 credits). A laboratory study of fundamental histological methods involving fixation, embedding, sectioning and staining of tissues for light microscopy.

BIO 5510 CURRENT TOPICS IN ECOLOGY (3 credits). Readings and discussions of recent advances and new concepts in ecological research.

BIO 5515 PHARMACOLOGY AND DRUG DESIGN (3 credits). An overview of basic principles of pharmacology, with particular emphasis on preclinical studies used in the development of new drugs. Topics include structure-function relationships, dose-response curves, target based drug assays, rational drug design and *in vitro* cytotoxicity assays.

BIO 5521 REGULATION OF ANIMAL AND PLANT DEVELOPMENT (3 credits). A detailed look at the mechanisms that govern animal and plant embryonic development. Modern methods of experimental developmental biology are covered in detail. Topics span the genetic, biochemical and molecular mechanisms that govern specific aspects of development. Emphasis is placed upon the review and discussion of current primary scientific literature.

BIO 5535 CURRENT TOPICS IN BIOTECHNOLOGY (3 credits). Lectures and discussions on the current advances in the area of biotechnology. The discussions center around the current literature, legal aspects and ethical considerations. Topics include DNA fingerprinting, eukaryotic genetic engineering, human gene therapy and patenting of genetically engineered organisms.

BIO 5537 APPLIED BIOTECHNOLOGY (6 credits). A field/laboratory course focusing on the collection isolation, characterization and screening of natural products, especially from marine organisms. Topics include taxonomy, microbial isolation, collection, extraction preparation, bioassay and chemical structure determination.

BIO 5539 MICROBIAL BIOTECHNOLOGY (3 credits). An overview of microbes as producers of economically important proteins and other organic compounds are presented. Topics include expression of proteins from cloned genes, antibiotics, fermentation, bacterial degradation, environmental applications and culture methodology.

BIO 5540 BIOCHEMICAL TOXICOLOGY (3 credits). A lecture course designed to examine the basic principles of toxicology, including pharmacological and metabolic processes that influence toxicity, carcinogenesis and mutagenesis. Occupational toxicology, including kidney, liver and respiratory toxins are discussed.

BIO 5541 BIOCHEMICAL TOXICOLOGY 2 (3 credits). A survey of toxic properties and biochemical transformations of organo-halides, phosphates, sulfides, metallics, natural products and inorganics.

BIO 5545 GROWTH AND DIVISION OF CELLS 1: PROKARYOTES (3 credits). The molecular biology of microbial reproduction, with emphasis on chromosome and plasmid DNA replication, the cell division cycle, regulators of gene expression and the mechanisms of cell division in bacteria.

BIO 5546 GROWTH AND DIVISION OF CELLS 2: EUKARYOTES (3 credits). The molecular biology of the growth processes of a variety of eukaryotic cells, ranging from yeast to human cells *in vivo*, including the mitotic cycle, oncogenes and growth factors, cellular senescence, tumor development and cancer therapy.

BIO 5570 DNA STRUCTURE AND FUNCTION (3 credits). An advanced course in DNA biology with focus on the current research topics covering DNA structure-function relationships. Particular emphasis is placed on the dynamic nature of DNA and the interaction of DNA and proteins to regulate gene expression. Prokaryotic, eukaryotic and viral systems are examined.

BIO 5571 DNA INTERACTIONS (2 credits). DNA interacts with a variety of agents, energetic radiations, small-molecule chemical mutagens and carcinogens and large regulatory and repair protein molecules. This seminar course considers recent literature sources and students will assimilate seminar skills required for professional scientific presentations.

BIO 5575 BIOLOGY OF CANCER (3 credits). A comprehensive overview of the biology and molecular biology of neoplastic disease. Special emphasis is placed on recent research with oncogenes and oncogenic viruses. Lectures on causes, spread and treatment of cancer are also presented.

BIO 5576 MOLECULAR GENETICS (3 credits). This course covers the essential topics in molecular genetics, beginning with the classic experiments involving bacteria and bacteriophage, progressing to the current focus on mapping human disease. Emphasis is on reading and discussing primary research literature with particular attention on the experimental approaches used.

BIO 5600 ADVANCED PLANT PHYSIOLOGY (3 credits). An in-depth presentation of major tropics in plant physiology with special emphasis on plant growth substances, growth and development and reproduction. Students review current literature and make frequent class presentations.

BIO 5605 PLANT CELL STUDIES (3 credits). Lecture and laboratory exercises on plant cells, the cell cycle, differentiation and plant cell culture. Students initiate *in vitro* cultures and manipulate cell development.

BIO 5615 COMPARATIVE VERTEBRATE PHYSIOLOGY (3 credits). Comparative physiology of vertebrates with special emphasis on the chemical and physical underpinnings of physiological processes.

BIO 5630 SENSORY BIOLOGY (3 credits). An introduction to vertebrate sensory systems. Special emphasis is placed on the mechanisms of sensory processing and perception of events of varying complexity. Students review and discuss current literature and several experiments are performed.

BIO 5635 INTRODUCTORY NEUROBIOLOGY (3 credits). Cellular and molecular mechanisms, modulation of ionic channels and biochemistry and pharmacology of synaptic transmission. Reviews synaptogenesis, axonal pathfinding and neuronal apostasies.

BIO 5725 PATHOGENIC BACTERIOLOGY (3 credits). A review of pathogenic bacteria that are responsible for disease and death. The course also explains pathogenic characteristics of bacteria as they relate to the immune system.

BIO 5735 SEMINAR IN MYCOBACTERIOLOGY (2 credits). The seminar will address the public health problems posed by organisms belonging to the family *Mycobacteriaceae*. Diseases caused by species in this family include tuberculosis, opportunistic infections in AIDS patients and leprosy.

BIO 5800 BIOGEOGRAPHY AND PHYLOGENETIC ECOLOGY OF FISHES (3 credits). How fishes manage to speciate, disperse, and occupy specific habitats. The course addresses evolutionary relationships and fish community evolution from freshwater tributaries to the deep sea. Stress will be placed on western Atlantic and eastern Pacific neotropical ichthyofaunas. *(Prerequisite: BIO 5010.)*

BIO 5801 EARLY LIFE HISTORY AND ECOLOGY OF FISHES IN SUBTROPICAL ECOSYSTEMS (5 credits). Phylogeny and comparative morphology of fishes relative to comparative life histories and evolution in subtropical environments. The ecology of subtropical ichthyofaunas from coastal freshwater tributaries to continental shelf reef formations is discussed. Taught at HBOI.

BIO 5802 BIOLOGY OF THE DEEP SEA BENTHOS (4 credits). An introduction to the ecology, physiology, morphology and reproduction of marine invertebrates living at bathyal and abyssal depths. The cruise component includes opportunities to dive in a research submersible and assist internationally known scientists in experimental deep-sea research. Taught at HBOI.

BIO 5803 REPRODUCTIVE AND LARVAL ECOLOGY OF MARINE INVERTEBRATES (4 credits). Evolution of reproductive strategies, larval ecology, recruitment and invertebrate embryology. Lab emphasizes culture methods for embryos from major and minor phyla. Field work introduces *in situ* methods. Taught at HBOI.

BIO 5804, 5805, 5806 DIRECTED INDEPENDENT RESEARCH IN REPRODUCTIVE AND LARVAL ECOLOGY OF MARINE INVERTEBRATES (2, 3, 4 credits). Individual field, library and laboratory projects on embryology, recruitment, larval behavior, larval mortality or aspects of reproduction. Students learn to investigate ecological problems involving early life history stages. Taught at HBOI.

BIO 5807 MARINE PHOTOECOLOGY (3 credits). An intensive course on the effects of light on animal behavior in the ocean. Emphasis on developing a practical approach to dealing with the real-world problems and pitfalls associated with making accurate light measurements in biological experiments. The laboratory involves field work. Taught at HBOI.

BIO 5808 AQUACULTURE PROCESSES AND METHODS (4 credits). Overview of aquaculture development in the world, site selection, hatchery design, aquaculture engineering, water treatment and culture protocols. Hands-on experience with cultivation of marine plants and algae, finfish, molluscs and marine and freshwater crustaceans. Taught at HBOI.

BIO 5809 MARINE FISH CULTURE (3 credits). Techniques for spawning and rearing marine finfish. An overview of egg and larval characteristics, chemical and physical requirements, diseases and energetics, with detailed information on selected cultured finfish and live and formulated foods. One or two field trips. Taught at HBOI.

BIO 5810 A SURVEY OF BIOLOGICAL LITERATURE (2 credits). A survey of biological sciences literature including principles of literature review, computer search techniques, grantsmanship and manuscript preparation. Oral and written presentations of technical topics in biological sciences required. Taught at HBOI.

BIO 5811 DIRECTED INDEPENDENT RESEARCH IN MARINE INVERTEBRATES (2 credits). Individual field, library, and laboratory projects in invertebrate morphology, physiology, ecology, behavior and/or embryology. Students use a variety of techniques to investigate topics such as symbiosis, feeding mechanisms and recruitment. Taught at HBOI.

BIO 5812 BIOLOGY OF MARINE PLANTS (4 credits). An in-depth study of the biology of marine plants, including macroalgae, seagrasses and mangroves. Following a brief systematic overview, the emphasis will be on ecology and physiology, with concentration on what roles marine plants have in coastal and marine ecosystems. Includes lectures, group discussions and field trips. Taught at HBOI.

BIO 5813 THE BIOLOGY OF SEA TURTLES (3 credits). A lecture, lab and field course introducing the behavioral, ecological and evolutionary adaptations of sea turtles. Major topics include species identification, functional anatomy, eggs, nests and hatchings, orientation and navigation, threats to survival and conservation strategies. Taught at HBOI.

BIO 5814 FUNCTIONAL BIOLOGY OF MARINE INVERTEBRATES (4 credits). The functional morphology, physiology, behavior and reproduction of marine invertebrates, with emphasis on living organisms collected from a variety of habitats in southeast Florida, including coral reefs. Lectures, field trips, lab work and discussion of literature. Taught at HBOI.

BIO 5815 MOLECULAR STUDIES OF MARINE BIODIVERSITY (3 credits). Lab and field studies of intra- and intergenetic variation of selected marine organisms. Studies on tropical mangrove and coral reef habitats in the Indian River Lagoon and Andros Island, Bahamas, will be made in marine conservation context.

BIO 5816 FUNCTIONAL BIOLOGY OF MARINE ANIMALS (3 credits). This course covers physiological, morphological and sensory adaptations of marine animals to a variety of stressful environments, including temperature, pressure and salinity extremes, low oxygen layers and low light environments.

BIO 5990 BIOLOGICAL SCIENCES SEMINAR (0 credit). Presentation and discussion of current research by visiting scientists, university faculty and graduate students.

BIO 5991 BIOLOGICAL RESEARCH SEMINAR (1 credit). Presentation and discussion of current research by visiting scientists, university faculty and graduate students.

BIO 5995 BIOLOGICAL RESEARCH (3 credits). Research under the guidance of a faculty member of the biological sciences in a selected area of biology.

BIO 5997 INDUSTRIAL INTERNSHIP (6 credits). This course involves at least 400 hours of supervised research activities in an approved industrial summer internship program. *(Prerequisite: Acceptance into an industrial summer internship program approved through the program coordinator.)*

BIO 5998 BIOLOGICAL RESEARCH ROTATION (3 credits). Provides an opportunity to familiarize the student with research activities that are being carried out in various laboratories and to learn about special problems, techniques and experimental designs. The student completes two rotations of approximately seven to eight weeks in different laboratories.

BIO 5999 THESIS (3 credits). Research and preparation for the master's thesis.

BIO 6999 DISSERTATION (3 credits). Research and preparation for the doctoral dissertation. *(Prerequisite: Admission to candidacy for the doctoral degree.)*

BUSINESS FOUNDATIONS

BUF 5400 FOUNDATION IN LEGAL, ETHICAL AND SOCIAL ENVIRONMENT OF BUSINESS (1 credit). Preparation for BUS 5450. This course investigates technical, governmental and legal responsibilities of business in light of political, moral, social and jurisprudence considerations. Students learn to analyze and deal with fundamental issues concerning the nature of society. This credit cannot be used to fulfill M.B.A. curriculum requirements.

BUF 5410 FOUNDATION IN QUANTITATIVE METHODS (1 credit). Preparation for BUS 5411. Applications of quantitative management science techniques used to analyze managerial problems. Mathematical and statistical concepts used include differential and integral calculus, linear and matrix algebra, descriptive and inferential statistics and linear programming. This credit cannot be used to fulfill M.B.A. curriculum requirements.

BUF 5420 FOUNDATION IN MANAGERIAL ECONOMICS (1 credit). Preparation for BUS 5421. Determination, at the national level, of production, employment, inflation and growth. An international perspective is taken as macroeconomic policies are examined. The course also explores how changing macroeconomic conditions affect the international business environment. This credit cannot be used to fulfill M.B.A. curriculum requirements.

BUF 5430 FOUNDATION IN FINANCIAL ACCOUNTING (1 credit). Preparation for BUS 5431. A study of accounting concepts, the accounting model, measurement processes, financial statements, financial analysis, the accounting cycle, monetary and fixed assets, inventory, current and long-term liabilities and equity structures of partnerships, proprietorships and corporations. This credit cannot be used to fulfill M.B.A. curriculum requirements.

BUSINESS

BUS 1301 BASIC ECONOMICS (3 credits). An introduction to basic macro- and microeconomic concepts. Topics include the economic role of government, business and individuals. The course seeks to acquaint the student with sufficient material to understand major concepts and terminology used in our economy and the global community. Credit cannot be applied toward any School of Management degree. (SS)

BUS 1601 COMPUTER APPLICATIONS FOR BUSINESS (3 credits). An introduction to the use of PC applications across the major functional areas of

business. Topics include word processing, spreadsheets, database management, presentation software and use of the Internet and World Wide Web. (CL)

BUS 2211 INTRODUCTION TO FINANCIAL ACCOUNTING (3 credits). Introduces the financial accounting environment, financial statements, the accounting cycle, and the theoretical framework of accounting measurement, emphasizing mechanics, measurement theory and the economic environment. *(Prerequisite: MTH 1000 or MTH 1001 or MTH 1701 or MTH 1702.)*

BUS 2212 INTRODUCTION TO MANAGERIAL ACCOUNTING (3 credits). Continues BUS 2211, emphasizing concepts and issues associated with the accounting and management of businesses, with particular emphasis on understanding the role of accounting in product costing, costing for quality, cost-justifying investment decisions, and performance evaluation and control of human behavior. *(Prerequisite: BUS 2211.)*

BUS 2303 MACROECONOMICS (3 credits). This course introduces the concepts that aid in understanding both aggregate economic conditions and the policy alternatives designed to stabilize national economies. Issues discussed include the determination of GDP and national income, inflation, unemployment, monetary policy, economic growth and exchange rates. *(Prerequisite: MTH 1000 or MTH 1001 or MTH 1701 or MTH 1702.)* (SS)

BUS 2304 MICROECONOMICS (3 credits). This course introduces the neoclassical theory of price determination. Topics discussed include supply and demand analysis, production and cost theory, market structures, externalities and public goods, factor payments, income distribution and informational asymmetries. *(Prerequisite: MTH 1000 or MTH 1001 or MTH 1701 or MTH 1702.)* (SS)

BUS 2601 LEGAL AND SOCIAL ENVIRONMENTS OF BUSINESS (3 credits). This course investigates the operational responsibilities of business in light of political, moral, ethical, social and jurisprudential considerations.

BUS 2703 STATISTICS FOR BUSINESS (3 credits). Introduces methods of collection, analysis, and interpretation of data. Topics include data presentation; measures of central tendency and dispersion; probability distributions; hypothesis testing; confidence interval estimation; analysis of variance; regression and correlation. *(Prerequisite: MTH 1000 or MTH 1001 or MTH 1701.)*

BUS 3208 FEDERAL INCOME TAX 1 (3 credits). An introduction to federal income taxation of individuals and business organizations. Topics may include an overview of the federal tax system and tax law, taxable and tax-exempt income, deductible and nondeductible expenses, credits, the tax effects of property transactions and the tax implications of different organizational forms for a business. *(Prerequisite: BUS 2212.)*

BUS 3211 INTERMEDIATE ACCOUNTING 1 (3 credits). Study of financial reporting concepts and generally accepted accounting principles including the accounting cycle, current assets and current liabilities with emphasis on analyzing financial events and financial reporting alternatives. *(Prerequisite: BUS 2212.)*

BUS 3212 INTERMEDIATE ACCOUNTING 2 (3 credits). Continues the study of financial reporting concepts and generally accepted accounting principles, including plant assets, intangible assets, long-term liabilities, leases and stockholders' equity with emphasis on analyzing financial events and financial reporting alternatives. *(Prerequisite: BUS 3211.)*

BUS 3213 COST AND MANAGERIAL ACCOUNTING (3 credits). Preparation of accounting information for use in decision making. Topics may include cost behavior and cost-volume-profit analysis, cost allocations, determining the cost of a product of service, inventory control, performance evaluation, profitability analysis and use of accounting information in decision making and capital budgeting. *(Prerequisite: BUS 2212.)*

BUS 3214 ACCOUNTING INFORMATION SYSTEMS (3 credits). An examination of accounting information systems used in business organization. Included are discussions of accounting system design, implementation and control of computer-based systems for managerial planning, decision making and control of an enterprise. *(Prerequisite: BUS 2212.)*

BUS 3302 MONEY AND BANKING (3 credits). This course examines both the role of money and the nature of the Federal Reserve's management of the monetary system. Topics include interest rate determination, banking regulations, formulation and execution of Federal Reserve monetary policy and transmission channels through which monetary policy affects employment and inflation. *(Prerequisites: BUS 2303, BUS 2304.)*

BUS 3401 CORPORATE FINANCE (3 credits). This survey course examines the components of the three basic issues that embody the financial management of a firm: capital budgeting, capital structure and short-term finance and net working capital. Corporate governance, ethics and international issues are also examined. *(Prerequisite: BUS 2212.)*

BUS 3404 PERSONAL FINANCIAL PLANNING (3 credits). This course prepares students to maximize resources in lifelong personal financial planning that includes budgeting, credit management, insurance, home ownership, investments and tax, retirement and estate planning. *(Prerequisite: MTH 1000 or MTH 1001 or MTH 1701 or MTH 1702.)*

BUS 3501 MANAGEMENT PRINCIPLES (3 credits). This course is designed to help students acquire management knowledge and to develop management skills. It enables the student to understand management as it relates to both the employer and employee and to acquaint the student with the various schools of management and the philosophy of management.

BUS 3502 HUMAN RELATIONS IN MANAGEMENT (3 credits). Focuses on the behavior of individuals and groups in organizations. The course combines theory, research and applications as tools for improving effectiveness in organizations. Emphasis is placed on providing the conceptual knowledge and skills needed to perform effectively in organizations. Noncredit for business majors.

BUS 3503 HUMAN RESOURCES MANAGEMENT (3 credits). This course is designed to provide the student with the foundation to embark on further study in the area of human resource management. Topics include equal employment opportunity, staffing the organization, training and development, performance appraisals, compensating employees, safety and health issues and labor relations. *(Prerequisite: BUS 3501.)*

BUS 3504 MANAGEMENT INFORMATION SYSTEMS (3 credits). An examination of information systems used in business organizations. Included are discussions of system design, implementation and control of computer-based systems for managerial planning, decision making and control of an enterprise. *(Prerequisite: BUS 1601 or CSE 1301; corequisite: BUS 3501.)*

BUS 3510 ADVANCED COMPUTER BUSINESS APPLICATIONS (3 credits). This course uses Virtual Basic programming to provide an environment and language for building custom programs that extend Office's capabilities. Students learn to build customized business information systems that are fully integrated with standard Microsoft Office applications. *(Prerequisite: BUS 1601.)* (CL)

BUS 3512 SYSTEMS DESIGN AND DEVELOPMENT FOR BUSINESS (3 credits). Introduces students to systems development life cycle and other structured analysis and design techniques. Computer-aided software engineering tools and concepts support the design, development, implementation and documentation of software projects. A modern approach to systems analysis and design is presented. *(Prerequisite: BUS 3504.)*

BUS 3514 INTRODUCTION TO OPERATING SYSTEMS AND NETWORKS FOR BUSINESS (3 credits). Provides understanding of computer operating systems and networks while avoiding technical discussions covered in traditional operating systems and networking courses. Focus is on practical aspects of evaluating operating system and network alternatives for business. *(Prerequisite: BUS 3504.)*

BUS 3601 MARKETING PRINCIPLES (3 credits). An examination of the principles of marketing with emphasis on the marketing concept, functions, consumer behavior, market segmentation, marketing strategy, marketing mixes, market research, marketing legislation and marketing control, as well as providing a foundation for higher-level courses in marketing.

BUS 3603 ADVERTISING AND PROMOTION MANAGEMENT (3 credits). Covers various advertising techniques used in radio, TV, magazines, newspapers, direct mail and billboards, including the relative advantages of the different media. Also reviews the integration of advertising as one element within the promotional and marketing mix. *(Prerequisite: BUS 3601.)*

BUS 3704 QUANTITATIVE METHODS (3 credits). This course emphasizes management science and operations research techniques in solving managerial problems. Topics include linear programming, sensitivity analysis, transportation and assignment problems, inventory models, CPM and PERT analysis, decision analysis and queuing analysis. *(Prerequisites: BUS 2703 and MTH 1001 or MTH 1702.)*

BUS 3705 MANAGING SMALL BUSINESS (3 credits). Focuses on the practical aspects of successfully launching and managing a small-business enterprise. Relevant topics are presented that enable the student to better evaluate entrepreneurial opportunities, choose small business ownership, and to foresee potential pitfalls in operating a small-business entity. *(Prerequisite: Junior standing.)*

BUS 4211 INTERNAL AUDIT (3 credits). This course examines the professional responsibility of auditors; professional auditing standards and ethical responsibilities; audit programs, procedures and evaluation of evidence; review and evaluation of internal controls and risks; and effective audit communication. *(Prerequisite: BUS 3211.)*

BUS 4213 INTERMEDIATE ACCOUNTING 3 (3 credits). Continued study of financial reporting concepts and generally accepted accounting principles. Includes accounting for income taxes, accounting change and error analysis, pension accounting, other post-retirement employee benefit accounting, the statement of cash flows, and current topics. *(Prerequisite: BUS 3212.)*

BUS 4216 GOVERNMENTAL ACCOUNTING (3 credits). Principles and procedures of accounting, financial reporting, and budgeting for governmental and nonprofit entities. Topics include general funds and special revenue funds, capital project funds, enterprise funds, fiduciary funds, and accounting for colleges and universities, health care entities, and voluntary health and welfare organizations. *(Prerequisite: BUS 3212.)*

BUS 4284 ACCOUNTING PRACTICUM (3 credits). This real-world business experience complements the varied academic disciplines covered in the accounting curriculum. Minimum requirement include written and oral presentations, weekly summary reports and 150 hours working at a host employer's location. Must be taken in the final semester before graduation. For accounting majors only. *(Corequisite: BUS 4702.)*

BUS 4401 INVESTMENT ANALYSIS (3 credits). This course provides an introduction to investment analysis. Topics include capital market theory, portfolio theory and management, and derivatives. Current issues are discussed with respect to the securities markets. *(Prerequisite: BUS 3401.)*

BUS 4402 SPECIAL TOPICS IN FINANCIAL MANAGEMENT (3 credits). Special topics pertaining to the field of finance are covered, including the financial environment, financial tools and models, along with the advanced study of financial institutions and corporate finance. The course blends advanced theory with practical application. *(Prerequisite: BUS 3401.)*

BUS 4425 ENVIRONMENTAL AND URBAN PLANNING (3 credits). The course introduces students to the concepts and implementation strategies for productive urban and environmental planning. *(Prerequisite: BUS 3501 or senior standing.)*

BUS 4426 ENVIRONMENTAL AND RESOURCE ECONOMICS (3 credits). Introduction to the behavioral sources of environmental problems. Topics include property rights, externalities, cost-benefit analysis, depletable and recyclable resources, pollution control, population growth, sustainable development, ecotourism and environmental justice. *(Prerequisites: MTH 1001 or MTH 1702, senior standing.)*

BUS 4501 PRODUCTION/OPERATIONS MANAGEMENT (3 credits). This course introduces current theory and practice in production and operations management. Topics include forecasting, quality, product/service design, work methods, facility layout and location, scheduling, inventory and project management. *(Prerequisite: BUS 3704.)*

BUS 4502 ORGANIZATIONAL BEHAVIOR AND THEORY (3 credits). An overview of classical and contemporary approaches to organizational behavior and theory. Course focus progresses from the micro (individual behavior) to macro (organizational processes, effectiveness and change). Special attention is given to group behavior. *(Prerequisite: BUS 3501.)*

BUS 4503 BUSINESS ETHICS (3 credits). Applies moral reasoning to work-related challenges encountered in modern organizations. Students consider personal values and organizational values in examining organizational culture as a metaphor for the moral environment of organization. Cases from business and government are used to help students practice. *(Prerequisite: BUS 3501.)*

BUS 4504 SPECIAL TOPICS IN MANAGEMENT (3 credits). Topics include subjects or issues that are of current concern to business and government organizations. The course also provides students with an opportunity to study in greater depth, topics that may have been just surveyed in other courses. A research paper is normally a requirement. *(Prerequisite: BUS 3501.)*

BUS 4508 WEB BASED TECHNOLOGIES (3 credits). Concepts and practice of the implementation and delivery of Web-enabled information systems are explored. Combines concepts and principles from database design, programming and Internet technology. An implementation-focused course, with the major focus on hands-on design and development of Web-based information systems. *(Prerequisites: BUS 3512, COM 4026)*

BUS 4509 MANAGEMENT OF DATABASE SYSTEMS (3 credits). Concepts of database systems in a relational database management software (RDBMS) environment, emphasizing data modeling, design and implementation. The entity-relationship model is used for conceptual design and an RDBMS is used for physical design. Students are required to design a functional database. *(Prerequisite: BUS 3512.)*

BUS 4583 SENIOR PROJECT (3 credits). Provides the experience of applying the concepts, tools and techniques introduced in previous courses. Project teams analyze, develop and re-engineer the requirements for solving a real world management information system problem. *(Prerequisites: BUS 3510, BUS 4508, BUS 4509.)*

BUS 4584 MIS PRACTICUM (3 credits). This real-world MIS managerial experience complements the varied academic disciplines covered in the curriculum. Minimum requirements include written and oral presentations, weekly summary reports and 150 hours working at a host employer's location. Must be taken in the final semester before graduation. For business management information systems majors only. *(Corequisite: BUS 4702.)*

BUS 4601 MARKETING ANALYSIS AND STRATEGY (3 credits). Advanced study of the managerial aspects of marketing to include the decision areas pertaining to the marketing environment, opportunity analysis, marketing strategy and product, channel, price and promotional decisions. Cases are used to aid the student in experiencing real-life business situations. *(Prerequisites: BUS 3601, BUS 3703.)*

BUS 4605 RETAIL MANAGEMENT (3 credits). This course is presented from the point of view of a potential manager. The objective is to provide a foundation for management decision making in a rapidly changing retail environment. Topics include retail strategy, service retailing, legal and ethical issues, information systems, buyer behavior, merchandise management and international retailing. *(Prerequisites: BUS 3501, BUS 3601.)*

BUS 4684 SENIOR BUSINESS RESEARCH (3 credits). This course familiarizes the student with research methodologies commonly utilized in the social sciences. The essential goals of this course are to enable students to conduct research and interpret research findings and assess the quality of published research. *(Prerequisites: BUS 2703, senior standing.)*

BUS 4701 INTERNATIONAL BUSINESS (3 credits). This course introduces the environmental factors confronting managers in international operations: cultural, economic, legal, political and institutional determinants. Students examine problems associated with managing organizational, financial, marketing and production policies in a global marketplace. *(Prerequisites: BUS 3401, BUS 3501.)*

BUS 4702 BUSINESS STRATEGY AND POLICY (3 credits). Basic concepts and techniques used in formulating competitive strategy at the corporate, business and functional levels. Business simulation models provide quantitative aspects of strategy formulation in a competitive environment. Must be taken in the final semester before graduation. *(Prerequisites: BUS 4501, BUS 4701; corequisite: BUS 4284 or BUS 4584 or BUS 4784.)*

BUS 4784 BUSINESS PRACTICUM (3 credits). This real-world business experience complements the varied academic disciplines covered in the business curriculum. Minimum requirements include written and oral presentations, weekly summary reports and 150 hours working at a host employer's location. Must be taken in the final semester before graduation. For business majors only. *(Corequisite: BUS 4702.)*

BUS 4790 DIRECTED BUSINESS STUDY (3 credits). An in-depth study of topics or problems of current interest to practicing managers. Students are required to develop and present a formal report that includes a statement of the objectives of the study effort, survey of the literature, methodology, analysis, results, conclusions and, if appropriate, recommendations. *(Prerequisite: Associate dean approval.)*

BUS 5023 MANAGEMENT AND ADMINISTRATION OF CONTRACTS (3 credits). This course offers a comprehensive analysis of the procurement process and the contractual relationships resulting therefrom. Topics range from a history of procurement through considerations dealing with applicable laws, policies, regulations, methods of contracting, types of contracts and cost-pricing principles.

BUS 5032 PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS (3 credits). A survey of personnel management and industrial relations practices and procedures, including wage and salary considerations, employee benefits and incentives, and labor-management relations. Emphasis is placed on the individual within the organization and development of the human resource.

BUS 5070 SPECIAL TOPICS IN BUSINESS (3 credits). Independent study in some area of business that allows the student to work closely with a faculty member and probe a subject within the business discipline in greater depth than is normally possible in a regular class. A comprehensive term paper is required.

BUS 5211 PROCUREMENT AND CONTRACT MANAGEMENT (3 credits). An in-depth overview of the federal acquisition process and introduction to the basic concepts, policies and procedures incident to government contracting through the FAR and supplementing directives.

BUS 5213 CONTRACT CHANGES, TERMINATIONS AND DISPUTES (3 credits). Case studies and lectures used to provide an in-depth examination of the post-award management problems associated with contract administration. Contract changes, terminations and disputes, as well as other issues, are covered. *(Prerequisite: BUS 5211.)*

BUS 5214 COST PRINCIPLES, EFFECTIVENESS AND CONTROL (3 credits). Financial and accounting overview of government acquisition policy and procedures. *(Prerequisite: BUS 5430.)*

BUS 5217 CONTRACT AND SUBCONTRACT FORMULATION (3 credits). An in-depth study of the pre-award phase of the federal acquisition process. Class discussions and case studies are used to examine management problems from the perspective of the contracting office, requisitioner, courts, Congress and the contractors. *(Prerequisite: BUS 5211.)*

BUS 5218 CONTRACT NEGOTIATIONS AND INCENTIVE CONTRACTS (3 credits). A seminar in which negotiation concepts and techniques are explored, analyzed, discussed and then placed into practice using mock negotiations. All types of contracts are examined. *(Prerequisite: BUS 5211.)*

BUS 5220 CONTRACT MANAGEMENT RESEARCH SEMINAR (3 credits). Advanced research seminar devoted to study and research of topical government contract management issues. *(Prerequisite: BUS 5211.)*

BUS 5400 LEGAL, ETHICAL AND SOCIAL ENVIRONMENTS OF BUSINESS (3 credits). This course investigates technical, governmental and legal responsibilities of business in light of political, moral, social and jurisprudential considerations. Students learn to better analyze and deal with fundamental issues concerning the nature of society, both as citizens and administrators. Not for M.B.A. credit.

BUS 5410 QUANTITATIVE METHODS FOR BUSINESS DECISIONS (3 credits). This course presents applications of quantitative management science techniques used to analyze managerial problems. Mathematical and statistical concepts utilized include differential and integral calculus, linear and matrix algebra, descriptive and inferential statistics, and linear programming. Not for M.B.A. credit.

BUS 5411 STATISTICAL METHODS FOR BUSINESS (3 credits). Students learn to apply statistical methods to compare, examine and estimate the outcome of various management options. Topics include statistical estimation, hypothesis testing, regression analysis, ANOVA, correlation analysis, sampling, time-series, decision theory and use of SPSS. *(Prerequisite: BUS 5410.)*

BUS 5416 APPLIED QUANTITATIVE METHODS FOR BUSINESS DECISIONS (3 credits). This course includes practical applications of integer programming, goal programming, decision analysis, utility theory and forecasting models. Computer software and case studies are an integral part of this course. *(Prerequisite: BUS 5410.)*

BUS 5420 MACROECONOMICS (3 credits). This course is concerned with the determination, at the national level, of production, employment, inflation and growth. An international perspective is taken as macroeconomic policies are examined in the presence of both goods and asset flows. The course also explores how changing macroeconomic conditions affect the international business environment. Not for M.B.A. credit.

BUS 5421 MANAGERIAL ECONOMICS (3 credits). This course provides students with an understanding of the microeconomic forces that influence firm decision making. Areas of study include competitive markets and market failure, benefit-cost analysis, demand estimation and forecasting, decision making under risk and uncertainty, production and cost estimation, and market structure analysis. *(Prerequisite: BUS 5411.)*

BUS 5426 ENVIRONMENTAL AND RESOURCE ECONOMICS (3 credits). The course introduces the behavioral sources of environmental problems. Topics include property rights, externalities, cost-benefit analysis, depletable and recyclable resources, pollution control, population growth, sustainable development, ecotourism and environmental justice. *(Prerequisite: BUS 5410 or MTH 1001 or MTH 1702.)*

BUS 5427 INTERNATIONAL TRADE THEORY AND POLICY (3 credits). The objective of this course is to explore the three basic questions underlying the pure theory of trade: what are the patterns of trade; under what terms is exchange conducted; and what are the consequences of impeding the free flow of goods and services. *(Prerequisite: BUS 5421.)*

BUS 5430 FINANCIAL ACCOUNTING (3 credits). This course is a study of accounting concepts, the accounting model, measurement processes, financial statements, financial analysis, the accounting cycle, monetary and fixed assets, inventory, current and long-term liabilities and equity structures of partnerships, proprietorships and corporations. Not for M.B.A. credit.

BUS 5431 MANAGERIAL ACCOUNTING (3 credits). This course focuses on internal reporting to managers for use in planning and control, in making nonroutine decisions and in formulating major plans and policies. Coverage includes cost-volume-profit relationships, flexible budgets and standards, job order and process cost, and cost allocation and accumulation. *(Prerequisite: BUS 5430.)*

BUS 5432 ADVANCED ACCOUNTING (3 credits). The objective of this course is to provide the accounting major with an intensive exposure to the subject of accounting for business combinations in a format designed to further the student's ability to solve complex accounting problems involving worksheet techniques.

BUS 5433 ADVANCED PROBLEMS AND CURRENT TOPICS (3 credits). This course provides the accounting major with a broad exposure to advanced subjects in accounting; furthers the student's ability to analyze and present solutions to complex accounting problems as well as interpret and apply theoretical issues; and develops the student's communication and presentation skills.

BUS 5434 ADVANCED AUDITING THEORY AND APPLICATION (3 credits). The objective of this course is to provide the accounting major exposure to the theory of auditing and development of audit programs; procedures for obtaining audit evidence; auditor responsibilities under Securities and Exchange Commission requirements.

BUS 5435 TAX AND FINANCIAL ACCOUNTING RESEARCH (3 credits). This course examines the various primary and secondary authorities available for answering questions in the area of tax and financial reporting. The main purpose is not to teach the respective rules in the areas of tax and financial reporting, but to teach students how to find authoritative answers to problems in these areas.

BUS 5436 GOVERNMENTAL AND NONPROFIT ACCOUNTING (3 credits). Principles and procedures of accounting, financial reporting and budgeting for governmental and nonprofit entities. Topics include general funds and special revenue funds, capital project funds, enterprise funds, fiduciary funds, and accounting for colleges and universities, health care entities and voluntary health and welfare organizations.

BUS 5440 FINANCIAL MANAGEMENT (3 credits). This course is a study of the concepts and tools of corporate financial management and financial planning, including capital budgeting, capital structure and net working capital. Throughout the course, the importance of ethics in financial decision making is considered. *(Prerequisites: BUS 5410, BUS 5420, BUS 5430.)*

BUS 5446 INVESTMENT MANAGEMENT (3 credits). This course investigates the concepts, theories and techniques underlying the development of investment policies and strategies.

BUS 5447 ENTREPRENEURIAL FINANCE (3 credits). This course explores both the capital structure and financial needs of a start-up company. In addition, students gain an understanding of intellectual property, as well as the techniques used to value nonpublicly traded companies. *(Prerequisite: BUS 5440.)*

BUS 5450 ORGANIZATIONAL BEHAVIOR (3 credits). This course presents existing research, theories and models explaining how individual and group behavior and processes shape the internal dynamics of organizations. The course is intended to provide the foundation to understand contemporary debates concerning alternative organizational designs and management practices.

BUS 5456 EMPLOYMENT LAW (3 credits). This course examines federal regulations governing the relationship between employees and employers, and emphasizes their respective rights and responsibilities. Topics covered include discrimination, sexual harassment, affirmative action, privacy, terminating employees, compensation and benefit regulations, family leave, and safety and health. *(Prerequisite: BUS 5400.)*

BUS 5457 NEGOTIATION AND CONFLICT RESOLUTION (3 credits). This course examines the management of conflict in organizations at the level of the individual and the group. The course provides a background in alternatives to litigation models including negotiation, mediation, peer-review systems and arbitration. Simulation exercises are used to develop the student's skills in applying various forms of dispute resolution.

BUS 5458 LEADERSHIP THEORY AND EFFECTIVE MANAGEMENT (3 credits). Students learn the leadership process and techniques used to train leaders by reading the literature, analyzing cases of corporate leadership and participation in experiential exercises that are used in leadership training. The course also reinforces leadership skills of interpersonal interaction, written analysis and oral presentation. *(Prerequisite: BUS 5450.)*

BUS 5460 MANAGEMENT INFORMATION SYSTEMS (3 credits). The course addresses policy and management issues surrounding information systems in today's enterprises: strategic use, organizational impact, project management, human resource issues and other topics germane to understanding management information systems. *(Prerequisite: BUS 5400.)*

BUS 5461 PRODUCTION AND OPERATIONS MANAGEMENT (3 credits). This course covers the translation of product and service requirements into facilities, procedures and operating organizations. Topics include product design, production alternatives, facilities location and layout, resource requirements planning, quality control and project management. Live case analyses are used. *(Prerequisite: BUS 5411.)*

BUS 5465 MANAGING INFORMATION (3 credits). This course explores how organizations gather, represent, process and distribute information and knowledge to employees and customers. Core topics covered include knowledge management, knowledge workers' productivity, data and process modeling and data mining. Major issues in information processing and management at the individual, group and organizational levels are examined.

BUS 5466 MANAGING SYSTEMS (3 credits). This course provides a foundation of critical issues in the design and implementation of changes to business and information systems. It focuses on the interdependence of information technologies and organizational characteristics by examining the management of business process redesign, IT leadership, managing projects and changes, and managing enterprise information systems.

BUS 5467 MANAGING ELECTRONIC COMMERCE (3 credits). The Internet and global communication networks have emerged as powerful strategic assets, providing both increased opportunity and uncertainty for business leaders. The use of electronic commerce is examined from three perspectives: business to consumer, business to business and intra-organizational.

BUS 5470 MARKETING MANAGEMENT (3 credits). The tools and techniques of managing marketing activities as well as an analysis of the marketing process are examined. Emphasis is on decision making, the refinement of skills needed to recognize and solve marketing problems and effective communication of recommendations. Case analysis is used extensively. *(Prerequisites: BUS 5421, BUS 5431.)*

BUS 5476 STRATEGIC MARKETING (3 credits). Topics include strategic analysis of a firm's activities from the marketer's point of view. Attention is given to marketing strategy formulation, implementation and control. Strategies for the functional areas of marketing (product, pricing, distribution and promotion) and their relevant application to E-commerce are assessed. *(Prerequisite: BUS 5470.)*

BUS 5480 STRATEGIC MANAGEMENT (3 credits). In-depth analysis of industries and competitors, and how to build and defend competitive advantages in forming a successful competitive strategy. Case analysis and management simulation convey the multifunctional nature of decision making at the top management level. Live-case analyses augment the course. (Must be taken in the final semester prior to graduation.)

BUS 5486 INTERNATIONAL BUSINESS (3 credits). This course emphasizes economic, social, cultural, legal and environmental influences on the formulation and execution of the business policy of firms engaged in multinational business. Students explore the functions, problems and decision-making processes of multinational business organizations. *(Prerequisite: BUS 5440.)*

BUS 5487 NEW VENTURE DEVELOPMENT (3 credits). Students examine the critical elements of creating and nurturing new business ventures; screen and evaluate ideas in the formulation phase, identify sources of funds and determine means to obtain financing; select a start-up activity and prepare a business plan that represents the basis for forming a company.

BUS 5499 INTERNSHIP (3 credits). Students must register with the director of industry/education programs in the School of Management at least two months prior to the start of the semester. Minimum requirements include formal written and oral presentations, weekly summary reports and a minimum of 120 hours working at a host employer's location. *(Prerequisite: Associate dean approval.)*

BUS 5999 THESIS (0–6 credits). Students must register with the director of industry/education programs at least two months prior to the start of the semester. Minimum requirements include formal written and oral presentations, weekly summary reports and a minimum of 120 hours working at a host employer's location. *(Prerequisite: Associate dean approval.)*

CHEMICAL ENGINEERING

CHE 1101 INTRODUCTION TO CHEMICAL ENGINEERING 1 (2 credits). An introduction to the chemical engineering profession. The role of an engineer as a problem-solver dealing with multiple constraints is discussed. Process flowsheets and piping and instrumentation diagrams in Microsoft PowerPoint. Introduction to National Instruments LabView-based data acquisition and control. *(Prerequisite: Enrollment in the chemical engineering program.)* (CL)

CHE 1102 INTRODUCTION TO CHEMICAL ENGINEERING 2 (1 credit). Students apply the skills learned in CHE 1101 to a design problem presented in oral and written form. Statistics, plotting and spreadsheeting in Microsoft Excel, and curve fitting using Oakdale Engineering DataFit are also presented. *(Prerequisite: CHE 1101 or instructor approval.)* (CL)

CHE 2101, 2102 CHEMICAL PROCESS PRINCIPLES 1, 2 (3, 3 credits). Basic principles and calculations in chemical engineering; application of physical and chemical principles to solutions of elementary engineering problems; steady- and unsteady-state material and energy balances; heats of formation, reaction and mixing; equilibrium process models. *(Prerequisites: CHM 1102, MTH 1002.)*

CHE 3110 CHEMICAL ENGINEERING THERMODYNAMICS (3 credits). A study of the thermodynamics of chemical solutions and reactions. The course includes ideal and non-ideal solutions, phase equilibria, single- and two-phase reaction equilibria. *(Prerequisite: CHE 2102.)*

CHE 3131 TRANSFER PROCESSES 1 (4 credits). Topics include molecular-level transport mechanisms, bulk transport of momentum, pipe flow and pipeline design and optimization, rheological behavior and viscometry, compressible flow, pressure and flow measurement, flow through fixed and fluidized beds, two-phase flow, pumping, gas compression, mixing, boundary-layer theory. *(Prerequisite: CHE 2102; corequisite: MTH 2201.)*

CHE 3132 TRANSFER PROCESSES 2 (4 credits). Heat and mass transfer, including conduction, forced and free convection, radiation, condensation and evaporation; heat transfer in reaction vessels; humidification and water cooling; thermowell and heat exchanger design and optimization; diffusion and stagnant-layer approximation; two-film theory and surface renewal; adsorption dynamics. *(Prerequisite: CHE 3131; corequisite: CHE 3110.)*

CHE 3141 CHEMICAL PROCESS ANALYSIS (2 credits). Modeling of chemical processes is integrated with computational methods for analysis. Introduction to the use of MATLAB in numerical analysis of chemical engineering problems. Topics include solution of linear and nonlinear systems of equations, solution of ordinary differential equations, numerical integration, regression analysis. *(Prerequisite: CHE 2102; corequisite: MTH 2201.)*

CHE 3170 INTRODUCTION TO ENVIRONMENTAL ENGINEERING (3 credits). An introduction to the field of environmental engineering that emphasizes the interrelationships among air, water and land pollution and the effect of ecological, economic and sociological constraints on the solution of environmental problems. *(Prerequisite: Junior standing.)*

CHE 3175 ENVIRONMENTAL ENGINEERING LABORATORY (1 credit). A weekly laboratory that demonstrates the principles of pollution control processes discussed in CHE 3170. *(Prerequisite: CHE 3170.)*

CHE 3180 INTRODUCTION TO DESIGN PROJECTS (1 credit). Fundamentals of organization and execution of engineering design projects. Seminars and design exercises. Formulation of a group proposal. *(Corequisite: CHE 3132.)*

CHE 3260 MATERIALS SCIENCE AND ENGINEERING (3 credits). A study of the relationships between materials processing, composition and structure, properties and performance. Includes electrical, mechanical and chemical properties of metals, ceramics, polymers, electronic materials and composites, as well as coating and protection materials. *(Prerequisites: CHM 1101, MTH 1002, PHY 1001.)*

CHE 3265 MATERIALS LABORATORY (1 credit). A laboratory course to complement CHE 3260. Illustration of materials processing, measurement and analysis of materials properties. *(Prerequisite: PHY 2091; corequisite: CHE 3260.)*

CHE 4105 UNIT OPERATIONS LABORATORY (2 credits). A weekly laboratory that demonstrates the practical applications of theories presented in CHE 3131, CHE 3132, and other upper-level chemical engineering courses. *(Prerequisite: CHE 3132.)*

CHE 4121 CHEMICAL PROCESS CONTROL (4 credits). A study of dynamic modeling and control of chemical processes. Topics include transfer function development, synthesis and tuning of feedback controllers, closed-loop stability analysis, frequency response, advanced control techniques. *(Prerequisite: CHE 3141.)*

CHE 4131 SEPARATION PROCESSES (3 credits). Fundamental principles and design of separation processes; batch and continuous flow, concurrent and countercurrent cascade; plate and packed towers; distillation, absorption, extraction; distillation column design and optimization. *(Prerequisite: CHE 3132.)*

CHE 4151 CHEMICAL ENGINEERING REACTOR DESIGN (3 credits). An introduction to the modeling and design of chemical reactors, including development of rate expressions for chemical reactions and analysis of experimental kinetic data. Emphasis is placed on the modeling of ideal mixed-flow and plug-flow reactors. *(Prerequisite: CHE 3131.)*

CHE 4181, 4182 CHEMICAL ENGINEERING PLANT DESIGN 1, 2 (3, 3 credits). Technical and economic analyses leading to design of complete facilities for chemical production. Process flow sheets and process integration are investigated, along with material and energy balances; process equipment selection and plant layout; use of computer-aided design software for process analysis; cost analysis; and a design report. *(Prerequisite: CHE 3132 ; corequisite: CHE 4131.)*

CHE 4206 UNIT OPERATIONS LABORATORY 2 (3 credits). Individual student laboratory projects. Each student is required to design and assemble experimental apparatus, define methods of data measurement and analysis, determine appropriate values for operating parameters and prepare a written report. *(Prerequisite: CHE 4105.)*

CHE 4230 SPECIAL TOPICS IN SEPARATION PROCESSES AND UNIT OPERATIONS (3 credits). A continuation of CHE 4131 emphasizing topics in the area of separation processes and unit operations. Topics may include absorption, drying, gas cleaning, cyclones, chromatography, membranes; particle filtration, microfiltration, ultra filtration, reverse osmosis; heat tracing, mixing, cooling towers, gas compressors. *(Prerequisite: CHE 4131.)*

CHE 4250 INTRODUCTION TO BIOCHEMICAL ENGINEERING (3 credits). Introduction to modeling and design of biochemical reactors, including development of rate expressions for biochemical (metabolic) reactions and cell growth. Separation and purification of reaction products. System optimization. *(Prerequisite: CHE 4151.)*

CHE 4281, 4282 INDEPENDENT STUDY IN CHEMICAL ENGINEERING (1, 2 credits). An in-depth study of a specialized area of chemical engineering. For each offering, subject matter depends on the expertise of the instructor. This course is limited in scope or duration. For chemical engineering majors only. *(Prerequisite: Senior standing or department head approval.)*

CHE 4284 INDUSTRIAL SAFETY (3 credits). Safety considerations in design and operation of industrial and manufacturing facilities; toxicology, fire and explosion hazards; and OSHA standards. *(Prerequisite: Senior standing in science or engineering.)*

CHE 4288 PETROLEUM PROCESSING (3 credits). Focuses on the properties of crude oil and each of a refinery's products, the details of each refinery operation, and the effects of economic considerations on each refinery operation. *(Prerequisite: CHE 4181 or graduate standing.)*

CHE 4291, 4292 INDEPENDENT STUDY IN CHEMICAL ENGINEERING 1, 2 (3, 3 credits). Individual projects under the direction of faculty member in the chemical engineering program. Projects include a literature review, project proposal, process design or research and written and oral reports. *(Prerequisite: Senior standing or department head approval.)*

CHE 4560 POLYMERIC MATERIALS (3 credits). General classes of polymers and their patterns of behavior; polymer synthesis and processing, polymer rheology and physical properties; and large-scale production problems. *(Prerequisite: CHE 3260.)*

CHE 4571 HAZARDOUS WASTE SYSTEMS DESIGN (3 credits). A study of equipment design and processes for the treatment and disposal of hazardous waste. Topics include chemical, physical and biological treatment; thermal incineration; and land disposal. *(Prerequisite: CHE 3170 or CVE 4050.)*

CHE 4591, 4592 SPECIAL TOPICS IN CHEMICAL ENGINEERING (3, 3 credits). An in-depth study of a specialized area of chemical engineering. For each offering, the subject matter depends on the expertise of the instructor. The specific course description is made available prior to each offering. *(Prerequisite: Instructor approval.)*

CHE 5100 CHEMICAL ENGINEERING SEMINAR (0 credit). Weekly seminar topics on chemical engineering research and practice. Presentations are made by students, faculty and visitors.

CHE 5101, 5102 TRANSPORT PHENOMENA 1, 2 (3, 3 credits). The fundamental principles of momentum, heat and mass transfer, and their application to chemical systems. These principles include derivation and analysis of the Navier-Stokes equations, the energy equations and the equations for mass transport; flows at small Reynolds Number and Stokes Law; the method of matched asymptotic expansions; and boundary-layer theory. Also included is the study of turbulence and multiphase phenomena.

CHE 5110 EQUILIBRIUM THERMODYNAMICS (3 credits). Advanced topics in phase and chemical equilibria; relationships between equilibrium properties and molecular-based theories of solutions; and fugacity coefficients, activity coefficients, phase composition.

CHE 5120 PROCESS CONTROL (3 credits). Analysis, design, stability and sensitivity; and optimization and transient response of staged, continuous and batch operations. Emphasis is on common mathematical and physical foundations, and automatic control systems.

CHE 5150 CHEMICAL REACTOR DESIGN (3 credits). Design of nonideal reactors; unsteady-state operation and stability analysis; multiphase reactors; and heat, mass and momentum transfer in reacting systems. *(Prerequisite: CHE 4151 or graduate standing in chemical engineering.)*

CHE 5230 SEPARATION PROCESSES (3 credits). Analysis of mass transfer in binary and multicomponent systems. Mathematical modeling of adsorption, extraction, reverse osmosis and other selected processes. *(Prerequisite: CHE 4131 or graduate standing in chemical engineering.)*

CHE 5252 CATALYTIC REACTOR DESIGN (3 credits). Modeling and design of reaction systems for catalytic and other surface reactions. Reactor stability; transient operation; industrial applications. *(Prerequisite: CHE 4151 or graduate standing in chemical engineering.)*

CHE 5291, 5292 SPECIAL TOPICS IN CHEMICAL ENGINEERING (3, 3 credits). An in-depth study of a specialized area of chemical engineering. For each offering, the subject matter depends on the expertise of the instructor. Specific course description is available prior to each offering of a course with this designation. *(Prerequisites: Instructor approval.)*

CHE 5567 NANOTECHNOLOGY (3 credits). Understanding and development of materials synthesis-structure-function relationships with emphasis on bulk and surface analytical techniques, catalyst synthesis methods, carbon nanofibers, hydrogen storage, lab-on-a-chip, molecular self-assembly and molecular recognition. *(Prerequisite: CHM 2002 or CHE 3260 or graduate standing.)*

CHE 5571 PHYSICAL/CHEMICAL PROCESSES FOR WATER TREATMENT (3 credits). Modeling and design of physical and chemical processes for water treatment: coagulation, sedimentation, filtration, chemical precipitation, adsorption, ion exchange, reverse osmosis, chemical oxidation. *(Prerequisite: CHE 3170 or graduate standing.)*

CHE 5572 BIOLOGICAL PROCESSES FOR WATER TREATMENT (3 credits). Modeling and design of biological processes used for water and wastewater treatment: aerobic and anaerobic treatment, sludge digestion, nutrient removal. Disinfection. *(Prerequisite: CHE 3170 or graduate standing.)*

CHE 5999 THESIS (0–3 credits). Individual research under the direction of a member of the graduate faculty on a selected topic. Six hours of thesis are required for the master's degree.

CHEMISTRY

CHM 1100 INTRODUCTION TO CHEMISTRY (3 credits). An introduction to the basic concepts of modern chemistry, which is designed to provide an adequate chemistry background for the successful completion of CHM 1101.

CHM 1101 GENERAL CHEMISTRY 1 (4 credits). This course covers fundamental principles of modern chemistry, including stoichiometry, properties of gases, liquids and solids, thermochemistry, atomic structure, properties of solutions and equilibrium, with an associated laboratory component.

CHM 1102 GENERAL CHEMISTRY 2 (4 credits). A continuation of CHM 1101, including acids and bases, thermodynamics, electrochemistry, kinetics, descriptive chemistry of metals and nonmetals, coordination chemistry, nuclear chemistry and introduction to organic chemistry, with an associated laboratory component. *(Prerequisite: CHM 1101.)*

CHM 2001, 2002 ORGANIC CHEMISTRY 1, 2 (3, 3 credits). The fundamentals of structure and reaction mechanisms are studied in these courses. Topics include a review of bonding, preparations and reactions of organic substances. *(Prerequisite: CHM 1102.)*

CHM 2011, 2012 ORGANIC CHEMISTRY LABORATORY 1, 2 (2, 2 credits). An introduction to organic chemistry techniques for laboratory operations-preparation, reaction and analysis of organic compounds. *(Corequisites: CHM 2001 for CHM 2011 and CHM 2002 for CHM 2012.)*

CHM 3001 PHYSICAL CHEMISTRY 1 (3 credits). Topics include fundamental principles of chemical phenomena; thermodynamics, equilibria and states of matter; and chemical kinetics. *(Prerequisites: CHM 2002, MTH 2001, PHY 2002.)*

CHM 3002 PHYSICAL CHEMISTRY 2 (3 credits). A continuation from CHM 3001, including chemical dynamics, quantum mechanics, atomic structures, chemical bonding and spectroscopy. *(Prerequisite: CHM 3001.)*

CHM 3011, 3012 PHYSICAL CHEMISTRY LABORATORY 1, 2 (2, 2 credits). Experiments illustrating the principles and techniques of physical chemistry studied in CHM 3001 and CHM 3002. *(Prerequisite: CHM 2011; corequisite: CHM 3001 for CHM 3011 and CHM 3002 for CHM 3012.)*

CHM 3301 ANALYTICAL CHEMISTRY 1 (3 credits). Focuses on the principles of modern analytical methods, including chemical separation and quantitative measurements, important equilibrium considerations and the treatment of experimental data. *(Prerequisite: CHM 2002.)*

CHM 3302 ANALYTICAL CHEMISTRY 2/INSTRUMENTATION (3 credits). Principles of modern chemical instrumentation, focusing on spectroscopy. *(Prerequisites: CHM 2202, CHM 3301; corequisite: CHM 3002.)*

CHM 3311 ANALYTICAL CHEMISTRY LABORATORY 1 (2 credits). Students conduct experiments in quantitative analytical techniques. *(Corequisite: CHM 3301.)*

CHM 3312 ANALYTICAL CHEMISTRY 2/INSTRUMENTATION LABORATORY (2 credits). Quantitative and instrumental analysis techniques to accompany CHM 3302. *(Prerequisite: CHM 3311; corequisites: CHM 3002, CHM 3302.)*

CHM 4001 INORGANIC CHEMISTRY 1 (3 credits). Basic theoretical concepts of inorganic chemistry as related to elementary structure and bonding, stressing representative elements; and donor-acceptor concepts, symmetry and group theory, and an introduction to transition metal chemistry. *(Prerequisite: CHM 3002.)*

CHM 4002 ADVANCED INORGANIC CHEMISTRY (3 credits). Topics include structure and stability in coordination chemistry, spectroscopy of transition metal compounds; descriptive transition metal chemistry and reactions of metal compounds; lanthanides and actinides; and an introduction to bio-inorganic chemistry. *(Prerequisite: CHM 4001.)*

CHM 4111 ADVANCED PHYSICAL CHEMISTRY (3 credits). Selected topics in physical chemistry, including statistical mechanics and molecular modeling. *(Prerequisite: CHM 3002.)*

CHM 4222 ENVIRONMENTAL CHEMISTRY (3 credits). Basic principles of inorganic and organic chemistry applied to natural systems, including applications of terrestrial, aquatic and atmospheric chemistry. *(Prerequisite: CHM 2002.)*

CHM 4304 ADVANCED ANALYTICAL CHEMISTRY (3 credits). Topics include electrode processes, thermodynamic and kinetic considerations, electrochemical methods and recent research articles. *(Prerequisites: CHM 3002, CHM 3302.)*

CHM 4500 ADVANCED ORGANIC CHEMISTRY (3 credits). Fundamentals of physical organic chemistry, including stereochemistry and structure, methods of mechanistic elucidation and selected mechanistic descriptions. *(Prerequisite: CHM 3002.)*

CHM 4550 POLYMER CHEMISTRY (3 credits). An introduction to classes of polymers, their general patterns of behavior, polymer synthesis, physics of the solid state, polymer characterization, polymer rheology and polymer processing. *(Prerequisite: CHM 3002.)*

CHM 4611 ADVANCED LABORATORY TECHNIQUES 1 (2 credits). Students study advanced laboratory techniques with emphasis on analytical and inorganic methodology. *(Prerequisite: Senior standing in chemistry.)*

CHM 4800, 4801 UNDERGRADUATE RESEARCH (3, 3 credits). Senior research is conducted under the direct supervision of a chemistry department faculty member. *(Prerequisite: Approval of the chemistry department head.)*

CHM 4900 CHEMISTRY SEMINAR (0 credit). Presentations on topics of current chemical research interest by students, faculty and distinguished visiting scientists.

CHM 4901 SENIOR RESEARCH SEMINAR (1 credit). Student presentations of the results of their senior research projects. *(Corequisite: CHM 4911.)*

CHM 4910, 4911 SENIOR THESIS IN CHEMISTRY (3, 3 credits). Research conducted under the direction of a chemistry department faculty member. The project includes the preparation and department approval of a written senior thesis during the third semester of study. *(Prerequisite: Senior standing in the research chemistry option.)*

CHM 5002 ADVANCED INORGANIC CHEMISTRY (3 credits). Topics include structure and stability in coordination chemistry, spectroscopy of transition metal compounds; descriptive transition metal chemistry and reactions of metal compounds; lanthanides and actinides; and an introduction to bio-inorganic chemistry.

CHM 5017 PHYSICAL METHODS IN INORGANIC CHEMISTRY (3 credits). Students investigate the application of principles of structure and bonding in inorganic chemistry and the physical methods used to elucidate these principles, such as electronic and vibrational spectroscopy, diffraction techniques and magnetic resonance techniques. *(Corequisite: CHM 5002.)*

CHM 5018 SPECIAL TOPICS IN INORGANIC CHEMISTRY (3 credits). Advanced topics in inorganic chemistry chosen from the areas of organometallic compounds, compounds of the less familiar elements, ligand field theory and advanced concepts in coordination chemistry. *(Prerequisite: CHM 5002.)*

CHM 5095 CHEMICAL RESEARCH PROJECTS (3 credits). Research projects under the direction of a member of the chemistry faculty in a selected area of chemistry.

CHM 5111 ADVANCED PHYSICAL CHEMISTRY (3 credits). Selected topics in physical chemistry, including statistical mechanics and molecular modeling.

CHM 5112 SPECIAL TOPICS IN PHYSICAL CHEMISTRY (3 credits). Selected topics in physical chemistry. *(Prerequisite: CHM 5111.)*

CHM 5114 APPLIED OPTICAL SPECTROSCOPY (3 credits). The applications of spectroscopy to chemistry, including photochemistry. *(Prerequisite: CHM 5111.)*

CHM 5119 CHEMICAL DYNAMICS (3 credits). Experimental methods in chemical kinetics, rate laws and mechanisms, statistical and dynamic theories of reaction rates and the application of the principles and techniques of kinetics to a variety of systems.

CHM 5304 ADVANCED ANALYTICAL CHEMISTRY (3 credits). Topics include electrode processes, thermodynamic and kinetic considerations, electrochemical methods and recent research articles.

CHM 5500 ADVANCED ORGANIC CHEMISTRY (3 credits). Fundamentals of physical organic chemistry, including stereochemistry and structure, methods of mechanistic elucidation and selected mechanistic descriptions.

CHM 5501 INTERPRETATION OF CHEMICAL SPECTRA (3 credits). A study of modern spectroscopic methods in organic chemistry. It includes the interpretation of 1- and 2-D spectra obtained by ultraviolet, infrared, proton and carbon-13 nuclear magnetic resonance and mass-spectral techniques.

CHM 5503 ORGANIC SYNTHESIS (3 credits). Students study reagents, their capabilities and limitations, and the art of using these reagents in the design of an organic synthesis. *(Prerequisite: CHM 5500.)*

CHM 5504 THEORETICAL ORGANIC CHEMISTRY (3 credits). Topics include molecular-orbital treatments of organic molecules, including basic Huckel theory; aromaticity; reactions influenced by orbital symmetry.

CHM 5507 NATURAL PRODUCTS (3 credits). A survey of organic natural products, with emphasis on marine organisms. Major structural families and their sources are outlined. The role of natural products in the environment, approaches to their analysis and structure elucidation, and biosynthesis of major classes of secondary metabolitesis are also included.

CHM 5520 MEDICINAL CHEMISTRY (3 credits). The study of the chemical nature of physiological mediators, the hormones which mediate life processes. Includes isolation, structure determination and synthesis of the mediators. Preparation of inhibitors or activators of enzymes which work on those mediators or agonists or antagonists to the mediators to correct imbalances which cause disease.

CHM 5550 POLYMER CHEMISTRY (3 credits). An introduction to classes of polymers, their general patterns of behavior, polymer synthesis, physics of the solid state, polymer characterization, polymer rheology and polymer processing.

CHM 5900 CHEMISTRY GRADUATE SEMINAR (0 credit). Seminars on current research in chemistry.

CHM 5901 CHEMISTRY THESIS SEMINAR (1 credit). The student presents a seminar on the results of thesis research. *(Prerequisite: Student must be in final semester of thesis research.)*

CHM 5999 THESIS (0–6 credits). Individual research for the master's degree under the direction of a member of the graduate faculty in chemistry.

CHM 6095 CHEMICAL RESEARCH (1–6 credits). Research under the guidance of the chemistry faculty. The area of research chosen may lead to preparation of a research proposal for dissertation work. *(Prerequisite: Doctoral student standing in chemistry.)*

CHM 6999 DISSERTATION (0–6 credits). Research and preparation of the doctoral dissertation. *(Prerequisite: Admission to candidacy for the doctoral degree.)*

COMMUNICATION

COM 1100 BASIC WRITING SKILLS (3 credits). Grammar and syntax and their application to the writing process. Students learn correct spelling, master punctuation rules, construct accurate sentences and develop coherent paragraphs. No credit toward graduation is earned. This course is required for students with low placement test scores.

COM 1101 COMPOSITION AND RHETORIC (3 credits). The first of two courses in college-level writing skills, Composition and Rhetoric focuses on writing essays using various rhetorical modes: persuasion, description, comparison and analysis. Basic methods of library research are presented, as well as the MLA documentation system. Students write one research paper and several essays. *(Prerequisite: COM 1100 or passing grade on the placement test.)*

COM 1102 WRITING ABOUT LITERATURE (3 credits). The second of two courses in college-level writing skills. This course focuses on reading and analyzing poems, plays and short works of fiction. Students write several essays and one research paper on literary topics. *(Prerequisite: COM 1101.)*

COM 2012 RESEARCH SOURCES AND SYSTEMS (1 credit). Designed to acquaint students with a variety of library services, sources and systems, this course emphasizes research strategies and tools useful in each student's field of study, as well as the use of print, internet and other electronic resources. *(Prerequisite: COM 1102.)*

COM 2150 CREATIVE WRITING (3 credits). Introduces the forms and techniques of writing creatively. Following a workshop structure, students present creative work for criticism by fellow students in a supportive environment firmly enlightened by attention to the best traditions of English literature. *(Prerequisite: COM 1102.)*

COM 2223 SCIENTIFIC AND TECHNICAL COMMUNICATION (3 credits). Practice in the technical and scientific writing style and format, including gathering and using data to prepare reports. Included are abstracts, reports, letters, technical descriptions, proposals and at least two oral presentations. *(Prerequisite: COM 1102.)* (COM)

COM 2224 BUSINESS AND PROFESSIONAL WRITING (3 credits). Designed for the future business professional, this course includes business research methods, report writing, business correspondence and communication in the workplace. Analytical, informational, routine and special reports are covered. *(Prerequisite: COM 1102.)* (COM)

COM 2241 JOURNALISM (3 credits). This course presents the methods and practice of news gathering, news writing and news editing. *(Prerequisite: COM 1102.)* (COM)

COM 2370 SPEECH (3 credits). An introduction to the concepts and techniques of effective public speaking and small group communication. Students prepare, organize and deliver different kinds of short speeches. *(Prerequisite: COM 1101.)* (COM)

COM 2425 INTRODUCTION TO COMMUNICATION (3 credits). Introductory course designed to familiarize students with the process of communication in interpersonal small group, organizational, mass and intercultural contexts. Introduces students to the study of communication and provides the background for understanding complex communication processes. *(Prerequisite: COM 1101.)* (COM)

COM 2501 INTRODUCTION TO VISUAL COMMUNICATION (3 credits). Designed for communication majors, this course introduces students to the principles and techniques of visual communication. Emphasis is on manipulating form to fit function as the student designs, implements and evaluates goal-oriented communication projects.

COM 2502 LAYOUT AND DESIGN (3 credits). This course covers the principles, techniques, and vocabulary required of designers of print communication projects, including a thorough understanding of the technology of offset printing. Course emphasis is on skills required in designing for print.

COM 2503 PHOTOGRAPHY (3 credits). Prepares students in the basics of commercial photography. It includes basic camera operation, use of light meters, film types and composition of pictures. It also includes lectures, demonstrations, examples and critiques of students' work. *(Prerequisite: COM 2223 or COM 2224.)* (COM)

COM 3070 PROFESSIONAL COMMUNICATION FOR EXECUTIVES (3 credits). Designed for future executives, this course covers interpersonal and group communication in the professions. Students prepare and deliver a variety of career-related presentations. (COM)

COM 3085 SPECIAL TOPICS IN APPLIED COMMUNICATION (3 credits). A study of an emerging and significant issue within the field of communication. Topics might be concerned with interpersonal persuasion, mass communication, media law, or advances in publications software. Course topics are announced prior to registration.

COM 3185 SPECIAL TOPICS IN COMPOSITION (3 credits). A study of a particular facet of English composition. Course topics are announced prior to registration.

COM 3210 EDITING (3 credits). Grammatical terminology and concepts essential to editing, as well as copy editing techniques for hardcopy and online materials. This course also includes the study of varied editorial roles and responsibilities in general and technical editing, as well as major style-guide requirements. *(Prerequisite: COM 2223 or COM 2224.)*

COM 3223 ADVANCED TECHNICAL WRITING (3 credits). Topics vary and may include, for example, online documentation, SGML, XML, proposal writing, scriptwriting, and writing for Web-based training. *(Prerequisite: COM 2223 or COM 2224.)* (COM)

COM 3231 WRITING ABOUT SCIENCE (3 credits). Designed for both communication and science majors, this course covers the methods of scientific writing, including ways in which complex scientific topics can be conveyed to popular audiences. It also includes more traditional types of scientific writing such as scientific journal articles and proposals. (COM)

COM 3250 SCRIPTWRITING (3 credits). An introduction to writing script for film, emphasizing the importance of story, substance and structure. Documentary film writing for television and video will be a component of the course. *(Prerequisite: COM 1102.)* (COM)

COM 3285 SPECIAL TOPICS IN PROFESSIONAL WRITING AND EDITING (3 credits). The study of a particular subject relating to professional writing and editing. Course topics are announced prior to registration.

COM 3385 SPECIAL TOPICS IN ORAL COMMUNICATION (3 credits). An intensive study in one aspect of oral communication. Course topics are announced prior to registration.

COM 3425 MASS COMMUNICATION (3 credits). A study of media influence from political, social and cultural perspectives. The course provides an examination of theory and media effects in its survey of film, print, broadcast and new technologies. Discussions will include the role of media in society and culture, issues related to the First Amendment and the implications of media mergers. (HU/SS)

COM 3440 PUBLIC RELATIONS (3 credits). A study of communication principles and the practices of developing good will between a person, firm or institution and the public; and the means of gaining publicity and influencing people. Students analyze specific case studies and propose appropriate strategies and campaigns. *(Prerequisite: COM 2223 or COM 2224.)*

COM 3485 SPECIAL TOPICS IN THEORETICAL COMMUNICATION (3 credits). A study in one aspect of theoretical communication. Course topics are announced prior to registration.

COM 3585 SPECIAL TOPICS IN VISUAL COMMUNICATION (3 credits). An in-depth study of one or more forms of visual communication. Course topics are announced prior to registration. *(Prerequisite: COM 2501.)*

COM 4000 THESIS PREPARATION (3 credits). This course is designed for students who are beginning to write a thesis or dissertation. Material covered includes sentence and paragraph strategies, tone and style, documentation, editing and revising. Noncredit for communication majors. *(Prerequisite: Demonstrated writing ability by examination.)*

COM 4026 PUBLISHING AND THE INTERNET (3 credits). This course concerns current issues and applications of online and Internet publishing. Topics include researching, designing and authoring effective online documents and presentations. Term work includes building an electronic portfolio. *(Prerequisites: COM 2223 or COM 2224, CSE 1301.)*

COM 4050 INDEPENDENT STUDY (3 credits). This course allows senior communication majors the opportunity to pursue advanced study in a communication-related topic of interest. Topics are approved and supervised by department faculty. A formal paper is required. *(Prerequisite: Program chair approval.)*

COM 4085 COMMUNICATION TECHNOLOGY: ISSUES AND APPLICATIONS (1–3 credits). Designed for communication majors, this course offers a study of a current topic (or topics) related to technology and communication. Course content varies from term to term.

COM 4090 COMMUNICATION INTERNSHIP (6 credits). Students work under the direct supervision of a business or industry professional and in coordination with the chair of the undergraduate communication program. Students with 99 or more semester hours and a 3.25 GPA in communication courses may apply. *(Prerequisite: Program chair approval.)*

COM 4424 ADVANCED BUSINESS AND PROFESSIONAL COMMUNICATION (3 credits). Topics vary and may include design and composition of corporate annual reports, instructional design for training seminars, scriptwriting for video production, advanced managerial report writing, proposal and grant writing, trade show promotion and preparation and corporate image design. *(Prerequisite: COM 2223 or COM 2224.)*

COM 4430 RESEARCH METHODS AND MATERIALS IN TECHNICAL AND PROFESSIONAL COMMUNICATION (3 credits). An in-depth examination of the methods of data collection and data analysis, and the research materials used in conducting research in communication. *(Prerequisite: COM 2223 or COM 2224.)*

COM 5000 INTRODUCTION TO TECHNICAL AND PROFESSIONAL COMMUNICATION (3 credits). Provides background to those students with limited experience in communication. Explores issues and key documents including abstracts, reports, proposals, and print and online resources in the field. Includes an introduction to document design.

COM 5002 WRITING FOR SPECIFIC PURPOSES (3 credits). Applies contemporary rhetorical strategies to the construction of written documents in a variety of discourse forms. Students analyze and generate professional-level articles, essays, manuals, proposals and reports to practice and develop expertise in specific genres.

COM 5050 THEORIES OF HUMAN COMMUNICATION (3 credits). Examines the full range of communication theories related to such areas as interpersonal communication, rhetoric, small-group communication, mass communication, linguistics, persuasion and multiculturalism.

COM 5102 RESEARCH METHODS AND MATERIALS IN TECHNICAL AND PROFESSIONAL COMMUNICATION (3 credits). An in-depth examination of the methods of data collection and data analysis, and the research materials used in conducting research in the discipline of technical and professional communication *(Prerequisite: Nine graduate-level credits or program chair approval.)*

COM 5144 SCIENCE JOURNALISM (3 credits). Examines science writing for various audiences, techniques and rhetorical strategies. The main thrust is on writing, but also focuses on the function and role of the mass media in the coverage of science, medicine and technology, with attention to communication theory and constraints placed on coverage by the media.

COM 5247 TECHNICAL EDITING (3 credits). An advanced course in the theory and practice of editing technical, scientific and professional prose. Students are introduced to the principles of copy and rewrite editing, techniques of production and essentials of preparing manuscripts for publication. Students develop and refine their professional skills via hands-on, decision-intensive editorial projects.

COM 5249 DOCUMENT DESIGN (3 credits). A course in visual design, with an emphasis on information accessibility, organizational purpose and reader/user needs. Working individually and as members of teams, students draft, design and critique technical documents of various kinds (e.g., manuals, software documentation, tutorials, technical reports and brochures).

COM 5250 PUBLIC RELATIONS (3 credits). A study of communication principles and strategies applied to the development of goodwill between a firm or institution and its publics. Students analyze cases and develop a public relations campaign.

COM 5251 ORAL PRESENTATION FOR BUSINESS AND TECHNICAL AUDIENCES (3 credits). The examination and practice of oral presentation techniques for business and technical audiences in various professional and organizational contexts, including audience analysis, planning and organizing content, audiovisual and graphic dimensions of oral presentations, handling questions and evaluative criteria.

COM 5252 SEMINAR IN MARKETING COMMUNICATION (3 credits). Introduces students to the theory and practice of conducting effective marketing communication campaigns and the underlying processes involved in promotional messages. Course materials focus on current advertising and persuasive communication strategies that achieve desired communication outcomes.

COM 5253 CUSTOMER SERVICE AND COMMUNICATION (3 credits). Examines customer contact personnel-consumer interaction. Focus is on key variables that shape communication behaviors and impact customer satisfaction levels, diagnosis of problems within these relationships and prescription of behaviors that increase the communication effectiveness of both participants.

COM 5345 COMMUNICATING IN THE GLOBAL ECONOMY (3 credits). Examines the elements of cross-cultural communication by analyzing the interface between the organization and its cultural environment. Focuses on developing skills to improve communication across both language and cultural barriers in a diverse domestic workplace and an international business environment.

COM 5353 ADVANCED MANAGERIAL REPORT WRITING (3 credits). An intensive examination of the function of report writing in contemporary business, industrial and governmental organizations. Major topics include audience analysis, conducting secondary and primary research for managerial purposes and integrating graphic aids.

COM 5355 SEMINAR: SPECIAL TOPICS IN TECHNICAL AND PROFESSIONAL COMMUNICATION (3 credits). An advanced seminar to investigate special topics and current issues in the discipline of technical, scientific and professional communication. Topics vary based on program needs and student/faculty interests. *(Prerequisite: Program chair approval.)*

COM 5400 INDEPENDENT STUDY (1–3 credits). This course offers master's-level independent research or directed study under faculty supervision.

COM 5565 TECHNICAL AND PROFESSIONAL COMMUNICATION INTERNSHIP (1–6 credits). Students work under the direct supervision of a business or industry professional and in coordination with the chair of the graduate communication program. *(Prerequisite: Program chair approval.)*

COM 5777 TECHNICAL AND PROFESSIONAL COMMUNICATION DESIGN PROJECT (1–6 credits). This is an individual project of a practical or applied nature under the direction of a member of the graduate faculty. Satisfactory completion of either a design project or traditional research-based thesis (with committee approval) is necessary for completion of the master's program, unless the nonthesis option is chosen.

COM 5999 THESIS (1–6 credits). Individual research work under the direction of a member of the graduate faculty. Satisfactory completion of either a traditional research-based thesis or design project (with committee approval) is necessary for the completion of the master's program and awarding of the degree, unless the nonthesis option is chosen.

COMPUTER ENGINEERING

See Electrical/Computer Engineering (ECE).

COMPUTER SCIENCE

CSE 1000 INTRODUCTION TO INFORMATION SYSTEMS (3 credits). This course provides an overview of the major concepts associated with a modern information system. These concepts include hardware and software, data processing, system development life cycles, single- and multiuser systems, tools and techniques, and information issues of privacy and ethics.

CSE 1001 FUNDAMENTALS OF SOFTWARE DEVELOPMENT 1 (4 credits). An introduction to software development as it applies to small programs. Students learn to program in a higher-level language and to read, understand, write and evolve typical small higher-level programs. (CL)

CSE 1002 FUNDAMENTALS OF SOFTWARE DEVELOPMENT 2 (4 credits). In this second course in the fundamentals of software development, students are introduced to the basic data structures and algorithms used in software design and implementation. Sorting and searching techniques are also introduced. *(Prerequisite: CSE 1001.)* (CL)

CSE 1101 COMPUTING DISCIPLINES AND CAREERS 1 (1 credit). An overview of computing-related disciplines and professional careers. Topics include an overview of software engineering, information systems and computer science; and an introduction to the ethical, moral and legal implications of crafting software.

CSE 1301 INTRODUCTION TO COMPUTER APPLICATIONS (3 credits). An overview of computers and terminology. Identification of appropriate problems and solution design using specific applications packages. The course includes an introduction to the use of word processors, data managers, spreadsheets and the Internet (e-mail and Web browsers). Credit cannot be applied toward any computer science degree. (CL)

CSE 1400 APPLIED DISCRETE MATHEMATICS (3 credits). This course introduces students to techniques from discrete mathematics that are widely used in computer science. It includes propositions and proofs, mathematical induction polynomials and probabilistic algorithms. *(Prerequisites: MTH 1000 or high school algebra and trigonometry, and a passing score on the placement test.)*

CSE 1502 INTRODUCTION TO SOFTWARE DEVELOPMENT WITH C++ (3 credits). An introduction to software for majors other than computer science. The course focuses on the stages of software development and practice in using C++. Topics include requirement analysis, design and implementation methods, testing procedures and an introduction to certifying program correctness. Credit cannot be applied toward any computer science degree. (CL)

CSE 1503 INTRODUCTION TO SOFTWARE DEVELOPMENT WITH FORTRAN (3 credits). An introduction to software for nonmajors. The course focuses on the stages of software development and practice in using FORTRAN. Topics include requirement analysis, design and implementation methods, testing procedures and an introduction to certifying program correctness. Credit cannot be applied toward any computer science degree. (CL)

CSE 2010 ALGORITHMS AND DATA STRUCTURES (4 credits). This course is an expansion of CSE 1002 to include algorithms and data structures fundamental to software systems development. Topics include abstraction, recursion, algorithm design and complexity analysis, linked lists, stacks, queues, trees and sorting and searching methods. *(Prerequisite: CSE 1002; corequisite: MTH 2051.)* (CL)

CSE 2050 PROGRAMMING IN A SECOND LANGUAGE (3 credits). An introduction to a second programming language for computer science majors. Students learn to read and write programs in a second language. The language chosen is one with wide popularity and use. The current language is C++. *(Prerequisite: CSE 1002 or instructor approval.)*

CSE 2234 INTRODUCTION TO SYSTEM ADMINISTRATION (1 credit). An introduction to the tasks involved in the administration of operating systems found on personal and multi-user computers. *(Prerequisite: CSE 2010 or ECE 2552 or instructor approval.)*

CSE 2400 APPLIED STATISTICS (3 credits). This course introduces probabilistic analysis and statistical analysis with application in computer science. It includes techniques to analyze algorithms and computer systems, such as Markov chains, regression and analysis of variance and simulation. *(Prerequisite: MTH 1002.)*

CSE 2410 INTRODUCTION TO SOFTWARE ENGINEERING (3 credits). A basis is presented for the integration of engineering rigor and software development, using a practical yet rigorous method of going from problem concept to software solution. Topics include requirements specification, functional specification and coding techniques using information hiding and stepwise refinement. *(Prerequisite: CSE 2010 or CSE 2502 or ECE 2552.)*

CSE 2502 ADVANCED SOFTWARE DEVELOPMENT WITH C++ (3 credits). The course extends topics introduced in CSE 1502 using C++ to solve specific programming problems. Topics include improved representation, implementation and certification of algorithms; advanced data structures; and methodologies for the design and implementation of programs. *(Prerequisite: CSE 1502.)*

CSE 3030 LEGAL, ETHICAL AND SOCIAL ISSUES IN COMPUTING (3 credits). An overview of legal, ethical and moral considerations for the computing profession. The impact of legal concepts on society, the need for ethical considerations in software systems development, and the potential need for professional certification. *(Prerequisites: COM 2223 or COM 2224 and at least one of CSE 1002, CSE 1502, CSE 1503, ECE 2551.)*

CSE 3101 MACHINE AND ASSEMBLY LANGUAGE (3 credits). A processor's instruction set and programming structures available to the assembly language programmer are presented. Relations between architecture, machine language and assembly language. Assembly program interfaces with the operating system and higher-level languages. *(Prerequisites: CSE 1002 and ECE 1551.)*

CSE 3280 COMPUTER GRAPHICS PROGRAMMING (3 credits). An introduction to computer graphics programming, the graphics pipeline, input and interaction using modern popular graphics APIs. Programming techniques for graphics primitives and transformations, viewing, lighting and shading, texturing and animation *(Prerequisite: CSE 2010 or CSE 2502 or ECE 2552.)*

CSE 3411 SOFTWARE TESTING 1 (3 credits). See SWE 5411. *(Prerequisites: CSE 1002, MTH 2051.)*

CSE 3421 SOFTWARE DESIGN METHODS (3 credits). This course explores methods for the design of software systems. Among the topics presented are formal specifications of software behavior, object-oriented analysis/design and structured analysis/design. *(Prerequisite: CSE 2410.)*

CSE 4001 OPERATING SYSTEMS CONCEPTS (3 credits). Examines the design and implementation of operating systems. Topics include process, storage and recovery management. Issues involved in moving from single-user systems to multitasking, multiprocessing and multiprocessor systems are explored. *(Prerequisites: CSE 2050, CSE 3101 or ECE 2552; corequisite: ECE 4551.)*

CSE 4020 DATABASE SYSTEMS (3 credits). An introduction to the fundamentals of computer database systems. Topics include a review of file structures, concepts of database design, functional units of a typical database system and application of database concepts to real-world problems. *(Prerequisite: CSE 2010.)*

CSE 4051 ADVANCED JAVA CONCEPTS (3 credits). A study of core Java and its major class libraries. Topics include exception handling, packages, threads, internationalization, building graphical user interfaces, applets, networking, RMI, introspection (Java beans), cryptography and database connectivity. *(Prerequisite: CSE 2010 or ECE 2552 or instructor approval.)*

CSE 4081 INTRODUCTION TO ANALYSIS OF ALGORITHMS (3 credits). This course covers time and space complexity of algorithms. Algorithms for sorting, searching, string processing and graph problems are analyzed. Strategies such as divide-and-conquer, greedy and dynamic programming are presented as problem-solution techniques. *(Prerequisite: CSE 2010.)*

CSE 4082 INTRODUCTION TO PARALLEL AND REAL-TIME ALGORITHMS (3 credits). The course introduces models of computation for parallel systems. Algorithms for parallel sorting, searching and matrix operations, and numerical computations are presented and analyzed. Real-time constraints and real-time scheduling algorithms are also addressed. *(Prerequisite: CSE 2010.)*

CSE 4083 FORMAL LANGUAGES AND AUTOMATA THEORY (3 credits). Abstract models of computers (finite automata, pushdown automata and Turning machines) and the language classes they recognize or generate (regular, context-free and recursively enumerable) are presented. Applications of these models to compiler design, algorithms and complexity theory are presented. *(Prerequisite: CSE 2010.)*

CSE 4101, 4102 COMPUTER SCIENCE PROJECTS 1, 2 (3, 3 credits). A two-semester senior-year capstone project sequence. Student teams implement a software project from conception to completion. *(Prerequisite: Senior standing.)*

CSE 4201, 4202 SOFTWARE DEVELOPMENT PROJECTS 1, 2 (3, 3 credits). A two-semester senior-year capstone project sequence. Student teams implement a software project from conception to completion. *(Prerequisite: Senior standing.)*

CSE 4220 SYSTEMS ANALYSIS AND DESIGN (3 credits). The methods and processes for systems analysis and design are covered. This course builds on technical skills through the application of analytic and design tasks associated with the systems development life cycle. The use of development teams and automated tool support are emphasized.

CSE 4221 SYSTEMS DEVELOPMENT WORKSHOP (3 credits). This capstone course promotes the application of concepts, tools and techniques that were introduced in previous courses. Project teams demonstrate their mastery of information technology in the development and implementation of a real-world information system. *(Prerequisite: CSE 4220.)*

CSE 4232 COMPUTER NETWORK PROGRAMMING (3 credits). Design and implementation of networked programs. Topics include multi-threading, client/server programming, remote method invocation, exception handling, object serialization, and shared-space programming. *(Prerequisite: CSE 2010 or CSE 2050 or ECE 2551.)*

CSE 4250 PROGRAMMING LANGUAGE CONCEPTS (3 credits). A survey of programming language concepts and design principles of programming paradigms (procedural, functional and logic). Topics include a history of programming languages, data types supported, control structures and run-time management of dynamic structures. *(Prerequisite: CSE 2010.)*

CSE 4251 COMPILER THEORY (3 credits). Introduces formal languages, the construction of scanners and recursive descent, LL(1) and LR(1) parsers, intermediate forms, symbol tables, code generation and optimization of resultant code. *(Prerequisites: CSE 2010, CSE 3101.)*

CSE 4257 GRAPHICAL USER INTERFACES (3 credits). A study of the theories and techniques of human-computer interaction and the design of direct manipulation graphical user interfaces that support menus, buttons, sliders and other widgets for input, text and graphics for output. Students design, implement and evaluate graphical user interface. *(Prerequisite: CSE 2010 or ECE 2552.)*

CSE 4280 COMPUTER GRAPHICS ALGORITHMS (3 credits). The algorithms implemented in the computer graphics pipeline for polygonal based models, including mathematical concepts and data structures for graphics, coordinate systems, clipping scan conversion, hidden-object detection, rendering and color models. *(Prerequisite: CSE 2010 or ECE 2552.)*

CSE 4301 INTRODUCTION TO ARTIFICIAL INTELLIGENCE (3 credits). This course surveys artificial intelligence, focusing on state-space and problem-reduction approaches to problem solving. Attention is given to the use of heuristics and their use in game-playing programs. Also presented are discussions of knowledge representation, automated reasoning and expert systems. *(Prerequisite: CSE 2010.)*

CSE 4401, 4402, 4403 INDEPENDENT STUDY IN COMPUTER SCIENCE (1, 2, 3 credits). Individual projects under the direction of faculty members of the Computer Science program. This course may be repeated for credit. *(Prerequisite: Instructor approval.)*

CSE 4410 SOFTWARE PROJECT MANAGEMENT (3 credits). This course provides an introduction to project management issues typical of large software projects. Topics include project planning, estimation, modeling, measurement and assessment techniques. Software project management tools are surveyed. An overview of the key CMM process areas for project management is provided. *(Prerequisite: CSE 2410.)*

CSE 4415 SOFTWARE TESTING 2 (3 credits). See SWE 5415.

CSE 4510 SPECIAL TOPICS IN COMPUTER SCIENCE (3 credits). This course explores new and emerging topics within the various disciplines included in the field of computer science. The subject matter will vary, depending on the instructor and other available resources. Course may be repeated for credit, provided the topics change. *(Prerequisite: Instructor approval.)*

CSE 4520 SPECIAL TOPICS IN SOFTWARE ENGINEERING (3 credits). This course provides instruction and experience in timely topics related to the production of quality-engineered software. *(Prerequisite: Instructor approval.)*

CSE 4610 REQUIREMENTS ENGINEERING (3 credits). An in-depth study of software requirements, engineering tools and techniques. Topics include gathering user requirements, formal specification of system behavior, system interfaces, end user and system documentation, and validation techniques. The end-user aspect of gathering and formalizing user expectations is emphasized. *(Prerequisite: CSE 2410.)*

CSE 4621 SOFTWARE METRICS AND MODELING (3 credits). See SWE 5621.

CSE 5000 INTRODUCTION TO PROGRAMMING (3 credits). An introduction to the fundamentals of software development. Topics include syntax and semantics of modern programming language and techniques for the design and implementation of simple programs. Credit cannot be applied toward computer science or computer information systems degrees.

CSE 5001 ASSEMBLY LANGUAGE AND ORGANIZATION (3 credits). Programming and execution model in the classical stored-program von Neumann machine. Assembly vs. machine language, instruction sets, addressing modes, shifting and masking, string manipulations, floating point representation, subprograms, hardware and software interrupts. Credit cannot be applied toward computer science or computer information systems degrees.

CSE 5100 DATA STRUCTURES AND ALGORITHMS (3 credits). Data structures including queues, stacks, lists, sets, hash tables, trees, heaps and graphs are studied. Algorithms manipulating and using these data structures are introduced and analyzed for time and space complexity. Credit cannot be applied toward a computer science degree. *(Prerequisites: CSE 5000, MTH 2051.)*

CSE 5210 FORMAL LANGUAGES AND AUTOMATA THEORY (3 credits). Abstract models of computers (finite automata, pushdown automata and Turing machines) and the language classes they recognize or generate (regular, context-free and recursively enumerable) are presented. Applications in compiler design, algorithms and complexity theory are presented. *(Prerequisite: CSE 5100.)*

CSE 5211 ANALYSIS OF ALGORITHMS (3 credits). Time and space complexity of computer algorithms. Algorithm classes, such as divide-and-conquer, greedy, dynamic programming and backtracking; techniques for solving recurrence equations; graph algorithms; searching and sorting; and deterministic and nondeterministic polynomial time problem classes. *(Prerequisite: CSE 5100.)*

CSE 5220 COMPUTER ARCHITECTURE (3 credits). History, organization, operation and performance evaluation of computer systems. Design of RISC and CISC instruction sets, arithmetic units, datapath and microprogrammed control, pipeline computers, hierarchical memory systems and input/output subsystems. Credit cannot be applied toward a computer science degree. *(Prerequisite: CSE 5001.)*

CSE 5230 OPERATING SYSTEMS 1 (3 credits). The initial components and various functions provided by operating systems, including the structure of operating systems, process scheduling, process synchronization, memory management, virtual memory, file system management and input/output device management. Credit cannot be applied toward a computer science degree. *(Prerequisites: CSE 5001, CSE 5100.)*

CSE 5231 COMPUTER NETWORKS (3 credits). Theory, design and analysis of computer communication systems. Topics include TCP/IP, Internet, the World Wide Web, ISO-OSI network architecture, LANs (Ethernet, Fast Ethernet, Token Ring, Token Bus, etc.) FDDI, ATM, SONET, wireless communications, satellite networks, DNS, firewalls, network modeling and simulation.

CSE 5232 NETWORK PROGRAMMING (3 credits). Design and implementation of programs that communicate with other programs across a computer network. Topics include streams, server-side networking, client-side networking, multithreading, exceptions and remote method invocation. *(Prerequisite: CSE 5231.)*

CSE 5240 PARALLEL PROCESSING (3 credits). Architectures for parallel computers and parallel algorithms for computational problems are investigated. Performance evaluation metrics for the performance of parallel processing are discussed. *(Prerequisites: CSE 5100, CSE 5220.)*

CSE 5241 DISTRIBUTED COMPUTING (3 credits). A study of the fundamental concepts in software systems that support and work in a distributed computing environment. Topics in network communication mechanisms, distributed operating systems, services supporting distributed systems, distributed database systems, fault-tolerant systems and distributed algorithms are discussed. *(Prerequisite: CSE 5230.)*

CSE 5250 PROGRAMMING LANGUAGES (3 credits). A survey of programming language concepts including language features, implementation issues and language groups. *(Prerequisite: CSE 5100.)*

CSE 5251 COMPILER THEORY AND DESIGN (3 credits). An extensive treatment of the major topics of compiler design, including lexical analysis, scanner-generator tools, parsing, syntax-directed translation, static semantic checking, storage organizations, code generation and code optimization. *(Prerequisite: CSE 5100.)*

CSE 5260 DATABASE SYSTEMS (3 credits). An introduction to the analysis and design of typical database systems. Includes theoretical and practical aspects of designing database systems. A substantial project is included. *(Corequisite: CSE 5100.)*

CSE 5261 INFORMATION RETRIEVAL (3 credits). Overview of key models (vector space, Boolean, probabilistic) and utilities (relevance ranking, relevance feedback, n-gram processing) for information retrieval. Additional models and utilities are also described based on current trends in the field. Benchmarking efforts and case studies are presented. *(Corequisite: CSE 5260.)*

CSE 5280 COMPUTER GRAPHICS (3 credits). The graphics pipeline for polygonal-based models. Mathematical concepts and data structures for graphics, coordinate systems, clipping, scan conversion, hidden-object detection, rendering, color models and graphics programming standards. *(Prerequisite: CSE 5100.)*

CSE 5281 GRAPHICAL USER INTERFACES (3 credits). The theories and techniques of human-computer interaction, and the design of direct manipulation graphical-user interfaces that support menus, buttons, sliders and other widgets for input, text and graphics for output. Students design, implement and evaluate a graphical-user interface. *(Prerequisite: CSE 5100.)*

CSE 5290 ARTIFICIAL INTELLIGENCE (3 credits). Introduction to the theoretical foundations of artificial intelligence, focusing on the areas of automated reasoning, search and heuristics. An AI language is introduced to implement concepts presented in the course. *(Prerequisite: CSE 5100.)*

CSE 5294 THEORY AND APPLICATIONS OF NEURAL NETWORKS (3 credits). Topics include learning in a single neuron, single and multi-layer perceptrons, recurrent neural networks, structured neural networks, neural networks to perform principal component analysis, principal component regression and partial least squares regression. *(Prerequisite: ECE 5201 or MTH 5102 or instructor approval.)*

CSE 5400 TOPICS IN COMPUTER SCIENCE (3 credits). Current topics in computer science at the introductory graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: Instructor approval.)*

CSE 5401 INDEPENDENT STUDY IN COMPUTER SCIENCE (1–3 credits). Working closely with a faculty member, the student probes a subject in greater depth than is normally possible in a regular class. A comprehensive paper is required. The course may be repeated for credit. *(Prerequisite: Instructor approval.)*

CSE 5402 PROJECTS IN COMPUTER SCIENCE (1–3 credits). The student works closely with a faculty member to develop a project in computer science to a greater depth than is normally possible in a regular class. An applied research project is required. *(Prerequisite: Instructor approval.)*

CSE 5500 COMPUTER SCIENCE SEMINAR (1 credit). Presentations by faculty, graduate students and guest speakers on topics of current interest. Appropriate participation in conferences, workshops or other professional activities may be substituted. This course may be repeated for credit.

CSE 5501 COMPUTER SCIENCES INTERNSHIP (1 credit). Industry-based internship experience under the supervision of a graduate faculty member, to provide professional experience to graduate students with no prior experience in a practical information technology setting. Presentations and reports are required. *(Prerequisites: at least nine graduate credit hours in computer sciences completed with at least a 3.0 GPA, and permission of the instructor.)*

CSE 5610 COMPUTATIONAL COMPLEXITY (3 credits). A review of problems, algorithms, Turing machines and computability. Boolean and first-order logic are studied, leading to undecidability results; relations among complexity classes are studied using reductions and completeness; approximate and randomized algorithms are presented. *(Prerequisites: CSE 5210, CSE 5211.)*

CSE 5620 ADVANCED COMPUTER ARCHITECTURE (3 credits). Design of interleaved memory systems and multiprocessor caches; linear and nonlinear pipelines; data-flow and reduction machines; Vector computers, multiprocessors and array processors. Performance, scheduling and scalability of parallel machines. *(Prerequisite: CSE 5220.)*

CSE 5630 ADVANCED OPERATING SYSTEMS (3 credits). A detailed study of the design and implementation of an operating system. Various data structures and algorithms for process, memory and input/output device management are discussed. Issues in distributed operating systems are investigated. *(Prerequisite: CSE 5230.)*

CSE 5631 ADVANCED COMPUTER NETWORKS (3 credits). Computer network design and analysis topics: network management, distributed network environments, bridges, routers, gateways, congestion control, ATM application program interface, multimedia and network applications. *(Prerequisite: CSE 5231.)*

CSE 5632 SURVIVABLE NETWORK OBJECTS (3 credits). Theory, design and analysis of secure computer communication systems. Topics include encryption, authentication, digital signature, digital certificate, secure socket layer, agent-based network applications and development of distributed applications over the Internet using COBRA and Java. *(Prerequisite: CSE 5631 or ECE 5535.)*

CSE 5650 ADVANCED PROGRAMMING LANGUAGES (3 credits). Theoretical topics in programming languages. The main topics are the lambda-calculus, functional programming, type interface and different approaches to the semantics of programming languages. *(Prerequisite: CSE 5250.)*

CSE 5660 DATABASE MANAGEMENT SYSTEMS (3 credits). A study of the internal components of a Database Management System (DBMS). Topics include data organization, query optimization, transaction processing, concurrency control, logging and recovery, security and distributed DBMS. *(Prerequisite: CSE 5260.)*

CSE 5661 ADVANCED INFORMATION RETRIEVAL (3 credits). Topics include but are not limited to integration of multiformat data, parallel processing, grammar processing, information filtering and integration of learning techniques into information processing. Research papers are read, presented, evaluated and extended. *(Prerequisite: CSE 5261.)*

CSE 5680 ADVANCED COMPUTER GRAPHICS (3 credits). Image synthesis using textures, shadows, ray tracing and radiosity methods. Animation, solid modeling fractals, nonuniform rational B-splines, antialiasing and advanced graphical data structures. *(Prerequisite: CSE 5280.)*

CSE 5690 EXPERT SYSTEMS (3 credits). A study of the components and characteristics of an expert (knowledge-based) system. Issues including knowledge acquisition/engineering, knowledge representation, reasoning and uncertainty are discussed. An AI language is explored to implement expert system concepts. *(Prerequisite: CSE 5290.)*

CSE 5691 SEARCH AND ARTIFICIAL INTELLIGENCE (3 credits). A survey of the latest results in AI research on effective search strategies for intelligent systems. Constructive and local approaches to search, heuristic search algorithms including A* and IDA, and adversary search techniques such as minimax and a-b will be investigated. *(Prerequisite: CSE 5290.)*

CSE 5692 CONSTRAINT REASONING (3 credits). Foundations of constraint satisfaction and constraint-based reasoning; problem representation and characterization; consistency checking, heuristics and search; deterministic and stochastic solving methods; applications such as scheduling, timetabling and temporal reasoning. *(Prerequisite: CSE 5100; recommended: CSE 5211 and CSE 5290.)*

CSE 5693 MACHINE LEARNING (3 credits). Computational paradigms and techniques in learning and adaptation. Topics include tree learning, rule learning, genetic algorithms, neural networks, case-based learning, Bayesian learning, analytical learning and reinforcement learning. *(Prerequisite: CSE 5290.)*

CSE 5801 INDEPENDENT RESEARCH IN COMPUTER SCIENCE (1–3 credits). Working closely with a faculty member, the student studies a research topic and writes a research paper. The course may be repeated for credit. *(Prerequisite: Instructor approval.)*

CSE 5802 RESEARCH PROJECTS IN COMPUTER SCIENCE (1–3 credits). The student works closely with a faculty member on a well-defined research project. The course may be repeated for credit. *(Prerequisite: Instructor approval.)*

CSE 5810 ADVANCED TOPICS IN COMPUTER SCIENCE THEORY (3 credits). Current topics in computer science theory at the graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: CSE 5210.)*

CSE 5820 ADVANCED TOPICS IN COMPUTER ARCHITECTURE (3 credits). Current topics in computer architecture at the graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: CSE 5220.)*

CSE 5830 ADVANCED TOPICS IN OPERATING SYSTEMS (3 credits). Current topics in operating systems at the graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: CSE 5230.)*

CSE 5835 ADVANCED TOPICS IN COMPUTER NETWORKS (3 credits). Current topics in computer networks at the advanced graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: CSE 5231.)*

CSE 5840 ADVANCED TOPICS IN PARALLEL AND DISTRIBUTED COMPUTING (3 credits). Current topics in parallel and distributed computing at the graduate level. Topics vary and the course may be repeated for credit. *(Prerequisites: CSE 5240, CSE 5241.)*

CSE 5850 ADVANCED TOPICS IN PROGRAM LANGUAGES (3 credits). Current topics in program languages at the graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: CSE 5250.)*

CSE 5860 ADVANCED TOPICS IN DATABASE SYSTEMS (3 credits). Current topics in database systems at the graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: CSE 5260.)*

CSE 5880 ADVANCED TOPICS IN COMPUTER GRAPHICS (3 credits). Current topics in computer graphics at the graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: CSE 5280.)*

CSE 5890 ADVANCED TOPICS IN ARTIFICIAL INTELLIGENCE (3 credits). Current topics in artificial intelligence at the graduate level. Topics vary and the course may be repeated for credit. *(Prerequisite: CSE 5290.)*

CSE 5999 THESIS (0–6 credits). Research and preparation of a thesis under the direction of a member of the graduate faculty. A maximum of six credit hours may be applied toward the master of science degree requirements. *(Prerequisite: Thesis supervisor approval.)*

CSE 6001 DOCTORAL-LEVEL TOPICS IN COMPUTER SCIENCE (3 credits). Advanced topics in computer science. Students conduct research on advanced topics, solve related problems, lead discussions and write expository papers on their work.

CSE 6990 RESEARCH IN COMPUTER SCIENCE (1–6 credits). Research conducted under the guidance of the doctoral-level graduate faculty. The area of research chosen may lead to preparation of a research proposal for dissertation work.

CSE 6999 DISSERTATION (0–6 credits). Research and preparation of the doctoral dissertation under the direction of the student's doctoral committee.

CIVIL ENGINEERING

CVE 1000 INTRODUCTION TO CIVIL ENGINEERING (3 credits). An introduction to the disciplines, professional aspects and ethics of civil engineering with lectures, hands-on projects, field trips and computer-assisted drawing (CAD). Topics include productive uses for microcomputers and engineering graphics in project planning, preliminary design and proposal preparation for a project.

CVE 1001 COMPUTER APPLICATIONS LAB (1 credit). This laboratory offers a broad background in computer applications with a strong emphasis on computer aided design. Word processing, spreadsheet coding and PowerPoint presentations are also briefly discussed. (CL)

CVE 2080 CONSTRUCTION MEASUREMENTS (3 credits). This course covers measurement of distances, elevations and angles; statistical errors and data adjustment; working with coordinates; topographic mapping and photogrammetry; global positioning systems (GPS); geographic information systems (GIS); and computer applications. *(Prerequisite: CVE 1001.)*

CVE 3012 ENGINEERING MATERIALS (3 credits). Stress-strain concepts and the relationship between the internal structure and the engineering properties as the basis for selection of materials. The materials studied include metals, concretes, timber, plastics and fiber composites. The course also includes laboratory testing.

CVE 3013 CIVIL ENGINEERING MATERIALS LAB (1 credit). This lab offers experiments in measurement techniques, materials testing, and engineering applications. *(Prerequisite: PHY 2091; corequisite: CVE 3012.)*

CVE 3015 STRUCTURAL ANALYSIS AND DESIGN (3 credits). An introduction to modeling of structures; elastic analysis of statically determinate trusses, beams and frames; influence lines for determinate and indeterminate structures; deflections by the method of virtual work and other methods; analysis of indeterminate structures. *(Prerequisite: MAE 3083.)*

CVE 3020 SOILS AND FOUNDATIONS (3 credits). A study of the application of mechanics and hydraulics to the analysis of soils. The course includes engineering geology, index properties, classification, compaction, effective stress, permeability, consolidation, and shear strength behavior of soil, as well as application to the design of foundations and retaining walls. *(Prerequisites: CVE 3030, MAE 3083.)*

CVE 3021 SOIL MECHANICS LAB (1 credit). This lab offers experiments in the sampling and testing of soil as an engineering material, to support topics in soil mechanics. *(Corequisite: CVE 3020.)*

CVE 3030 FLUID MECHANICS (3 credits). Topics include pressure distribution in flowing and static fluids; integral expressions for conservation of mass and momentum; energy equation; similitude; and flow through conduits. *(Prerequisites: MAE 2081, MTH 2201.)*

CVE 3032 HYDRAULICS AND HYDROLOGY (3 credits). Topics include steady flow in open channels, analysis of water surface profiles, channel design; measurements and estimation of components in the hydrologic cycle and unit hydrograph theory; statistical design methods and hydrologic routing. *(Prerequisite: CVE 3030.)*

CVE 3033 HYDRAULICS LAB (1 credit). This lab offers experiments in fundamental and applied fluid mechanics. *(Corequisite: CVE 3030.)*

CVE 3040 WATER SUPPLY AND TREATMENT PROCESSES (3 credits). An analysis and design of conventional water supply and treatment, including an examination of water-quality parameters and water distribution systems. *(Prerequisite: CHM 1101.)*

CVE 3042 WATER AND WASTEWATER SYSTEMS FOR LAND DEVELOPMENT (3 credits). This course covers the topics necessary to design potable water and domestic wastewater utility systems for land development projects. Topics include the treatment and distribution of potable water and the collection and treatment of wastewater. *(Prerequisites: CVE 1001, CHM 1101; corequisite: CVE 3030.)*

CVE 3050 WASTEWATER TREATMENT AND POLLUTION CONTROL (3 credits). An analysis and design of conventional wastewater treatment systems. It also includes the design of wastewater collection and pumping facilities. *(Prerequisite: CHM 1101.)*

CVE 3052 MUNICIPAL WATER AND WASTEWATER SYSTEMS (3 credits). This course covers the topics necessary to design and develop large scale potable water and domestic wastewater treatment facilities. The course includes site planning; physical, chemical, and biological treatment; sludge processing and advanced treatment methods. *(Prerequisites: CHM 1101, CVE 1001.)*

CVE 4000 ENGINEERING ECONOMY AND PLANNING (3 credits). Economic evaluation of engineering alternatives. Topics include time value of money, replacement alternatives, benefit/cost analysis, minimum cost analysis, depreciation, taxes and inflation. *(Prerequisite: Junior standing.)*

CVE 4011 COMPUTER ANALYSIS OF STRUCTURES (3 credits). Structural analysis using matrix methods and mathematical modeling of structures. *(Prerequisite: CVE 3015.)*

CVE 4013 STEEL STRUCTURES (3 credits). A study of the design of various elements of steel structures including tension members, beams, columns, beam-columns and connections; an introduction to the AISC codes. A design project is included. *(Prerequisite: CVE 3015.)*

CVE 4016 REINFORCED CONCRETE STRUCTURES (3 credits). The basic mechanics of reinforced concrete and the design of reinforced concrete structural elements and structures. An introduction to the design practices and procedures of the ACI code. A design project is included. *(Prerequisite: CVE 3015.)*

CVE 4019 TIMBER STRUCTURES (3 credits). See CVE 5019.

CVE 4020 FOUNDATION DESIGN (3 credits). Application of soil mechanics to foundation engineering, exploration techniques, foundation selection criteria, design and construction; analysis and design of spread, mat and pile foundations, retaining wall design, drilled piers, caissons, design using geotechnical fabrics and slope stability. *(Prerequisite: CVE 3020.)*

CVE 4035 URBAN HYDROLOGY (3 credits). State-of-the-art water-quality and water-quantity computer models are used to predict the impact of urbanization on receiving waters. Students design a stormwater management system as a project. *(Prerequisite: CVE 3032.)*

CVE 4050 SOLID AND HAZARDOUS WASTE (3 credits). The design process used in investigation and remediation of sites contaminated with solid or hazardous waste. It also covers the processing, treatment and disposal of solid and hazardous wastes.

CVE 4060 TRANSPORTATION ENGINEERING (3 credits). Modes of transportation are reviewed with emphasis on highways, including vehicle characteristics, geometric alignment, traffic analysis, queuing theories, signal timing, levels of service, traffic forecasting, pavement design and airport runway design and layout. *(Prerequisites: CVE 2080, CVE 3020.)*

CVE 4070 CONSTRUCTION ENGINEERING (3 credits). The fundamentals of construction engineering from a project management point of view. Focus on basics of construction project management principles including scope, quality control, planning and scheduling, cost engineering, risk management and loss prevention, local environment, information and communications, and stakeholder relations. *(Prerequisites: CVE 3012, CVE 3013 or instructor approval.)*

CVE 4073 CONSTRUCTION COST ENGINEERING (3 credits). See CVE 5073.

CVE 4080 URBAN PLANNING (3 credits). Analysis for urban planning, development of master plan emphasizing engineering aspects of utilities, transportation and other city facilities. *(Corequisite: CVE 4000.)*

CVE 4090 SELECTED TOPICS IN CIVIL ENGINEERING (3 credits). Advanced topics in civil engineering in which a formal course does not exist at Florida Tech. Classes are conducted on a seminar basis with extensive student participation. Topics are chosen according to student interest and faculty expertise. *(Prerequisite: Department head approval.)*

CVE 4091, 4092 DESIGN PROJECT 1, 2 (1, 3 credits). The study of a student project in civil engineering design, which is conducted under the guidance of the faculty with peer review. The student selects a project and submits a project proposal that reviews alternatives and presents a schedule for project completion in Design Project 2. Oral and written reports are used throughout the sequence. *(Prerequisite: Senior standing.)*

CVE 4095 INDEPENDENT STUDY IN CIVIL ENGINEERING (3 credits). An independent study undertaken on a cooperative basis between a student and a member of the faculty. Typically, it is a short-term research-related project. *(Prerequisite: Department head approval.)*

CVE 5014 ADVANCED STEEL DESIGN (3 credits). Behavior and design of steel structures with an emphasis on the AISC-LRFD specifications. Topics include plate girders, continuous beams, complex connections, frames and composite construction. *(Prerequisite: CVE 4013.)*

CVE 5015 STRUCTURAL SYSTEMS DESIGN (3 credits). The planning and design of structural systems in steel, reinforced concrete and timber with emphasis on lateral-load resisting systems. Wind and earthquake engineering design aspects are introduced. *(Prerequisite: CVE 3015.)*

CVE 5019 DESIGN OF TIMBER STRUCTURES (3 credits). The engineering properties of timber and their effect on design of timber structures. A study of the design of various elements of timber structures including tension members, beams, beam-columns, diaphragms and connections according to the NDS ASD specification. A design project is included. *(Prerequisite: CVE 3015.)*

CVE 5020 GEOTECHNICAL ENGINEERING (3 credits). Advanced treatment of theory and principles of engineering soil mechanics as related to permeability, capillary, seepage forces, stress distribution, effective stress, consolidation and shear strength. Topics include laboratory testing of soils for engineering properties. *(Prerequisite: CVE 3020.)*

CVE 5025 FOUNDATION DESIGN (3 credits). Explores the application of soil mechanics to foundation engineering, exploration techniques, foundation selection criteria, design and construction; analysis and design of spread, mat and pile foundations, retaining wall design, drilled piers, caissons, design using geotechnical fabrics and slope stability. *(Prerequisite: CVE 3020.)*

CVE 5035 DESIGN CONCEPTS IN URBAN HYDROLOGY (3 credits). State-of-the-art water-quality and water-quantity computer models are used to predict the impact of urbanization on receiving waters. Students design a stormwater management system as a project. *(Prerequisite: CVE 3032.)*

CVE 5037 NUMERICAL GROUNDWATER MODELING (3 credits). A study of the partial differential equations governing the motion of fluids and solute or contaminants in subsurface media; introduction to finite difference methods; description of the Galerkin finite element method). State-of-the-art models, such as MODFLOW and SUTRA are used to solve real-world problems. *(Prerequisite: CVE 5039.)*

CVE 5039 GROUNDWATER HYDROLOGY AND CONTAMINANT TRANSPORT (3 credits). This course covers energy concepts and governing equations in groundwater, estimation of aquifer properties, well and well-field design, saltwater intrusion, artificial recharge and modeling of contaminant transport in groundwater. *(Prerequisites: CVE 3030, CVE 3032.)*

CVE 5040 URBAN PLANNING (3 credits). Analysis for urban planning, development of master plan emphasizing engineering aspects of utilities, transportation and other city facilities. *(Corequisite: CVE 4000.)*

CVE 5050 DESIGN OF REMEDIATION SYSTEMS (3 credits). Covers the design process to clean up soil and groundwater contaminated with hazardous waste, including the design of contaminated groundwater capture systems, contaminant treatment, treated water disposal and air phase emission compliance.

CVE 5052 SOLID WASTE MANAGEMENT (3 credits). Regulation, generation, storage, treatment and disposal of solid wastes. Emphasis is placed on the management of solid waste in an environment of changing regulations. *(Prerequisites: CVE 5050 and instructor approval.)*

CVE 5060 HIGHWAY DESIGN (3 credits). Topics include vehicle stopping sight distances, vertical and horizontal curve layout, cut and fill, analysis of level of service, queuing theory, flexible and rigid pavement designs, pavement overlay designs, nondestructive evaluation of pavements and pavement rehabilitation techniques. *(Prerequisite: CVE 3020.)*

CVE 5072 CONSTRUCTION CONTRACTS, LAW AND SPECIFICATIONS (3 credits). Topics include liability, real property and water rights; environmental and comprehensive planning laws and requirements; evidence, expert witness, claims, disputes and arbitration; contract specifications and drawings; resolution of differences; change orders and contract modifications; and case studies. *(Prerequisite: CVE 4070.)*

CVE 5073 CONSTRUCTION COST ENGINEERING (3 credits). Explores the application of cost engineering principles and estimating within a project management framework in conjunction with scope definition, quality control, planning and scheduling, risk management and loss prevention techniques, local conditions, information and communications, and working relations with stakeholders. *(Prerequisite: CVE 4000.)*

CVE 5080 SELECTED TOPICS IN CIVIL ENGINEERING (1–3 credits). Advanced topics in civil engineering. Classes are conducted on a seminar basis with extensive student participation. Topics are chosen according to student interest. *(Prerequisite: Instructor approval.)*

CVE 5095 SPECIAL PROJECTS IN CIVIL ENGINEERING (1–3 credits). Special graduate study undertaken on a cooperative basis between a student and a member of the graduate faculty. The project may include a literature search in a selected area or the design and fabrication of research equipment. *(Prerequisite: Department head approval.)*

CVE 5999 THESIS RESEARCH (0–3 credits). Individual research under the direction of a member of the graduate faculty in a selected topic. *(Prerequisite: thesis adviser approval.)*

CVE 6991 RESEARCH IN CIVIL ENGINEERING (1–3 credits). Research under the guidance of a member of the civil engineering faculty in a selected area of civil engineering. It is repeatable as required.

CVE 6999 DISSERTATION (0–3 credits). Research and preparation of the doctoral dissertation.

COOPERATIVE EDUCATION

CWE 1001, 2001, 3001, 4001 COOPERATIVE EDUCATION 1, 2, 3, 4 (1–3 credits). The co-op program is designed to prepare students for professional careers by integrating alternate periods of academic study and career-related work experience. Students are placed in private industry, business and public agencies, and if registered for three credits are classified as full-time students every semester. Students must meet specific academic standards and be recommended for assignment by the university to be eligible for the co-op program. Co-op credits can be used as free elective credits in most programs. All students on co-op assignments are required to register for the appropriate co-op course and must have the co-op coordinator's approval to register. All co-op courses are pass/fail (P/F) graded. *(Prerequisite: Completion of 24 credit hours with at least a 2.5 GPA.)*

CWE 5000 GRADUATE COOPERATIVE EDUCATION (0 credit). The graduate co-op course is designed to provide opportunities for graduate students who desire work experience related to their fields of study. No academic credit is awarded, but in other respects, the preceding course description and restrictions all apply. *(Prerequisite: Completion of nine graduate credit hours, with at least a 3.0 GPA.)*

ELECTRICAL AND COMPUTER ENGINEERING

ECE 1551 DIGITAL LOGIC (4 credits). The design of specialized processors and introduction to generalized processors. Topics include state diagram, state assignment, transition diagram, combinational and sequential logic, programmable logic devices, dynamic registers, counters and memories. Extensive hands-on experience, including logic simulation, hardware implementation, Web experience, circuit drawing and diagramming software.

ECE 1552 COMPUTER DESIGN (4 credits). Design of computer structures and embedded systems. Topics include processor units, instruction set architecture, embedded systems organization and control, input/output organization, timer implementation, interrupts and basic computer organization and design. Development of a working knowledge of the process through laboratory development, interfacing and programming. *(Prerequisite: ECE 1551.)* (CL)

ECE 2111 CIRCUIT THEORY 1 (4 credits). Covers concepts of transient and steady-state behavior of passive electrical circuits; techniques for circuit analysis including mesh and nodal analysis, and equivalent circuits; first- and second-order circuits, superposition, Laplace transform techniques; and laboratory projects. *(Prerequisite: PHY 1001; corequisite: MTH 2201.)*

ECE 2112 CIRCUIT THEORY 2 (4 credits). As a continuation of ECE 2111, this course covers phasors and steady-state response; AC power and two-port equivalent circuits transfer functions; Fourier analysis transforms analysis, Laplace transforms and laboratory projects. *(Prerequisites: ECE 2111, MTH 2201.)*

ECE 2551 SOFTWARE/HARDWARE DESIGN (3 credits). Software and hardware aspects of computer design and corresponding interdependencies. Use of C++ and current graphical software-development environments. Laboratory includes the application of high-level language concepts to manipulate microcontrollers, graphical user interfaces and communication ports. *(Prerequisite: ECE 1552.)* (CL)

ECE 2552 SOFTWARE/HARDWARE INTEGRATION (3 credits). Progression from developing software/hardware modules to the vertical system of hardware device drivers, operating systems and application user interfaces. Current software engineering techniques including data structures are applied to integrate software and hardware using modern programming languages (e.g., C++). *(Prerequisite: ECE 2551.)* (CL)

ECE 3111 ELECTRONICS (4 credits). An introduction to diodes, bipolar, and field-effect transistors; analysis and design of semiconductor circuits, single and multistage amplifiers; design algorithms; operational amplifiers and oscillators; and laboratory projects. *(Prerequisite: ECE 2111.)*

ECE 3222 SIGNALS AND SYSTEMS (3 credits). This course covers properties and applications of Fourier, Laplace and z transforms to linear continuous and discrete systems, and introduces state-space description of systems. *(Prerequisite: ECE 2112.)*

ECE 3240 JUNIOR DESIGN (1 credit). Introduces the concepts, principles and methodology of collaborative electrical or computer engineering design through seminars, discussions and interaction with seniors completing their capstone design projects. Students form teams and study the feasibility of potential senior project selections. *(Prerequisite: Junior standing.)*

ECE 3331 ELECTRON DEVICES (3 credits). Semiconductor materials and physics, electrons and holes, semiconductor diodes, bipolar transistors and field effect devices. *(Prerequisite: MTH 2201; corequisite: PHY 2003.)*

ECE 3442 ELECTROMAGNETIC WAVES (3 credits). Validity of circuit principles at high frequencies, electromagnetic wave on lines, impedance measurements using Smith chart, impedance matching techniques, waveguides and fiber-optical transmission systems, antennas and radiation waves, satellite data links and radar systems. *(Prerequisite: ECE 2112.)*

ECE 3541 DIGITAL STATE MACHINES (3 credits). Set theory, order and equivalence relations, partitions, lattices, generating functions, cardinality, elementary number theory, graph theory, planar graphs, directed graphs, finite state machines, finite automata. *(Prerequisites: ECE 1552, MTH 1002.)*

ECE 3551 MICROCOMPUTER SYSTEMS 1 (4 credits). An introduction to applications of microprocessors, microprocessor architecture, assembly programming, hardware configuration, memory section design, input/output and exception processing, and includes laboratory projects. *(Prerequisites: ECE 1552, ECE 2111.)*

ECE 3552 MICROCOMPUTER SYSTEMS 2 (4 credits). This course covers design of microcomputer systems interfacing and their peripherals; interrupts, exception processing and hardware/software integration; small-system controller design using microcontrollers; and laboratory projects. *(Prerequisites: ECE 3111, ECE 3551.)*

ECE 3553 MULTIFARIOUS SYSTEMS 1 (4 credits). Vertical integration of many dissimilar systems at the hardware and software level. Digital logic, microcontroller structure and design; machine code and advanced C++. Design and integration of dissimilar systems that make use of differing hardware, software languages and operating environments. Case studies. Several common programming languages. *(Prerequisite: ECE 2552.)*

ECE 4001 SPECIAL TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING (1 credit). Laboratory or lecture is offered in selected fields of computer and electrical engineering. May be repeated as needed.

ECE 4112 DIGITAL ELECTRONICS (3 credits). Includes relevant physics, electronics, and transmission line theory important to modern computers. Important device-level concepts used to build digital systems are introduced and used to design integrated circuits with primary focus on interface requirements. Transmission line theory relevant to system-level interconnect and network requirements. *(Prerequisites: ECE 3111, PHY 2003.)*

ECE 4113 ELECTRONICS DESIGN (3 credits). Includes analysis and design of analog microelectronic circuits. Topics include differential and multistage amplifiers, frequency response, feedback, output stages, analog integrated circuits, fibers and waveform-shaping circuits. *(Prerequisite: ECE 3111.)*

ECE 4221 COMMUNICATION SYSTEMS (3 credits). Topics include review of signals in electrical communication; Fourier series, Fourier transform, noise and signal-to-noise ratio, power spectral density and autocorrelation function, linear (amplitude) modulation; exponential (angle) modulation; generation and detection of amplitude and angle modulated waves; and sampling theory. *(Prerequisite: ECE 3222.)*

ECE 4223 APPLICATIONS OF OPERATIONAL AMPLIFIERS (3 credits). Emphasizes the engineering applications of modern analog microelectronic circuits. Topics include amplifier design, feedback and filters. *(Prerequisite: ECE 3111.)*

ECE 4224 COMMUNICATIONS AND CONTROL SYSTEMS LABORATORY (3 credits). Topics include experiments on VCOs, tuned circuits, amplifiers, filters, balanced modulator, AM generation and detection, FM generation and detection, sampling/aliasing. Control theory experiments (OP-AMP stability, cardiac pacemaker control, single axis lunar excursion module, magnetic levitation system) using MATLAB. *(Corequisite: ECE 4221.)*

ECE 4225 DIGITAL FILTERING AND SIGNAL PROCESSING (3 credits). Analysis of discrete systems, use of z-transforms and discrete Fourier transforms and are used to design digital filters. *(Prerequisite: ECE 3222.)*

ECE 4226 PATTERN RECOGNITION AND DETECTION (3 credits). Introduction to Bayesian adaptive and nonadaptive decision and its application to the design, analysis and evaluation of optimal systems for detection, pattern recognition and feature extraction; applications to communications, failure detection and target detection and recognition are included.

ECE 4231 CONTROL SYSTEMS (3 credits). Analysis and design of linear time-invariant control systems. Topics include electrical, mechanical, thermal, fluid and information handling elements encountered in control systems; modeling of systems of interconnected elements; transfer function (classical) and state space (modern) descriptions of control systems; signal flow graphs. *(Prerequisite: ECE 3222.)*

ECE 4232 ADVANCED CONTROL SYSTEMS (3 credits). Introductory coverage of digital control systems and nonlinear control systems. Digital control concepts covered include ideal sampler, z-transforms, mapping from the s-plane to the z-plane, A/D and D/A conversion, reconstruction of sampled signals, sample and hold devices, state variable techniques for discrete systems and stability concepts. *(Prerequisite: ECE 4231.)*

ECE 4241, 4242 SYSTEM DESIGN 1, 2 (3, 3 credits). Engineering design fundamentals are applied to student design projects. Topics include study of the design process and related topics such as optimization techniques, reliability prediction, engineering economics, safety, aesthetics, ethics and social impact. Students carry out a project from conception through design, fabrication, testing and delivery. *(Prerequisite: Senior standing.)*

ECE 4300 SPECIAL TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING (3 credits). Courses are offered in selected fields of computer and electrical engineering.

ECE 4311 MICROELECTRONICS FABRICATION LABORATORY (3 credits). In this course, students fabricate silicon p-channel transistors. The course includes lectures on transistor processing and fabrication in the clean room. *(Prerequisite: Senior standing or instructor approval.)*

ECE 4330 INTEGRATED CIRCUIT DESIGN AND LAYOUT LABORATORY (3 credits). An introduction to the design and layout of integrated circuits at the transistor level. Integrated circuits are designed using standard engineering techniques. The course stresses the understanding of and use of IC development tools. *(Prerequisite: ECE 3111.)*

ECE 4332 ELECTROOPTIC DEVICES AND SYSTEMS (3 credits). Discusses the theory of operation of key photonic/fiber-optic devices that are used in a wide variety of electronic systems. Devices include lasers, light emitting diodes, photodetectors, CCD arrays, liquid crystal displays, optical fibers, etc. Explains the basic operation of various electrooptic systems. *(Prerequisites: ECE 3331, ECE 3442.)*

ECE 4442 MICROWAVE LABORATORY (3 credits). Lectures, laboratory experiments and demonstrations; transmission lines; impedance measurement, stub tuning and impedance matching techniques using the Smith chart; time domain reflectometry; microwave antennas, radar and satellite data transmission systems; spectrum analyzers; and noise figure measurements. *(Prerequisite: ECE 3442.)*

ECE 4551 COMPUTER ARCHITECTURE (3 credits). This course covers instruction set design, processor and control unit design, handling of exceptions, ALU arithmetic and implementation, pipelining, pipeline hazards, memory hierarchy, cache memory types and I/O interface design. *(Prerequisite: ECE 3551.)*

ECE 4553 MULTIFARIOUS SYSTEMS 2 (4 credits). Vertical integration of many dissimilar systems at the hardware and software level. Design and integration of dissimilar systems that use differing software languages, hardware, and operating environments including complex distributed state machines. Fault redundant protocols, distributed common object module technology, GUI. Complex enterprise level systems. *(Prerequisite: ECE 3553.)*

ECE 4561 COMPUTER COMMUNICATIONS (3 credits). Theory, design, and analysis of computer communication systems. Topics include TCP/IP, Internet, the World Wide Web, ISO-OSI network architecture, LANs, wireless communications, satellite networks, UNIX network programming, network modeling and simulation. *(Prerequisite: ECE 2552.)*

ECE 4800 INDEPENDENT STUDY (3 credits). Special projects are undertaken on a cooperative basis between a student and a member of the faculty. It can include such work as a literature search in a given area of design and fabrication of equipment as a laboratory project.

ECE 4991 ELECTRIC AND ELECTRONIC CIRCUITS (3 credits). A study of circuit theory for nonelectrical engineering students; transient and steady-state behavior of passive linear-lumped-parameter electric circuits; and AC circuit theory, network equations, network theorems; transfer functions and equivalent circuits. *(Prerequisites: MTH 2001, PHY 2002.)*

ECE 5111 RADIO FREQUENCY PROPAGATION (3 credits). Link budgets, free space propagation, antenna radiation patterns, multipath, fading, interference, reflection, refraction, rain attenuation, indoor propagation and RF safety. Applications to radar and terrestrial as well as satellite communication systems are considered. Real world effects and impairment reduction methods. *(Prerequisites: ECE 3442, ECE 4221, MTH 2401.)*

ECE 5112 INTRODUCTION TO WIRELESS SYSTEMS AND APPLICATIONS (3 credits). Principles, fundamental equations, and functional components that use RF propagation for various applications are developed. A broad variety of applications (e.g., communications, radar) are described including the functions and interconnection of subsystems. System design considerations for applications. *(Prerequisite: ECE 3442, ECE 4221, MTH 2401.)*

ECE 5113 WIRELESS LOCAL AREA NETWORKS (3 credits). This introductory course provides the basics of wireless networking and WLAN technologies, the leading WLAN standards, WLAN configurations, WLAN implementation considerations, the benefits and applications of WLANs, WLAN trends and case studies.

ECE 5114 RADIO LOCATION, SENSING AND MEASUREMENT (3 credits). The theory and functional design of a variety of important applications of radio, e.g., location and tracking systems, navigation, radio altimetry and radar mapping systems. For each application, real world effects and impairment reduction methods are treated. *(Prerequisite: ECE 5111 or ECE 5112.)*

ECE 5115 MODERN WIRELESS DESIGN CONCEPTS (3 credits). Key design criteria, techniques, and component technologies of major components or sub-systems for wireless applications are treated, including transmitters and power amplifiers, receivers, modems, synthesizers, mixers and duplexers. *(Prerequisites: ECE 3442, ECE 4221.)*

ECE 5201, 5202 LINEAR SYSTEMS 1, 2 (3, 3 credits). These courses consist of a study of linear spaces, linear operators and matrix calculus; mathematical description of linear dynamic systems, the relation between state variable descriptions and system transfer functions; controllability and observability of systems, realization of rational transfer function matrices and an introduction to nonlinear analysis. *(Prerequisite: ECE 4231 or MTH 2201.)*

ECE 5221 PERSONAL COMMUNICATION SYSTEMS (3 credits). This course provides an overview of the principles of operation, general architectures, access methods, modulation schemes and performance of cellular and personal communications systems. Design criteria for modern systems and use of real world tools to demonstrate design concepts are presented.

ECE 5222 COMPONENTS FOR PERSONAL COMMUNICATION SYSTEMS (3 credits). Basic operation of components is described and students will build and characterize key subsystems using a vector network analyzer. *(Prerequisite: ECE 4221.)*

ECE 5223 DIGITAL COMMUNICATIONS (3 credits). This course covers physical media, digital modulation, detection, intersymbol interference, adaptive equalization, spectrum control, error control, synchronization. *(Prerequisites: ECE 4221, MTH 5425.)*

ECE 5231 OPTIMAL SYSTEMS (3 credits). Includes optimization of dynamic systems, calculus of variations, necessary conditions for optimality; the study of constrained systems using the maximum principle and development of cost functions; Hamilton-Jacobi theory, Pontryagin's principle and dynamic programming; linear optimal deterministic optimal tracking systems; and robust control. *(Prerequisite: ECE 5201; corequisite: MTH 5425.)*

ECE 5233 SATELLITE COMMUNICATIONS (3 credits). A comprehensive study of the systems aspects of satellite communications, with emphasis on digital communications. An analysis is included of AWGN channels, performance degradation caused by band limiting, nonlinearities, phase noise, etc. The course presents a survey of existing operational satellite systems. *(Prerequisite: ECE 4221.)*

ECE 5234 COMMUNICATION THEORY (3 credits). This course covers theory of signal spaces; dimensionality and distance; optimum methods of statistical detection and estimation; characteristics of noise; introduction to information theory, including channel capacity, source coding and channel coding; and time-bandwidth limitations and rate-distortion theory. *(Prerequisites: ECE 4221, MTH 5425.)*

ECE 5238 ERROR CONTROL CODING (3 credits). Topics include an introduction to algebra, linear block codes, Galois fields, cyclic codes, circuits for cyclic codes, BCH codes, spectral techniques for encoding and decoding, and convolutional codes.

ECE 5243 DIGITAL CONTROL SYSTEMS (3 credits). An analysis and design of digital control systems using state-variable techniques and time-domain analysis; sampling, z-transform analysis and the frequency domain; and controllability and observability. *(Prerequisite: ECE 5201.)*

ECE 5244 ADVANCED DIGITAL CONTROL SYSTEMS (3 credits). Include digital simulation techniques and digital redesign, multirate sampled-data systems, discrete stochastic optimal control and estimation and hardware implementation issues relating to sampled-data control systems. Students are expected to perform computer simulations using a standard controls software package. *(Prerequisite: ECE 5243.)*

ECE 5245 DIGITAL SIGNAL PROCESSING 1 (3 credits). A description of discrete-time signals in the time and frequency domains; z-transform, discrete Fourier transform, FFT algorithms; introduction to classical digital filter design techniques; and introduction to linear predictive coding.

ECE 5246 DIGITAL SIGNAL PROCESSING 2 (3 credits). Modern methods of data compression, signal modeling spectral estimation and linear prediction; Wiener filtering and an introduction to Kalman filtering and adaptive filtering; and other topics from the current literature. *(Prerequisites: ECE 5245, MTH 5425.)*

ECE 5248 ADVANCED FILTERING (3 credits). Bayesian estimation theory; filtering, smoothing and prediction for linear and nonlinear systems, gaussian and nongaussian models, and for known or unknown models; fast algorithms for filter design and implementation; linear, nonlinear and adaptive filters; applications. *(Prerequisites: ECE 5201, MTH 5425.)*

ECE 5251 RADAR SYSTEMS (3 credits). Characteristics of radar, prediction of range and performance, types of radar (pulse-Doppler, MTI, CW, etc.); modern radar technologies, phased-array systems, clutter, jamming; and an introduction to signal processing methods.

ECE 5256 DIGITAL IMAGE PROCESSING (3 credits). Investigates image processing by machine for such purposes as robotics, biomedicine, remote sensing and photogrammetry. Topics include image enhancement and image analysis, transform techniques including the wavelet transform, feature extraction, segmentation, compression and morphology.

ECE 5258 PATTERN RECOGNITION (3 credits). Includes Bayes decision theory; optimal pattern recognition algorithms; feature extraction criteria and algorithms; adaptive pattern recognition: supervised and unsupervised learning; and applications to failure detection, target recognition, image recognition and speech recognition. *(Prerequisites: ECE 5201, MTH 5425.)*

ECE 5260 APPLICATION OF ARTIFICIAL NEURAL NETWORKS IN EE (3 credits). Current applications of artificial neural networks to various topics in electrical engineering will be presented. Neural signal processing, closed loop neural control and design of neural systems will be discussed. *(Prerequisite: MTH 5320 or instructor approval.)*

ECE 5268 THEORY AND APPLICATIONS OF NEURAL NETWORKS (3 credits). Topics include learning in a single neuron, single- and multi-layer perceptrons, recurrent neural networks, structured neural networks, neural networks to perform principal component analysis, principal component regression and partial least squares regression. *(Prerequisite: ECE 5201 or MTH 5102 or instructor approval.)*

ECE 5270 SPECIAL TOPICS IN SYSTEMS (3 credits). A course based on topics of current interest in the technical literature on systems.

ECE 5272 SPECIAL TOPICS IN COMMAND, CONTROL, COMMUNICATION AND INTELLIGENCE IN SYSTEMS ENGINEERING (3 credits). Different C3I topics are treated in different semesters, depending on student interest and topic timeliness. Topics come from broad C3I areas such as sensor data fusion, estimation, tracking, probability and statistical models and optimization. State-of-the-art techniques and algorithms are explored.

ECE 5301 SEMICONDUCTOR DEVICE THEORY (3 credits). Review of basic semiconductor physics and band theory; development of detailed theory of p-n junctions; Schottky barrier diodes, bipolar transistors and heterojunctions. Introduction of field effect transistor theory include JFETs, MOSFETs and VLSI technologies. *(Prerequisite: ECE 3331.)*

ECE 5310 VLSI PROCESSING (3 credits). Presents VLSI fabrication theory. Course includes silicon material properties, growth techniques and defects; details of chemical vapor deposition (CVD), thermal oxidation, solid-state diffusion, ion implantation, VLSI lithography and metallization. *(Prerequisite: ECE 3331.)*

ECE 5311 MICROELECTRONICS FABRICATION LAB (3 credits). Hands-on fabrication and testing of integrated circuits including oxidation, diffusion, photolithography, metallization and etching. Students perform all process steps required, beginning with polished silicon wafers and ending with completed integrated circuits that are tested and characterized.

ECE 5333 ANALOG IC DESIGN (3 credits). Design of analog integrated circuits using Bipolar, CMOS and related technologies. Topics include Bipolar and MOS DC/AC models, fundamental single-stage amplifier topologies, current sources and bias networks, power amplifier topologies and opamp circuit design. *(Prerequisites: ECE 3111, ECE 3331.)*

ECE 5335 ADVANCED IC DESIGN AND SIMULATION (3 credits). Design of advanced analog circuit and system ICs using opamps and transconductance amplifiers as the core component. Topics include opamp modeling, fully differential opamp considerations and noise limitations. Filter approximation and active network synthesis using switched-capacitor techniques. A/D and D/A conversion. *(Prerequisite: ECE 5333.)*

ECE 5350 OPTICAL ELECTRONICS (3 credits). Principles of stimulated emission; electromagnetic field modes in optical resonators; ray tracing techniques in laser resonators and beam delivery systems; Gaussian beam profiles and laser line widths; noise in lasers and optical amplifiers; excitation methods; mode locking and Q-switching techniques; picosecond and femtosecond laser pulse generation; optical bistable devices.

ECE 5351 FIBER-OPTIC COMMUNICATION SYSTEMS (3 credits). Includes optical fiber links, comparison between optical and electronic communication links; data encoding and bit error rates; properties of single, multimode and polarization preserving optical fibers, including attenuation, pulse spreading, bandwidth and maximum bit rate; transmitter and receiver design considerations, link design.

ECE 5352 FIBER-OPTIC SENSOR SYSTEMS (3 credits). Students study fundamental theory and state-of-the-art fiber-optic sensor systems; comparison with conventional sensors for strain, temperature, electric and magnetic fields; specialized fiber-optic components; use of multimode, singlemode, polarization preserving and high birefringence optical fibers, interferometric- and intensity-based sensor architectures.

ECE 5353 OPTICAL COMPUTING (3 credits). A study of the basic principles, applications and recent advances in optical signal processing. Topics include diffraction theory, Fourier transform optics, devices, machine vision algorithms, optical neural networks.

ECE 5354 ACOUSTOOPTIC AND ELECTROOPTIC DEVICES (3 credits). Theory of operation and system applications, including optical wave propagation through an anisotropic medium, electrooptic and acoustooptic effects; Raman-Nath and Bragg regimes of operation, acoustooptic and electrooptic material properties and selection criteria, operation of laser modulators, deflectors and frequency.

ECE 5355 ELECTROOPTICS LABORATORY (3 credits). Lectures and experiments in photonics with emphasis on fiber optics, optical fibers, photodetectors, links, sensors, etc.

ECE 5356 OPTICAL WAVEGUIDES AND DEVICES (3 credits). Applications of Maxwell's equations and time-harmonic electromagnetic waves to fiber-optical waveguides; ray trajectories; electromagnetic fields in single- and multimode fibers; attenuation and dispersion mechanisms; inelastic scattering and nonlinear propagation; erbium-doped ultra-broadband optical traveling wave amplifiers.

ECE 5358 ADVANCED TOPICS IN PHOTONICS (3 credits). Addresses state-of-the-art topics in the current literature in electrooptics.

ECE 5370 SPECIAL TOPICS IN PHOTONICS (3 credits). This course based on topics of current interest in the technical literature on electrooptics.

ECE 5371 SPECIAL TOPICS IN MICROELECTRONICS (3 credits). This course is based on topics of current interest in the technical literature on microelectronics.

ECE 5410 ELECTRODYNAMICS 1 (3 credits). Electrostatics and boundary value problems; solutions of Laplace's and Poisson's equations in Cartesian, spherical and cylindrical coordinates; electrostatic multipole fields; fields in dielectrics; magnetostatics; Maxwell's equations; plane electromagnetic waves; guided waves and resonant cavities; antennas and vector diffraction.

ECE 5411 ELECTRODYNAMICS 2 (3 credits). Special relativity; Lorentz transformations, relativistic kinematics, relativistic energy and momentum; covariance in electrodynamics; relativistic transformations of electromagnetic fields; Lagrangian and Hamiltonian formulations of relativistic particles and fields; the Lienard-Wiechert potentials; radiation from relativistic ally moving charges.

ECE 5412 ELECTRODYNAMICS 3 (3 credits). Klystrons and linear particle accelerators, proton synchrotrons and particle beam dynamics, synchrotron radiation, Cherenkov and transition radiation, free electron lasers. *(Prerequisite: ECE 5411.)*

ECE 5418 FIELD THEORY OF GUIDED WAVES 1 (3 credits). Maxwell's equations; time-harmonic electromagnetic waves; vector and scalar wave equations, analysis of electromagnetic field modes in rectangular and circular cylindrical waveguides using vector potential methods; phase and group velocity; transverse wave impedance; propagating waves and evanescent fields; resonant cavities.

ECE 5419 FIELD THEORY OF GUIDED WAVES 2 (3 credits). Hybrid field modes, longitudinal section electric (LSE) and magnetic (LSM) modes in partially filled waveguides; inhomogeneous boundary conditions and transcendental eigenvalue equations; dielectric waveguides and resonators; stripline and microstrip lines; ridged waveguides; spherical transmission lines and cavities.

ECE 5425 ANTENNAS 1 (3 credits). Students review basic electromagnetic principles; radiation from infinitesimal electric and magnetic dipoles; antenna directivity and gain; the one-way and radar range equations; array theory and phased arrays; wire antennas and broadband antennas.

ECE 5426 ANTENNAS 2 (3 credits). Equivalence principles; vector diffraction and its application to horn and reflector antennas; pattern antenna synthesis.

ECE 5430 ELECTROMAGNETIC TENSOR GREEN FUNCTIONS (3 credits). Green functions and their application to electromagnetics. Sturm-Liouville systems, eigenfunction expansions, and integral equation formulations of Green functions; time-harmonic electromagnetic fields and scalar Helmholtz-equation Green function solutions; vector electromagnetic wave equations and Dyadic Green functions. *(Prerequisite: ECE 3442.)*

ECE 5431 COMPUTATIONAL ELECTROMAGNETICS (3 credits). Finite difference solutions of differential equations; moment method solutions of integral equations; FDTD, FEM and GTD in electrodynamics.

ECE 5450 AUTOMATED RF MEASUREMENT (3 credits). Operating principles of vector network analyzers and their use in measurement of active and passive two-port RF and microwave networks, including detailed treatment of scattering parameters; spectrum analyzers and their use in measuring two-port transfer functions and mixer signal responses.

ECE 5451 MICROWAVE CIRCUIT DESIGN (3 credits). Scattering matrix representation of two-port microwave networks; impedance matching networks and signal flow graphs; microwave transistor amplifier and oscillator design; synthesis of Butterworth and Tschebyscheff filters.

ECE 5525 SPEECH PROCESSING (3 credits). Fundamentals of digital speech processing, digital models for speech signals, acoustic theory of speech production, speech perception, speech analysis, homomorphic speech processing, coding of speech signals, linear predictive coding, methods for speech recognition and digital speech processing for man-machine communication by voice. *(Prerequisite: ECE 3222.)*

ECE 5526 SPEECH RECOGNITION (3 credits.) Basic approaches in speech recognition, dynamic time warping, hidden Markov models and neural networks. *(Prerequisite: ECE 5525.)*

ECE 5527 SEARCH AND DECODING IN SPEECH RECOGNITION (3 credits). Issues with searching for best answers from recognition hypotheses generated by the recognizer, including lattice networks, dictionaries, language modeling and its use in speech recognition, network search algorithms, word networks and standard lattice format, finite state grammars, Bi-grams, N-grams and other language modeling techniques. *(Prerequisite: ECE 5226.)*

ECE 5528 ACOUSTICS OF AMERICAN ENGLISH SPEECH (3 credits). American English phonemes, speech and sound analysis, static properties of speech sounds; consonants, vowels, obsturent and vowel transitions, consonantal sonorant and vowels, consonant interactions and acoustic variability.

ECE 5534 COMPUTER NETWORKS 1 (3 credits). Theory, design, and analysis of computer communications systems. Topics include TCP/IP, Internet, the World Wide Web, ISO-OSI network architecture, LANs (Ethernet, Fast Ethernet, Token Ring, Token Bus, etc.), ATM, SONET, wireless communications, satellite networks, network modeling and simulation. *(Prerequisite: ECE 4561.)*

ECE 5535 COMPUTER NETWORKS 2 (3 credits). A continuation of ECE 5534 to include the following computer network design and analysis topics: network security, network management, distributed network environment, bridges, routers, gateways, congestion control, UNIX network programming, multimedia and network applications. *(Prerequisite: ECE 5534.)*

ECE 5546 SURVIVABLE NETWORK OBJECTS (3 credits). Development of distributed applications capable of surviving and roaming throughout the Internet by adapting to new environments while protecting their states. Topics include encryption, authentication, digital signature, digital certificate, secure socket layer, agent-based network applications and object registry. *(Prerequisite: ECE 5534.)*

ECE 5547 PRACTICAL INTERNET (3 credits). Network planning and configuration, switches, routers, firewalls, intrusion detection systems, private networks and virtual private networks, network management, client-server applications. *(Prerequisite: CSE 5231 or ECE 4561 or ECE 5534.)*

ECE 5551 HIGH-PERFORMANCE COMPUTING AND COMMUNICATION CONCEPTS (3 credits). Software and hardware concepts of high-performance computing and communications. Vertical integration of integrated circuits is addressed through HPCC computer architectures, including a thorough treatment of software for HPCC systems. *(Prerequisites: CSE 2502 and CSE 4001 or ECE 3551.)*

ECE 5555 WAVELET TRANSFORMS FOR IMAGE PROCESSING (3 credits). Topics include wavelet transforms, multiresolution analysis and wavelet design. Applications to signal compression, de-noising and feature detection are discussed. *(Prerequisite: ECE 5201 or ECE 5245.)*

ECE 5561 SWITCHING CONCEPTS (3 credits). The theory and logic design of combinational and sequential circuits. Topics include Boolean algebra, combinational circuit analysis, synthesis, decomposition, symmetric functions, threshold functions and logical completeness; sequential circuit analysis, synthesis and state minimization; and linear sequential circuits. *(Prerequisite: ECE 1552.)*

ECE 5570 SPECIAL TOPICS IN COMPUTER ENGINEERING (3 credits). This course is based on state-of-the-art topics in the current literature in computer engineering. *(Prerequisite: Instructor approval.)*

ECE 5571, 5572 DIGITAL SYSTEM DESIGN 1, 2 (3, 3 credits). An application of techniques learned in switching theory to the hardware organization of digital systems. Topics include organization and programming of a small computer; design convention; introduction to a hardware-design programming language and hardware programs; control unit microprogramming; intersystem communication; interrupt and input/output.

ECE 5577, 5578 DIAGNOSIS AND RELIABLE DESIGN OF DIGITAL SYSTEM 1, 2 (3, 3 credits). This course sequence addresses concepts of test generation, simulation and reliability enhancing design techniques for digital circuits and systems. Topics include basic concepts of reliability as applied to digital systems and the importance of maintainability; faults in digital circuits; test generation; fault-tolerant design.

ECE 5583 MULTIPROCESSING SYSTEMS (3 credits). Topics include the uniprocessor organization; the need for more than one processor; complexity of the task, widely different tasks, physically distant tasks, reliability; multiprocessor organization; parallel processing, distributed processing, networks; multiprocessor hierarchy; vertical hierarchy, horizontal hierarchy. *(Prerequisite: ECE 5571.)*

ECE 5595 SPECIAL PROJECTS IN COMPUTER ENGINEERING (3 credits). Special graduate projects are undertaken on a cooperative basis between the student and a member of the graduate faculty. *(Prerequisite: Instructor approval.)*

ECE 5951 SEMINAR IN ELECTRICAL AND COMPUTER ENGINEERING (1 credit). Familiarizes students with various topics in the areas of electrical and computer engineering. Faculty, graduate students and industry researchers offer weekly lectures. *(Prerequisite: Graduate standing.)*

ECE 5961 INTERNSHIP IN ELECTRICAL AND COMPUTER ENGINEERING (1 credit). This graduate level course provides an opportunity to gain practical experience in industries related to electrical or computer engineering. Students are placed in an industrial environment under the supervision of a practicing engineer. *(Prerequisite: Graduate standing.)*

ECE 5999 THESIS IN ELECTRICAL OR COMPUTER ENGINEERING (0–3 credits). Individual work under the direction of a member or members of the graduate faculty on a selected topic.

ECE 6301 ADVANCED SEMICONDUCTOR DEVICE THEORY (3 credits). Several semiconductor physical phenomena related to electrical device operation are discussed, including scattering and recombination theory, interactions of photons and phonons, detailed band theory and quantum effects in semiconductor devices. *(Prerequisite: ECE 5301.)*

ECE 6999 RESEARCH AND DISSERTATION IN ELECTRICAL OR COMPUTER ENGINEERING (0–6 credits). Taken by appointment with members of the electrical engineering graduate faculty. *(Prerequisite: Department head approval.)*

SCIENCE/MATHEMATICS EDUCATION

EDS 1005 INTRODUCTION TO EDUCATION (3 credits). Deepen understanding of education with a focus on schools, students, teachers, foundations, and the teaching profession. Topics include current education issues related to the philosophy, history, and politics of education, particularly in the United States.

EDS 1031 SURVEY OF SCIENCE 1: PHYSICAL SCIENCE (3 credits). Includes a survey of physics, chemistry and astronomy including motion, forces, energy, electricity, waves, the metric system and the application of science and technology to everyday living.

EDS 1032 SURVEY OF SCIENCE 2: LIFE SCIENCE (3 credits). Facilitates student understanding of laws, phenomena and processes of cellular and human biology, and to address selected current topics in ecology and environmental science.

EDS 2032 EDUCATIONAL TECHNOLOGY (3 credits). Prepares pre-service teachers for the classroom use of microcomputers and audiovisual equipment. It is designed to be taken before or during student teaching, and introduces a variety of ways that microcomputers and technology are being used in the classroom. (CL)

EDS 2042 LITERACY INSTRUCTION IN SECONDARY SCHOOL CONTENT (3 credits). Instructs preservice mathematics, science and technology teachers in the methods of teaching reading. Includes strategies, assessment, literature and writing. *(Prerequisite: EDS 1005.)*

EDS 3033 MEASUREMENT AND EVALUATION (3 credits). Investigates the foundation of educational measurement and evaluation, the techniques of educational measurement and the presentation and interpretation of data in an educational setting.

EDS 3034 ASSESSMENT AND EVALUATION (3 credits). Designed to help students develop both understanding and competence in alternative/authentic assessment and grading, and various kinds of school-based evaluation. Definitions and frameworks will guide readings and exercises. Selected competencies in these areas are designed to prepare students to meet teacher requirements. *(Prerequisite: EDS 3033.)*

EDS 3095 CLINICAL AND FIELD EXPERIENCE 1 (2 credits). Students engage in clinical and field experiences that complement EDS 3033 and EDS 4051. These experiences include assigned observations in secondary school classrooms, tutoring, small group work and other practical experiences. *(Corequisites: EDS 3033, EDS 4051.)*

EDS 3096 CLINICAL AND FIELD EXPERIENCE 2 (2 credits). Students engage in clinical and field experiences that complement EDS 3034 and 4071, 4072 or 4073. *(Corequisites: EDS 3034, and EDS 4071 or EDS 4072 or EDS 4073.)*

EDS 4051 METHODS AND MANAGEMENT OF MIDDLE AND HIGH SCHOOL TEACHING (4 credits). Students demonstrate methods of classroom management that constitute effective teaching practice as defined by the Florida Performance Measurement System. *(Prerequisite: EDS 1005.)*

EDS 4061 MULTILINGUAL/MULTICULTURAL EDUCATION (3 credits). Prepares future teachers with resources to promote cross-cultural awareness, language development and academic progress. Special attention to approaches, methodologies and techniques designed for limited English proficient children that help all students achieve success in content areas. *(Prerequisite: EDS 4071 or EDS 4072 or EDS 4073.)*

EDS 4071 METHODS AND STRATEGIES FOR TEACHING MIDDLE AND HIGH SCHOOL SCIENCE (4 credits). A study of the methods, programs and materials for teaching middle- and high-school science. Emphasis is on the laboratory-centered inquiry approach. *(Prerequisite: EDS 4051.)*

EDS 4072 METHODS AND STRATEGIES FOR TEACHING MIDDLE AND HIGH SCHOOL MATH (4 credits). Investigates the principles, skills and methods of teaching mathematics at the middle- and secondary-school level. Emphasis is on application and practice, featuring a hands-on, discovery approach. *(Prerequisite: EDS 4051.)*

EDS 4073 METHODS AND STRATEGIES FOR TEACHING COMPUTER SCIENCE K–12 (4 credits). Investigates the principles, skills and methods of teaching computer science at the K–12 level. Emphasis is on application and practice using computers. *(Prerequisite: EDS 4051.)*

EDS 4095 STUDENT TEACHING 1 (6 credits). An introduction to Florida's Beginning Teacher Program, the domains, the supporting research, and the evaluation instruments. Role-playing and the video camera are used to support the development of skills in the six teaching domains. Course requirements include 200 hours of student teaching experience. *(Prerequisite: EDS 4071 or EDS 4072 or EDS 4073.)*

EDS 4096 STUDENT TEACHING 2 (12 credits). Student teaching is the culminating experience required for all students in teacher education for graduation and recommendation for certification. It is an internship in an approved school under the supervision of an experienced, approved supervising teacher. *(Prerequisite: Completion of all other EDS course requirements.)*

EDS 4250 SCIENCE EDUCATION CASE STUDY (1–3 credits). In conjunction with adviser, student selects a single specific issue of topic in science education and performs an in-depth study of that area. *(Prerequisite: Instructor approval.)*

EDS 4595 STUDENT TEACHING (6 credits). An internship in an approved school under the supervision of an experienced, approved supervising teacher. Noncredit for undergraduate education majors. *(Prerequisites: Department head approval, EDS 4051, and EDS 4071 or EDS 4072 or EDS 4073.)*

EDS 4900 INTERDISCIPLINARY SCIENCE CAPSTONE SEMINAR (1 credit). This seminar is part of the capstone experience for a B.S. degree in the interdisciplinary science program. It is taken during the final semester of the program. Students are required to write a paper and present it orally. *(Prerequisite: Instructor approval.)*

EDS 5033 EFFECTIVE TEACHING AT THE COLLEGE LEVEL (3 credits). This course is designed for graduate students and/or faculty who currently teach or will be teaching undergraduates. Topics include methods of instruction, curriculum/course planning and delivery, record keeping and evaluation. Opportunities for self-assessment will also be provided.

EDS 5045 MULTILINGUAL/MULTICULTURAL EDUCATION (3 credits). Prepares future teachers with resources to promote cross-cultural awareness, language development and academic progress. Special attention to approaches, methodologies and techniques designed for limited English proficient children that help all students achieve success in content areas. *(Prerequisites: EDS 4071 or EDS 4072, PSY 2443.)*

EDS 5051 METHODS AND MANAGEMENT OF MIDDLE AND SECONDARY SCHOOL TEACHING (4 credits). Students demonstrate methods of classroom management that constitute effective teaching practice as defined by the Florida Performance Measurement System.

EDS 5055 FOUNDATIONS AND MANAGEMENT OF CLASSROOM INSTRUCTION (3 credits). A contemporary examination of the field and foundations of education and the teaching profession. Topics include the dynamics of school life, effective teaching practices, classroom management, ethical and legal issues facing teachers, economic and political issues, the history of American education and educational reform.

EDS 5067 MEASUREMENT AND EVALUATION (3 credits). Course work will include the foundations of educational measurement and evaluation, the techniques of educational measurement, the presentation and analysis of data collected through measurement and the application of measurement and evaluation. *(Prerequisite: Undergraduate statistics course.)*

EDS 5068 EDUCATIONAL ASSESSMENT (3 credits). This course expands on topics from statistics and undergraduate measurement and evaluation. Topics include validity, reliability, generalizability, item response theory, school testing, standardized tests and alternative assessment. Emphasis is on the purpose, methods and uses of student and teacher data. *(Prerequisite: Instructor approval.)*

EDS 5070 EDUCATIONAL STATISTICS (3 credits). Topics include sampling procedures, frequency distributions, measures of central tendency, estimation of variability, the normal distribution, differences between two groups, analysis of variance and correlation. Also included are nonparametric techniques, multivariate techniques and computer analysis of educational data.

EDS 5071 METHODS AND STRATEGIES OF TEACHING MIDDLE AND HIGH SCHOOL SCIENCE (4 credits). A study of the methods, programs and materials for teaching middle and high school science. Emphasis is on the laboratory-centered inquiry approach. *(Prerequisite: EDS 5051.)*

EDS 5072 METHODS AND STRATEGIES OF TEACHING MIDDLE AND HIGH SCHOOL MATHEMATICS (4 credits). Investigates the principles, skills and methods of teaching mathematics at the middle and secondary school level. Emphasis is on application and practice, featuring a hands-on discovery approach. *(Prerequisite: EDS 5051.)*

EDS 5081 RESEARCH 1 (1–6 credits). Individual research work conducted under the supervision of a science education faculty member.

EDS 5095 ESSENTIALS OF EDUCATIONAL RESEARCH (3 credits). Includes research skills and related competencies involved in the planning, conducting and reporting of applied research studies of the type required for a graduate degree.

EDS 5097 SCIENCE EDUCATION SEMINAR (1 credit). This seminar course includes reports and discussions of current research by staff, students, and guest educators.

EDS 5135 READING IN THE CONTENT AREA (3 credits). Students develop strategies for designing lessons that will lead middle and high school students to become active readers, engaged in the process of learning with textbooks as well as supplemental materials. An exploration of how to create active learning environments in which students know how, when and why to use all modes of language to learn is included.

EDS 5147 SCHOOL LAW (3 credits). The legal aspects of school financing, church-state relationships, injury to pupils, teacher and student rights and related maters. It includes examination of legislative case law related to these topics.

EDS 5203 THEORIES AND TRENDS IN EDUCATION (3 credits). Reviews basic principles in current educational theory and current trends in education.

EDS 5226 INTRODUCTION TO COMPUTERS IN EDUCATION (3 credits). An introductory review of various uses for microcomputers in schools. Topics include a review of current hardware available, computer application software, use of the World Wide Web, computer-assisted instruction software, networking and legal/ethical issues.

EDS 5227 EDUCATIONAL SOFTWARE EVALUATION AND DESIGN (3 credits). Proper design and appropriate evaluation of education software. Students write programs using established design techniques and procedures. Crash-proofing programs, user help menu methods, documentation techniques and screen formatting are covered. *(Prerequisite: EDS 5226.)*

EDS 5228 PRACTICUM IN COMPUTER EDUCATION (3 credits). The student creates a software product such as CAI courseware, classroom management programs or educational games. The course includes the development, field testing, evaluating and refinement of the product. Each student will complete the course with a publishable product. *(Prerequisite: EDS 5227.)*

EDS 5229 METHODS OF TEACHING COMPUTER LITERACY AND COMPUTER SCIENCE (3 credits). This methods course deals with two areas. First, it explores methods of teaching computer literacy and computer applications. Included are strategies for integrating computers into school curricula. Second, it deals with methods of teaching computer science.

EDS 5250 CASE STUDY: SCIENCE EDUCATION (1–3 credits). The case study involves a student selecting, in conjunction with his or her adviser, a single specific issue or topic in science education and performing an in-depth study of that area. The course is designed to allow a student with a special interest area in science education to pursue guided study in that area.

EDS 5299 CURRENT TOPICS IN COMPUTER EDUCATION (3 credits). Current topics in the use of computers in the educational setting. Course content varies from year to year.

EDS 5410 FOUNDATIONS OF ENVIRONMENTAL EDUCATION (3 credits). This course serves as an introduction to and overview of the field of Environmental Education. It includes an overview of the history and definition of EE, models of environmental literacy and behavior, and published needs assessments and status reports. It closes with an analysis of current needs/problems and opportunities in Florida.

EDS 5420 METHODS IN ECOLOGY AND ENVIRONMENTAL SCIENCE CONTENT (3 credits). This course focuses on concepts in ecology and environmental science, and principles for teaching and learning concepts. Students are introduced to models for teaching/learning concepts and generate lessons using selected models. The course concludes with an analysis of educational materials.

EDS 5430 METHODS FOR ENVIRONMENTAL PROBLEMS AND ISSUE INVESTIGATION (3 credits). This course focuses on skills for analyzing, investigating and evaluating environmental problems and issues. Students practice these skills and apply them in an investigation on a selected problem/issue. Other topics include skill-based teaching strategies and emphasis on these skills in programs and print materials.

EDS 5440 METHODS FOR CITIZENSHIP AND ENVIRONMENTAL RESPONSIBILITY (3 credits). This course emphasizes rationales and strategies for teaching citizenship and environmental responsibility. Students explore these topics from various perspectives, and develop and apply skills in these areas. They will review pertinent guidelines and strategies in social studies, science and environmental education.

EDS 5999 THESIS (0–6 credits). Individual research work, under the direction of a member of the graduate faculty, on a selected topic.

EDS 6000 READINGS IN EDUCATIONAL RESEARCH (3 credits). Investigation of relevant research in science, mathematics, environmental or computer education.

EDS 6010 RESEARCH PRACTICUM (3 credits). Creation of a pilot study in preparation for the doctoral dissertation.

EDS 6070 STATISTICS FOR EDUCATIONAL RESEARCH (3 credits). Topics include multiple regression/correlation methods, multivariate techniques and computer analysis of educational data. *(Prerequisite: EDS 5070.)*

EDS 6090 RESEARCH SEMINAR (0 credit). Allows faculty and peer Ed.D. students the opportunity to provide input and feedback into the development, design, conduct and reporting of Ed.D. dissertation studies. *(Corequisite: EDS 6999.)*

EDS 6095 RESEARCH-SCIENCE EDUCATION (1–6 credits). Research, under the guidance of a member of the science education faculty, in a selected area of science education.

EDS 6999 DISSERTATION-SCIENCE EDUCATION (0–9 credits). Research and preparation of the doctoral dissertation. *(Prerequisite: Admission to candidacy for the doctoral degree.)*

INTRODUCTION TO ENGINEERING

EGN 1000 INTRODUCTION TO ENGINEERING (3 credits). An introduction to engineering problem solving and professional aspects and ethics of engineering with lectures, laboratory demonstrations and field trips. Includes productive uses for microcomputers and spreadsheets. Presents an introduction to the fields of science and engineering taught at Florida Tech.

ENGINEERING MANAGEMENT

Note: Instructor approval is a prerequisite for all engineering management courses.

ENM 5100 QUALITY ENGINEERING (3 credits). Principles and techniques for establishing quality goals, identification of customer needs and requirements, measurement of quality objectives and product/process engineering to improve system performance.

ENM 5200 PROJECT ENGINEERING (3 credits). Principles of project management to design and develop products and services within budget, on time and to specification. Topics include work planning, organization design, requirements analysis, project control and PERT/CPM.

ENM 5310 TOPICS IN SYSTEMS ENGINEERING (3 credits). Topics selected from the field of systems engineering, such as requirement analysis, function allocation, cost engineering, risk management and system-level design.

ENM 5320 TOPICS IN TECHNICAL MARKETING (3 credits). Topics such as technology diffusion, competitive advantage, innovation, product development and positioning of high-technology products and services.

ENM 5330 TOPICS IN ENGINEERING OPERATIONS AND LOGISTICS (3 credits). Topics such as forecasting, plant location, facility layout, inventory systems, maintenance, process engineering, supply chains, scheduling, manufacturing and materials handling.

ENM 5340 TOPICS IN TEAM DYNAMICS AND PRODUCTIVITY (3 credits). Topics selected from the areas of team building, communications, creative problem solving in engineering, work design and engineering ethics.

ENM 5350 TOPICS IN ENGINEERING MODELING AND DESIGN (3 credits). Topics such as simulation, visualization, animation, graphics, CAD, deterministic and probabilistic models, and data analysis.

ENM 5360 TOPICS IN PRODUCT DEVELOPMENT AND TECHNOLOGY STRATEGY (3 credits). Topics such as technology transfer, product strategy formulation, visioning, technology road maps and innovation.

ENM 5495 SPECIAL PROJECTS IN ENGINEERING MANAGEMENT (3 credits). Special graduate projects are undertaken on a cooperative basis between the student and a member of the graduate faculty. The project may include a literature search in a selected area or research and development in one of the engineering management specialty areas.

ENM 5900 ENGINEERING MANAGEMENT INTERNSHIP (3 credits). Industry-based internship experience undertaken under the supervision of a member of the graduate faculty. The objective is to provide industrial experience to students without prior experience in a practical engineering setting. Industrial presentations are required.

ENM 5999 THESIS RESEARCH (3 credits). Individual research work under the direction of a member of the graduate faculty on a selected topic.

ENVIRONMENTAL SCIENCES

ENS 1001 THE WHOLE EARTH COURSE (3 credits). Six interrelated modules (cosmosphere, geosphere, hydrosphere, atmosphere, biosphere, anthroposphere) taught by faculty of the College of Engineering, School of Aeronautics, and College of Science and Liberal Arts, emphasizing the interactions and interdependence of Earth Systems including the role of humans in global change.

ENS 3101 ATMOSPHERIC ENVIRONMENTS (3 credits). Origin, fate, effects and distribution of air pollutants. Dispersion modeling, federal and state legislation, source control and monitoring will be covered. *(Prerequisite: Junior standing.)*

ENS 3105 ATMOSPHERIC POLLUTION LAB (1 credit). Laboratory exercises provide hands-on familiarity with air sampling devices and analytical methods of analysis. Laboratory work involves both the acquisition and the analysis of atmospheric samples. *(Corequisites: CHM 1101, ENS 3101, PHY 1001.)*

ENS 3911 ENVIRONMENTAL FIELD PROJECTS PROPOSAL (1 credit). Preparations are made for the summer research program, Environmental Field Projects. Students are guided through the process of selecting, designing and proposing research projects to be carried out during the summer.

ENS 4001 THE EARTH SYSTEM: SCIENCE, ENGINEERING, MANAGEMENT AND EDUCATION (3 credits). Series of seminar-style presentations by faculty, invited lecturers and students. Designed to holistically understand Earth as a system and the complexities of interactions between the near-Earth space environment, the solid Earth, the fluid Earth and the living Earth including humankind.

ENS 4004 AQUATIC ENVIRONMENTAL TOXICOLOGY (3 credits). See ENS 5004. *(Prerequisites: BIO 1020, CHM 1102, senior standing.)*

ENS 4010 GEOGRAPHIC INFORMATION SYSTEMS (3 credits). Concepts and applications of geographic information systems (GIS). Case studies are presented from environmental and geoscience applications.

ENS 4300 RENEWABLE ENERGY AND THE ENVIRONMENT (3 credits). Understanding human energy needs; alternative generating systems; renewable sources including biomass, hydro, ocean current, solar and wind; socio-economic implications of sustainable energy.

ENS 4600 RADIATION AND ENVIRONMENTAL PROTECTION (3 credits). Covers the sources and mechanisms that create environmental radiation hazards and methods for detection and measurement of radiation and a study of the biological effects of radiation. Methods of protection and decontamination are developed. *(Prerequisite: Instructor approval or senior standing.)*

ENS 4700 ENVIRONMENTAL HYDROLOGY (3 credits). Covers descriptive and quantitative aspects of surface and groundwater hydrology, emphasizing both data interpretation and measurement methodology. Subject areas of particular importance to environmental scientists and meteorologists are stressed. *(Prerequisite: Senior standing.)*

ENS 4701 ENVIRONMENTAL REGULATION AND IMPACT ASSESSMENT (3 credits). An analysis of environmental legislation and the impacts and implications of these regulations on society. Emphasis is placed on environmental impact analysis and environmental impact statement preparation methods. *(Prerequisite: Instructor approval or senior standing.)*

ENS 4800 LIMNOLOGY (3 credits). Chemical, physical, and biological dynamics of inland waters. *(Prerequisites: BIO 1020, CHM 1102.)*

ENS 4901, 4902, 4903 SPECIAL TOPICS IN ENVIRONMENTAL SCIENCE 1, 2, 3 (1, 2, 3 credits). Special course topics not covered in the regular curriculum, offered on occasion to specific student groups. *(Prerequisite: Instructor approval.)*

ENS 4911, 4912, 4913 ENVIRONMENTAL FIELD PROJECTS 1, 2, 3 (1, 2, 3 credits). These summer research investigations focus on environmental problems of local, regional and global dimensions. A major focus has been on the Indian River Lagoon system. Students often work in teams configured to accomplish the specific objectives. *(Prerequisite: Instructor approval or senior standing.)*

ENS 5000 ENVIRONMENTAL SCIENCE SEMINAR (0 credit). Reports and discussions of current research and environmental events by graduate students, faculty and visiting scientists. Required attendance for all graduate students.

ENS 5001 GLOBAL ENVIRONMENTAL PROBLEMS AND SOLUTIONS (3 credits). Analysis of global environmental problems including human population growth, climate change, ozone depletion, deforestation and decertification. Students research specific problems and develop potential solutions. *(Prerequisite: Instructor approval.)*

ENS 5004 AQUATIC ENVIRONMENTAL TOXICOLOGY (3 credits). The concepts of toxicology, classifications, kinetics of biological effects, and environmental sampling and testing. Topics include effect of environmental agents on aquatic systems and the fate of chemicals in the environment. *(Prerequisite: Graduate standing in science or engineering.)*

ENS 5009 INTERNSHIP (0–3 credits). Application of environmental resources management principles in off-campus activities designed to give actual experience with planning agencies, regulatory agencies and other related activities. The internship is designed to meet the background, training and career needs of the individual student. *(Prerequisite: Department head approval.)*

ENS 5010 ENVIRONMENTAL OPTICS AND REMOTE SENSING (3 credits). Methods for collecting and analyzing field and laboratory optical data related to water and plant canopies are described in detail. The methods covered via lectures and assignments are related to their use in remote sensing of the environment. *(Prerequisite: Instructor approval.)*

ENS 5101 INTRODUCTION TO AIR POLLUTION (3 credits). Origin, fate, effects and distribution of air pollutants. Coverage includes dispersion modeling, legislation, source control and monitoring.

ENS 5600 RADIATION AND ENVIRONMENTAL PROTECTION (3 credits). Covers the sources and mechanisms that create environmental radiation hazards and methods for detection and measurement of radiation and a study of the biological effects of radiation. Methods of protection and decontamination are developed.

ENS 5610 PRINCIPLES OF ENVIRONMENTAL SECURITY (3 credits). Scientific foundations of environmental hazards, factors leading to environmental instability, ecosystem resilience and sustainability, techniques to monitor the response of the Earth system, information synthesis, disaster preparedness and emergency response procedures, technical and political aspects of treaty monitoring, case studies.

ENS 5700 INTRODUCTION TO WATER RESOURCES (3 credits). Both descriptive and quantitative surface water and groundwater hydrology are stressed, particularly subjects of importance to environmental scientists such as hydrologic budgets, storm water management and groundwater quantity and quality.

ENS 5701 ENVIRONMENTAL REGULATION AND IMPACT ASSESSMENT (3 credits). An analysis of environmental legislation and the impacts and implications of these regulations on society. Emphasis is placed on environmental impact analysis and environmental impact statement preparation methods. *(Prerequisite: Graduate standing in science or engineering.)*

ENS 5800 LIMNOLOGY (3 credits). Chemical, physical, and biological dynamics of inland waters. *(Prerequisite: Graduate standing in science or engineering.)*

ENS 5901, 5092, 5093 SPECIAL TOPICS IN ENVIRONMENTAL SCIENCE (1, 2, 3 credits). Special course topics not covered in the regular curriculum. These courses are offered on occasion to specific student groups. *(Prerequisite: Instructor approval.)*

ENS 5999 THESIS RESEARCH (0–3 credits). Individual research under the direction of a member of the graduate faculty in a selected environmental topic. May be repeated for a maximum of six credits. *(Prerequisite: Thesis adviser approval.)*

ENS 6993 RESEARCH IN ENVIRONMENTAL SCIENCE (1–3 credits). Research under the guidance of a member of the graduate faculty. The course is repeatable as required.

ENS 6999 DISSERTATION IN ENVIRONMENTAL SCIENCE (0–6 credits). Research and preparation of the doctoral dissertation. *(Prerequisite: Admission to candidacy for the doctoral degree.)*

ENGLISH AS A SECOND LANGUAGE

Note: Credit cannot be applied toward any Florida Tech degree.

ESL 3401 GRAMMAR (3 credits). Enables students to communicate in oral and written forms of English using complex sentences. The focus is on formal academic structure, which is required for technical reading and writing.

ESL 3402 ORAL COMMUNICATION (3 credits). This course gives the more advanced student of English practice in oral communication within an academic setting. It also offers the student controlled practice with vowels, consonants, word stress and intonation patterns.

ESL 3403 LISTENING COMPREHENSION (3 credits). Provides students the opportunity to hear authentic English spoken with different speech patterns in a variety of academic lectures, to develop note-taking skills and to synthesize the facts contained in the listening selections.

ESL 3404 READING (3 credits). Offers guided practice in reading scientifically and academically oriented materials in English, with emphasis on strategies necessary to improve reading speed and quality of comprehension. It provides an opportunity for students to acquire vocabulary and a grasp of basic scientific concepts.

ESL 3405 WRITING (3 credits). Enables the student of English to apply techniques needed in planning, organizing and developing a good paragraph. Emphasis is on extended in-class written work, with individualized corrections and rewriting.

ESL 4001 GRAMMAR (3 credits). Includes a brief review of basic English structure and sentence patterns, followed by extensive practice on the features of more advanced English structure. Focus is on the elimination of habitual errors and on the acquisition of the quality and quantity of language necessary for academic success.

ESL 4002 ORAL COMMUNICATION (3 credits). This course teaches advanced skills in public speaking to the student of English. The course deals primarily with formal speaking situations, but also gives instruction in small group and interpersonal communication.

ESL 4003 LISTENING COMPREHENSION (3 credits). Prepares students of English for academic lecture comprehension. Students learn to refine note-taking skills and to synthesize information heard in lectures.

ESL 4004 READING (3 credits). Offers further directed reading of scientifically oriented academic materials in English, with emphasis on the development of efficient comprehension and analysis of a basic terminology in several fundamental scientific, technical and management disciplines.

ESL 4005 WRITING (3 credits). Provides extensive practice in basic organizational techniques needed for academic writing in English. Emphasis is on refining complex sentence structure and analyzing and organizing details into an appropriate paragraph.

HUMANITIES

Note: HUM 2051 and HUM 2052 are prerequisites for all 3000-level humanities courses.

HUM 2015 MYTHOLOGY (3 credits). A study of mythical structures, themes and characters in narratives from Sumerian, Egyptian, Classical, Medieval and non-European cultures. Topics include mythical elements in ritual, literature, music, dance and visual arts throughout history and their applications in the modern world. *(Prerequisite: COM 1102.)* (HU)

HUM 2051 CIVILIZATION 1: ANCIENT THROUGH MEDIEVAL (3 credits). An introduction to civilization from its early development to the European Renaissance. The emphasis is on the interpretation of primary texts that reflect the intellectual and historical changes in society. This is the first of two interdisciplinary courses. *(Prerequisite: COM 1102.)*

HUM 2052 CIVILIZATION 2: RENAISSANCE THROUGH MODERN (3 credits). Similar in purpose and method to Civilization 1, this course continues the interpretation of primary texts in which the emphasis is on the Renaissance period, the Enlightenment, Romanticism and the Modern Age. *(Prerequisite: COM 1102.)*

HUM 2080 PRINCIPLES OF SOCIOLOGY (3 credits). An introduction to the systematic explanation of man's social nature, types of groups and institutions, social processes and social changes. *(Prerequisite: COM 1102.)* (SS)

HUM 2480 INTRODUCTION TO POLITICAL SCIENCE (3 credits). Introduces students to the theories and concepts of political science. Emphasis is placed on examining the interaction between ideas, values and institutions in contemporary U.S. political culture. (SS)

HUM 2510 LOGIC (3 credits). This course deals mainly with deductive logic, although all the fallacies of reasoning are examined in both an informal and a formal context. The role of logic in both science and law is brought out, as well as ways of making formal proofs of validity. (HU)

HUM 2540 ETHICS (3 credits). A study of the most general standards of human conduct. Topics include current issues, professed moral authorities, conscience and the social development of moral codes, meanings of ethical terms, objectivity and subjectivity, determinism and emotivism, and critical expositions of some major ethical theories. (HU)

HUM 2570 BIOETHICS (3 credits). A study of ethical questions raised by 20th-century technology as they affect medicine, ecology and social issues. (HU)

HUM 3026 THE CIVILIZATION OF ISLAM (3 credits). Focuses on some of the achievements of Islam from 7th-century Arabic, to medieval Spain and India, to the 20th century. It will use documents from literature, theology, architecture, science and the contemporary media. (HU)

HUM 3085 SPECIAL TOPICS IN HUMANITIES (3 credits). This interdisciplinary course offers a study of a particular period, movement, genre or individual that embraces more than a single humanistic discipline. Course topics are announced prior to registration. (HU)

HUM 3141 EUROPEAN ART HISTORY (3 credits). Introduces the student to the history of European art from its foundations in the ancient Near East to the modern era. Emphasis is placed on the monumental traditions of sculpture, painting and architecture. (HU)

HUM 3150 MASTERWORKS OF MUSIC (3 credits). Works of master composers in the various stylistic periods, 1600 to the present: Bach and Handel; Mozart and Haydn; Beethoven; the 19th and early 20th centuries. (HU)

HUM 3185 SPECIAL TOPICS IN FINE ARTS (3 credits). A study of a particular period, movement or individual artist or composer. Course topics are announced prior to registration. (HU)

HUM 3230 SHAKESPEARE AND HIS CONTEMPORARIES (3 credits). Explores the development of English theater during the reign of Queen Elizabeth I and King James I. Students read representative plays by Shakespeare and his contemporaries. (HU)

HUM 3255 THE SHORT STORY (3 credits). A study of the development of the short story as a literary form with particular emphasis upon the outstanding practitioners of this genre in the 20th century. Attention is given to recent trends in the short story. (HU)

HUM 3275 CONTEMPORARY LITERATURE (3 credits). A study of literature since the 1960s. Readings may include short stories, plays, poems and novels by McGuane, Davies, Percy, Fowles, Pinter, Beckett and Morrison. The syllabus varies considerably from semester to semester. (HU)

HUM 3280 NARRATIVE FILM (3 credits). Examines the structures and techniques that narrative films use to communicate ideas. Students examine films from various genres, of different types and from all periods of film history. (HU)

HUM 3285 SPECIAL TOPICS IN LITERATURE (3 credits). A study of a particular author, a group of authors, a historical literary movement or a literary theme or genre. Course topics will be announced prior to registration. (HU)

HUM 3331 AMERICAN HISTORY: PRE-COLUMBIAN TO CIVIL WAR ERA (3 credits). This course surveys some of the basic problems in U.S. history through the Civil War era. Emphasis is given to origins, social characteristics and competing cultural values of the peoples that formed the American nation. (HU/SS)

HUM 3332 AMERICAN HISTORY: FROM RECONSTRUCTION TO THE PRESENT (3 credits). Students examine the major ideas, ideals and events that have determined the American experience in the 19th and 20th centuries. (HU/SS)

HUM 3351 HISTORY OF SCIENCE AND TECHNOLOGY: ANCIENT AND MEDIEVAL (3 credits). Surveys the origins of science in antiquity and the Middle Ages. Topics include development of mathematical, physical and biological thought in the ancient and medieval period, and the relationship between science, technology and religion. (HU/SS)

HUM 3352 HISTORY OF SCIENCE AND TECHNOLOGY: RENAISSANCE TO PRESENT (3 credits). Surveys the principal developments in science, mathematics and technology from the Renaissance to the present. Topics include scientific revolution, development of modern biology and the relationship between technology and science. (HU/SS)

HUM 3385 SPECIAL TOPICS IN HISTORY (3 credits). This course offers an opportunity for an in-depth analysis of a historical problem or event. Topics include a wide range of possibilities. Course topics are announced prior to registration. (HU/SS)

HUM 3485 SPECIAL TOPICS IN SOCIAL SCIENCE (3 credits). A study of a particular social group or institution, social process or social change. Course topics are announced prior to registration. (SS)

HUM 3521 WORLD RELIGIONS (3 credits). Introduces religion and examines the philosophy of religion. Religion is seen as humanity's attempt to grapple with the question of the meaning of life, the forms that religious perspectives have taken and the universal aspects of human existence. (HU)

HUM 3551 SURVEY OF ANCIENT AND MEDIEVAL PHILOSOPHY (3 credits). A survey of the history of philosophy from its beginnings with the pre-Socratic Greeks up through its influence on Christian Scholasticism in the Middle Ages. It covers the sweep of intellectual history from Thales to Thomas. (HU)

HUM 3552 SURVEY OF MODERN AND CONTEMPORARY PHILOSOPHY (3 credits). A survey of philosophy beginning with the Renaissance rise of science. The course follows Rationalism and Empiricism, the philosophies of Kant, Hegel and Marx, and concludes with two main movements of the 20th century: analytic philosophy and existentialism. (HU)

HUM 3585 SPECIAL TOPICS IN PHILOSOPHY (3 credits). A study of a particular period, movement, or individual philosopher or religious figure. Course topics are announced prior to registration. (HU)

HUM 4100 SENIOR CAPSTONE PROJECT (3 credits). A project consisting of original research that will result in a substantial written work about a significant issue in the humanities is intended to serve as the culmination of a humanities major's undergraduate program. *(Prerequisite: Senior status and department head approval.)* (HU)

HUM 4150 INDEPENDENT STUDY (3 credits). This course offers the humanities major an opportunity to study a particular period, movement, genre or individual, under the supervision of a faculty member. *(Prerequisite: Department head approval.)* (HU)

LANGUAGE REVIEW

Note: Credit cannot be applied toward any Florida Tech degree.

LNE 1040 READING SKILLS REVIEW (3 credits). An intensive review of academic reading skills with emphasis on vocabulary building, reading for specific information, making inferences or judgments about what is read, and improving test-taking skills. This course is designed for nonnative speakers of English who require review work for academic success.

LNE 1050 WRITING SKILLS REVIEW (3 credits). An intensive review of the elements of grammar with emphasis on vocabulary and syntax. This course provides basic techniques of paragraph writing and is designed for nonnative speakers of English who require review work for academic success.

LANGUAGES AND LINGUISTICS

LNG 1101, 1102 ELEMENTARY FRENCH 1, 2 (3, 3 credits). An introduction to the four basic language skills (listening, speaking, reading and writing) in French and to French culture. Native speakers may not take these courses. (HU/SS)

LNG 1201, 1202 ELEMENTARY GERMAN 1, 2 (3, 3 credits). An introduction to the four basic language skills (listening, speaking, reading and writing) in German and to German culture. Native speakers may not take these courses. (HU/SS)

LNG 1301, 1302 ELEMENTARY SPANISH 1, 2 (3, 3 credits). An introduction to the four basic language skills (listening, speaking, reading and writing) in Spanish and to Spanish culture. Native speakers may not take this course. (HU/SS)

LNG 1601, 1602 ELEMENTARY ITALIAN 1, 2 (3, 3 credits). An introduction to the four basic language skills (listening, speaking, reading and writing) in Italian and to Italian culture. Native speakers may not take these courses. (HU/SS)

LNG 2101, 2102 INTERMEDIATE FRENCH 1, 2 (3, 3 credits). A review of French grammar, with emphasis on conversation and reading assignments from literature and culture at the intermediate level. Native speakers may not take these courses. *(Prerequisite: LNG 1102 or two years of high school French.)* (HU/SS)

LNG 2201, 2202 INTERMEDIATE GERMAN 1, 2 (3, 3 credits). A review of German grammar, with emphasis on conversation and reading assignments from literature and culture. Native speakers may not take these courses. *(Prerequisite: LNG 1202 or two years of high school German.)* (HU/SS)

LNG 2301, 2302 INTERMEDIATE SPANISH 1, 2 (3, 3 credits). A review of Spanish grammar, with emphasis on conversation and reading assignments from literature and culture at the intermediate level. Native speakers may not take these courses. *(Prerequisite: LNG 1302 or two years of high school Spanish.)* (HU/SS)

LNG 3085 SPECIAL TOPICS IN FOREIGN LANGUAGE LITERATURE (3 credits). An advanced study of a particular author, a group of authors, a historical literary movement or a literary theme or genre in the original foreign language. Course topics will be announced in advance. *(Prerequisite: LNG 2102 or LNG 2302.)* (HU/SS)

LNG 3301, 3302 ADVANCED SPANISH 1, 2 (3, 3 credits). Selected readings from Spanish literature and other timely topics for continued development in reading, writing and speaking skills. *(Prerequisite: LNG 2302 or four years of high school Spanish or prerequisite course.)* (HU/SS)

LNG 3401 GENERAL LINGUISTICS (3 credits). Students explore the foundation blocks of human language: phonology, morphology, syntax and semantics. They also study current linguistic theory, language universals and the social and biological aspects of language acquisition. (HU/SS)

LNG 3402 SOCIOLINGUISTICS (3 credits). Students are introduced to the sociology of language and the many ways people use language to communicate and interact socially. (HU/SS)

LNG 5210 ASPECTS OF LANGUAGE (3 credits). Provides a comprehensive overview of a variety of complex and intricate aspects of language and linguistic science. Major topics will include: sounds and sound patterns (phonology); word formations and their patterns (morphology); sentence structure (syntax); and meaning (semantics).

MECHANICAL/AEROSPACE ENGINEERING

MAE 1022 INTRODUCTION TO MECHANICAL ENGINEERING 1 (2 credits). Introduces students to engineering problem-solving methodologies. A computer-based approach is used including word processing, spreadsheet, data visualization, numeric computation and computer-aided design. Student teams write proposals for design projects completed in MAE 1023. (CL)

MAE 1023 INTRODUCTION TO MECHANICAL ENGINEERING 2 (1 credit). Student team projects are carried to fruition including the design, implementation and evaluation of their designs relevant to the given design criteria. Interim written and oral reports are required, as well as a final report and design demonstration. Normally these design projects will involve team competition. *(Prerequisite: MAE 1022.)*

MAE 1025 MECHANICAL ENGINEERING PRACTICUM 1 (1 credit). Students support senior student engineering design team projects by helping to develop design concepts, formalize designs through sketches and drawings, fabricate mechanical components, test component performance and other activities related to the successful completion of design projects. *(Corequisite: MAE 1023.)*

MAE 1201 INTRODUCTION TO AEROSPACE ENGINEERING (1 credit). Provides a broad overview of the aerospace engineering profession through class meetings involving formal lectures and presentations, and site/laboratory visits. Introduces the concept of aerospace design as a precursor to a competitive freshman design project to be implemented in MAE 1202.

MAE 1202 AEROSPACE PRACTICUM (2 credits). Introduces elementary design concepts related to aerodynamics and aerospace structures. A computer-based setting includes word processing, spreadsheet analysis, computer-aided design, graphics and documentation. Group design projects are planned, analyzed, constructed, tested and reported in both lecture and laboratory settings. *(Prerequisite: MAE 1201.)* (CL)

MAE 2024 SOLIDS MODELING AND 3-D MECHANICAL DESIGN PRINCIPLES (3 credits). Students create geometries in isometric and perspective views, free-form solids and sectioned solids to produce layouts for dimensioning/tolerancing. Computer analysis focuses on determining inertial properties and interference checking. *(Corequisite: MAE 3083.)*

MAE 2025 MECHANICAL ENGINEERING PRACTICUM 2 (1 credit). A continuation of MAE 1025 with a higher level of responsibility and more advanced requirements. *(Prerequisite: MAE 1025.)*

MAE 2081 APPLIED MECHANICS: STATICS (3 credits). Topics include the elements of statics in co-planar and three-dimensional systems; equilibrium of particles and rigid bodies; simple structures, centroids and center of gravity; beam shear and bending moment; friction; and virtual work. *(Prerequisite: PHY 1001; corequisite: MTH 2001.)*

MAE 2082 APPLIED MECHANICS: DYNAMICS (3 credits). An analysis of kinematics and kinetics of particles, systems of particles, and rigid bodies. Absolute and relative motion approaches are discussed. Force-mass-acceleration, work-energy and impulse-momentum methods are employed. *(Prerequisite: MAE 2081.)*

MAE 2201 AEROSPACE FUNDAMENTALS (2 credits). An introduction to the theory and analysis of structures, aerodynamics, propulsion and control. The theoretical advances and continuing developments are presented from a historical perspective by stressing the roles and contributions of pioneers. *(Prerequisites: MTH 1002, PHY 1001.)*

MAE 3024 COMPUTER-AIDED ENGINEERING (3 credits). Students generate finite element models from solid geometries, defining load, boundary and constraint conditions, characterizing material properties and optimizing performance. Students use computer models to perform stress, stability and dynamic analysis of mechanical components and assemblies. *(Prerequisites: CHE 3260, MAE 2024, MAE 2082.)*

MAE 3025 MECHANICAL ENGINEERING PRACTICUM 3 (1 credit). A continuation of MAE 2025 with a higher level of responsibility and more advanced requirements. *(Prerequisite: MAE 2025.)*

MAE 3061 FLUID MECHANICS 1 (3 credits). The course includes an introduction to fluid variables; fluid statics; flow kinematics; equations of mass, momentum and energy conservation in both integral and differential formulations; similitude and dimensional analysis; the stress tensor; inviscid and viscous flows; flow in pipes; laminar and turbulent flows. *(Prerequisites: MAE 2082, MAE 3191, MTH 2201, PHY 2002.)*

MAE 3062 FLUID MECHANICS 2 (3 credits). A study of high-speed compressible flow. Boundary-layer theory introduced in MAE 3061 is extended to the compressible case. Other topics include normal and oblique shocks; compressible flow in ducts and nozzles; Mach waves; Prandtl-Meyer expansions; method of characteristics; unsteady 1-D flows; and conical flow. *(Prerequisite: MAE 3061.)*

MAE 3064 FLUID MECHANICS LABORATORY (1 credit). A laboratory course that provides a working familiarity with the physical principles, measurement and flow visualization techniques in fluid mechanics. *(Prerequisites: MAE 2082, MAE 3191, MTH 2201, PHY 2002, PHY 2092.)*

MAE 3083 MECHANICS OF MATERIALS (3 credits). Stress and strain; mechanical properties of materials; Hooke's law; axial, torsion, pure bending and transverse loading of members; transformations of stress and strain; failure criteria; strain measurements; thin-walled pressure vessels; design for strength; energy methods; design for impact; column buckling and stability. *(Prerequisite: MAE 2081.)*

MAE 3090 DESIGN OF MACHINE ELEMENTS (3 credits). The design of basic machine elements with an emphasis on failure prevention. Elements include screws, fasteners, connections, welded/brazed joints, springs, bearings, gears, clutches, brakes, couplings, flywheels, flexible mechanical elements and shafts. *(Prerequisites: CHE 3260, CHE 3265, MAE 3083.)*

MAE 3091 THEORY OF MACHINES (3 credits). Kinematics and dynamics of mechanisms, including structural and mobility considerations; graphical, analytical and computer methods for velocities and accelerations in constrained motion; cams and gears; analysis of combined static and dynamic forces arising from uniform and accelerated motion; and dynamic balancing. *(Prerequisites: MAE 2082, MTH 2201.)*

MAE 3191 ENGINEERING THERMODYNAMICS 1 (3 credits). A study of the conservation of energy and mass in closed- and open-flow systems. It includes the physical properties and equations of state for pure substances; the first and second laws of thermodynamics; and reversible processes and carnot cycle. *(Prerequisite: CHM 1101; corequisites: MTH 2001, PHY 2002.)*

MAE 3192 ENGINEERING THERMODYNAMICS 2 (3 credits). Practical problems involving power and refrigeration cycles and chemical thermodynamics, the combustion process and compressible flows as examined in applications involving nozzles and blade passages. *(Prerequisite: MAE 3191.)*

MAE 3241 AERODYNAMICS AND FLIGHT MECHANICS (3 credits). Dynamics of frictionless fluid including the effects of unsteadiness and three dimensionality; tools and rules for the construction of elementary flows about bodies, flows about airfoils and wings in three dimensions. *(Prerequisites: MAE 3061, MTH 3501; corequisite: MAE 3062.)*

MAE 3260 EXPERIMENTAL AERODYNAMICS (3 credits). A laboratory course that offers theory and practice in wind tunnel test techniques, measurements of lift and drag by force balance, pressure distributions and wake surveys, LDA, thermal anemometry, computer-based data acquisition and reduction using LABVIEW and uncertainty analysis. *(Prerequisites: MAE 3064, MAE 3241.)*

MAE 3291 JUNIOR DESIGN (1 credit). Introduces the concepts and methodology of rational aerospace design through interaction with seniors completing their capstone design projects and development of team proposals for capstone design projects that will be implemented during the senior year. *(Prerequisite: Junior standing.)*

MAE 4014 CONTROL SYSTEMS (3 credits). This course stresses both classical and modern control methodologies. Topics include frequency and time-domain representation of linear systems, stability analysis and design techniques. *(Prerequisites: ECE 4991, MTH 2201.)*

MAE 4024 MECHANICAL VIBRATIONS (3 credits). Focuses on both discrete and continuous systems. Topics include free and forced vibration of single and multiple degrees of freedom systems, and vibration control techniques. *(Prerequisites: MAE 2082, MAE 3083, MTH 3201.)*

MAE 4050 APPLIED FINITE ELEMENT METHOD IN MECHANICAL DESIGN (3 credits). The finite element method is presented with application to mechanical design configurations. Numerical solutions are generated for mechanical components subjected to static, dynamic and buckling loads. *(Prerequisites: MAE 2082, MAE 3083.)*

MAE 4071 THERMAL SYSTEMS DESIGN (3 credits). Radiative heat transfer applications in thermal systems. Elementary methods of optimization for design. Application of thermodynamics, fluid mechanics and heat transfer. Equipment fundamentals with emphasis on heat exchanger design and analysis. Design projects involving use of software and laboratory experiments. *(Prerequisite: MAE 4171.)*

MAE 4074 HEAT TRANSFER LABORATORY (1 credit). A laboratory course intended to reinforce the activities associated with MAE 4171 and MAE 4071. The student investigates the physics of heat transfer (conduction, convection, radiation) using modern experimental techniques. *(Prerequisite: MAE 4171.)*

MAE 4078 COMPUTER-AIDED DESIGN (3 credits). A study of techniques used in 3-D computer-aided design (CAD) systems in the design process; principles of geometry construction, detailing, solids modeling and rendering; and interfacing CAD generated parts with finite element (FE) software for design analysis and evaluation. *(Prerequisites: MAE 2082, MAE 3083.)*

MAE 4090 ROBOTICS AND AUTOMATED MANUFACTURING (3 credits). Topics include industrial robots, robot actuators, teaching robots, automated parts handling, robot workcell planning and implementation, numerical control and CAD/CAM, programmable logic controllers and modern rapid prototyping techniques. *(Prerequisite: MAE 3091.)*

MAE 4121 MANUFACTURING ENVIRONMENT (3 credits). An introduction to manufacturing processes traditional and nontraditional processes, as well as computer-aided manufacturing and robotics. Design for manufacture and assembly; Deming and Taguchi; short machine-shop lab; and individual or group product design. *(Prerequisites: CHE 3260, CHE 3265, MAE 3083.)*

MAE 4171 PRINCIPLES OF HEAT TRANSFER (3 credits). Steady-state and transient heat conduction for one- and multidimensional systems; free and forced convection in both internal and external flows for laminar and turbulent conditions; boiling and condensation. Introduction to radiation properties, blackbody radiation and surface emission. *(Prerequisites: MAE 3061, MTH 3201.)*

MAE 4175 HEATING, VENTILATION AND AIR CONDITIONING (3 credits). Air-vapor mixture properties and psychrometrics, solar radiation in heating and air conditioning applications, heating/cooling load calculations, annual energy consumption, heat generation and cooling processes. *(Prerequisites: MAE 3061, MAE 3192, MAE 4171.)*

MAE 4176 COMBUSTION ENGINEERING (3 credits). Analysis of combustion devices and systems (e.g., boilers, gas turbines, engines), pollutant formation and control, fuels, analysis of open flames and fires. *(Prerequisite: MAE 4171 or instructor approval.)*

MAE 4177 ENERGY CONVERSION TECHNOLOGIES (3 credits). Energy resources, conversion processes and energy economics. Consideration of fuel supplies, thermodynamics, environmental impact and energy storage. Emphasis on conversion of natural sources to electricity, treating both the technical and economic aspects of fossil, nuclear, solar and geothermal power production. *(Prerequisites: MAE 3192, MAE 4171.)*

MAE 4178 SOLAR ENERGY ANALYSIS (3 credits). Fundamental issues such as solar radiation, radiation properties of opaque and transparent materials, solar collectors and storage, system thermal calculations and solar process economics; application areas such as solar water heating, building heating and cooling, solar thermal power systems. *(Prerequisite: MAE 4071.)*

MAE 4190 DESIGN METHODOLOGIES AND PRACTICE (1 credit). Covers engineering ethics and design methodologies with case studies. Presentation of relevant design projects and case studies are made by faculty and invited engineers representing local industry. Development of a proposal for MAE 4193 is required. *(Prerequisites: COM 2223 and junior standing in mechanical engineering.)*

MAE 4193 MECHANICAL ENGINEERING DESIGN 1 (3 credits). Student teams work on engineering projects proposed in MAE 4190 or by the faculty, as well as projects sponsored by industry. These projects are selected from a broad range of technical areas, including mechanical design, thermal and fluid system analyses, instrumentation and control, energy system analysis. *(Prerequisites: MAE 4190, senior standing.)*

MAE 4194 MECHANICAL ENGINEERING DESIGN 2 (4 credits). Student teams complete their design projects. Details of engineering analyses and prototype construction and testing results including sensitivity, optimization and cost analyses are presented and outlined in a written final report. Oral presentations are made to faculty and engineers from participating industry. *(Prerequisite: MAE 4193.)*

MAE 4242 AIRCRAFT STABILITY AND CONTROL (3 credits). Static stability of an airplane in pitch and sideslip; static manual control; general equations of unsteady motion; the stability of derivatives; stability of uncontrolled motion (lateral and longitudinal), including characteristic motions, their frequencies and their rates of decay. *(Prerequisites: MAE 3061, MTH 3101.)*

MAE 4261 AIR-BREATHING ENGINES (3 credits). A study of the performance analysis and component design of air-breathing engines. The course includes ideal and actual cycle analyses, thrust and efficiency considerations, the flows in inlets and diffusers, combustors and nozzles, as well as compressors and turbines. *(Prerequisite: MAE 3062.)*

MAE 4262 ROCKETS AND MISSION ANALYSIS (3 credits). Deals with performance analysis of rockets, the primary emphasis will be on chemical rocket propulsion: thrust and specific impulse, mission requirements and rocket staging; solid- and liquid-propellant rockets, and propellants; and orbital mechanics and mission analyses. *(Prerequisite: MAE 4261.)*

MAE 4281 AEROSPACE STRUCTURAL DESIGN (3 credits). Bending, shear and torsion of open and closed sections, bending of thin plates, structural instability; stress analysis of aircraft components, introduction to finite element methods, airworthiness and elementary aeroelasticity. Design issues are stressed in all topics. *(Prerequisite: MAE 3083; corequisites: MAE 4284, MTH 3201.)*

MAE 4284 AEROSPACE ENGINEERING STRUCTURES LABORATORY (1 credit). Experimental testing of structures and structural components. Presents a variety of testing methods and utilizes a variety of materials, including advanced composites. Introduces topics in experimental stress analysis. Hands-on involvement by students is emphasized in all areas. *(Prerequisite: MAE 3083; corequisite: MAE 4281.)*

MAE 4291, 4292 AEROSPACE ENGINEERING DESIGN 1, 2 (3, 3 credits). Design of an aircraft, spacecraft or component to meet desired needs. Students are given a simulated request for proposals including a measure of merit and a set of specifications that a satisfactory design must meet. Students form teams to work under faculty supervision to develop a design to best meet these requirements. Students present their designs in written reports at the end of each semester. Lectures, readings and group discussions introduce some of the ethical and legal issues that engineers must face. *(Prerequisites: MAE 3062, MAE 3083, MAE 3241, MAE 4281; corequisites: MAE 3260, MAE 4242, MAE 4261.)*

MAE 4300 INDEPENDENT STUDY IN MECHANICAL ENGINEERING (3 credits). Student/faculty research on topics of mutual interest on an individual basis. The subject matter is topical to mechanical engineering at a level that is commensurate with advanced undergraduate standing. *(Prerequisite: Department head approval.)*

MAE 4316 MECHATRONICS (3 credits). Microprocessor-based control of electromechanical systems. Sensors and actuators; assembly programming and microprocessor architecture; serial and parallel input/output, programmable peripherals, interrupts. Signal interfacing, standard interface protocols, analog to digital conversion and real-time control. Design of microprocessor-based systems. *(Prerequisite: Senior standing.)*

MAE 4318 INSTRUMENTATION AND MEASUREMENT SYSTEMS (3 credits). Fundamentals of sensors and measurements for engineering applications; software/hardware tools for development of computer-based instrumentation systems. Analog signals, signal conditioning. Programming virtual instruments. Communication standards; data acquisition and process control. *(Prerequisite: Senior standing.)*

MAE 4322 ADVANCED CONTROLLER DESIGN: MULTIVARIABLE AND NONLINEAR (3 credits). Design and implementation of high-performance feedback control systems for engineering applications. Feedback and sensitivity. Feedforward, multiloop and MIMO systems. Frequency response techniques. Controller design based on frequency response. Advanced linear methods. Analysis and design of nonlinear systems. *(Prerequisite: MAE 4024.)*

MAE 4400 INDEPENDENT STUDY IN AEROSPACE ENGINEERING (3 credits). Research on aerospace engineering topics of mutual interest to students and faculty on an individual basis. May qualify as a technical elective, subject to faculty approval. *(Prerequisite: Department head approval.)*

MAE 4500 SPECIAL TOPICS IN MECHANICAL ENGINEERING (3 credits). Faculty presents technical course material on topics of special interest to mechanical engineers. The normal format consists of classroom lectures and assigned readings or projects for the students. Course may fulfill requirements of a technical elective, subject to faculty approval. *(Prerequisite: Department head approval.)*

MAE 4600 SPECIAL TOPICS IN AEROSPACE ENGINEERING (3 credits). Technical course material presented by faculty on an irregular basis on topics of special interest to aerospace engineers. May qualify as a technical elective, subject to program approval. *(Prerequisite: Department head approval.)*

MAE 4630 MODELING, SIMULATION AND DESIGN OF DYNAMIC SYSTEMS (3 credits). Covers various systems, including mechanical, electrical, thermal, fluid, etc.; state-variable and input-output techniques; classical and Laplace transform and numerical solutions; transient and steady-state and frequency response analyses; and comparison with experimental response. *(Prerequisite: Senior standing.)*

MAE 5050 FINITE ELEMENT FUNDAMENTALS (3 credits). Includes finite element formulation of a continuum, virtual work and energy principles, one- and two-dimensional problems; Ritz method, weighted residuals; time-dependent problems; Isoparametric formulations and recent developments utilizing elementary finite element methods and existing software. *(Prerequisites: MAE 2082, MAE 3083, MTH 2201.)*

MAE 5060 APPLICATIONS IN FINITE ELEMENT METHODS (3 credits). Emphasizes finite element simulation methods for problems in mechanical design; static solutions; eigenvalue techniques in stability and dynamic analysis; direct and reduced basis formulation of dynamical equations; analyses of structures; use of commercially available software. *(Prerequisites: MAE 2082, MAE 3083, MTH 2201.)*

MAE 5110 CONTINUUM MECHANICS (3 credits). Mathematical preliminaries, kinematics of motion, equation of conservation mass, equations for the rates of change of translational momentum, rotational momentum, and energy; the entropy inequality; models of material behavior including the linearly viscous fluid and the linearly elastic solid. *(Prerequisites: MTH 2001, MTH 2201.)*

MAE 5120 AERODYNAMICS OF WINGS AND BODIES (3 credits). Approximate analytic solution of nonlinear problems in aerodynamics (including those associated with the effects of compressibility) by iterative methods that exploit the smallness of small parameter; flow about slender wings and bodies; flow about wings with high-aspect ratio. *(Prerequisite: MAE 5110.)*

MAE 5130 VISCOUS FLOWS (3 credits). Theory of Navier-Stokes equations; exact solutions for steady and unsteady plane, duct, jet and stagnation point flows; Stokes and Oseen approximations; the Prandtl concept of the boundary layer and similarity solutions Blasius, Hiemenz, Faulkner and Skan, Hartree, etc.; approximate solutions for nonsimilar boundary layers. *(Prerequisite: MAE 5110.)*

MAE 5140 EXPERIMENTAL FLUID DYNAMICS (3 credits). Introduces students to test facilities such as wind tunnels and water tanks. Topics include measurements of force and pressure distribution on airfoil principles and applications of laser Doppler velocimetry, hot-wire anemometry, flow visualization methods and modern data acquisition systems (LABVIEW). *(Prerequisite: MAE 5110.)*

MAE 5150 COMPUTATIONAL FLUID DYNAMICS (3 credits). Elliptic, parabolic, and hyperbolic PDEs; finite-difference formulations; explicit and implicit methods, stability analysis; operator splitting, multistep methods; boundary conditions; grid generation techniques; applications involving Euler boundary layer and full Navier-Stokes equations. *(Prerequisites: MAE 5110, MTH 3201.)*

MAE 5160 GAS DYNAMICS (3 credits). Differential conservation equations; one-dimensional steady flows; unsteady wave motion; small perturbations and linearized flows; bodies of revolution, conical flows, and slender body theory; blunt-body flows; three-dimensional supersonic flows; transonic flows; the method of characteristics and numerical computation for supersonic flows; real gas effects. *(Prerequisites: MAE 5110, MAE 5150.)*

MAE 5180 TURBULENT FLOWS (3 credits). General introduction, isotropic, homogeneous and shear-flow turbulence, transport processes in turbulent flows, wall and free turbulent shear flows, atmospheric turbulence. *(Prerequisite: MAE 5110 or MAE 5130.)*

MAE 5190 SELECTED TOPICS IN FLUID DYNAMICS (3 credits). Selected topics reflecting the current research interests of the faculty and visiting scholars.

MAE 5210 CONDUCTION HEAT TRANSFER (3 credits). Conservation of energy in a deformable continuous medium, the thermal conductivity tensor, superposition, Duhamel's theorem and product solutions; heat flow in one dimension, similarity, Sturm-Liouville theory, the Laplace transform and variable conductivity; generalized Fourier series and Green function techniques. *(Prerequisite: MAE 4171.)*

MAE 5220 CONVECTION HEAT TRANSFER (3 credits). Review of the principle of energy conservation, heat conducting fluid; boundary-layer approximations for large Reynold's number; exact and approximate treatment of laminar internal and external forced convection; turbulent forced convection; and buoyancy-induced convection. *(Prerequisite: MAE 5210 or instructor approval.)*

MAE 5230 RADIATION HEAT TRANSFER (3 credits). Development of radiative properties from electromagnetic theory; theory and analysis of shape factors, enclosure radiative transfer with diffuse-gray and nongray surfaces and an introduction to radiative transfer within participating media and semitransparent solids. *(Prerequisite: MAE 4171.)*

MAE 5290 SELECTED TOPICS IN HEAT TRANSFER AND ENERGY (3 credits). Advanced topics reflecting the current research interests of the faculty and visiting scholars. *(Prerequisite: Instructor approval.)*

MAE 5310 COMBUSTION FUNDAMENTALS (3 credits). Includes equilibrium chemical thermodynamics and thermochemistry, chemical kinetics, transport phenomena and conservation equations; Rankine-Hugoniot theory, Chapman-Jouguet waves and detonation and deflagration; diffusion flames and premixed flames; flammability, ignition, and quenching. *(Prerequisite: MAE 3062.)*

MAE 5320 INTERNAL COMBUSTION ENGINES (3 credits). Investigates the applications of thermodynamic, fluid dynamic and combustion principles to spark- and compression-ignition engines, and direct-injection stratified charge engines; ideal and actual cycle analyses; exhaust emissions, air pollution and control; engine heat transfer; and engine modeling. *(Prerequisite: MAE 5310.)*

MAE 5350 GAS TURBINES (3 credits). Introduces characteristics, performance analyses and design methodologies for stationary aircraft gas turbines. Topics include gas turbine cycle analyses, component design of combustors, compressors, turbines and nozzles, fluid dynamics and heat transfer, gas turbine fuels and emissions. *(Prerequisite: MAE 5310.)*

MAE 5360 HYPERSONIC AIR-BREATHING ENGINES (3 credits). Introduces the analysis of hypersonic aerospace vehicles, with emphasis on air-breathing propulsion concepts and systems. Topics include performance behavior and cycle analysis of ramjets and scramjets, supersonic mixing and combustion processes, and component design. *(Prerequisite: MAE 5310.)*

MAE 5390 SELECTED TOPICS IN COMBUSTION AND PROPULSION (3 credits). Address selected topics reflecting the current research interests of the faculty and visiting scholars. *(Prerequisite: Instructor approval.)*

MAE 5410 ELASTICITY (3 credits). An analysis of stress and strain in two and three dimensions, equilibrium, compatibility and constitutive equations, energy methods, flexure, stretching, torsion and contact stress formulations, axially symmetric problems. *(Prerequisite: MTH 5201 or instructor approval.)*

MAE 5420 ADVANCED MECHANICAL DESIGN (3 credits). Covers essential aspects of elasticity-plasticity, kinematics, dynamics, tribology and materials science. *(Prerequisites: MAE 4024, and MAE 4194 or MAE 4292.)*

MAE 5430 DESIGN OF AEROSPACE STRUCTURES (3 credits). Applications of mechanics to lightweight structures. Considers designing with monolithic and advanced composite materials; stiffened shell structures; buckling instability;

failure analysis; variable section beams subjected to nonuniform loads; and computer formulations used in solving structural problems. *(Prerequisite: MAE 4281.)*

MAE 5460 FRACTURE MECHANICS AND FATIGUE OF MATERIALS (3 credits). Static and dynamic design and maintenance to prevent structural failure; presence of cracks, stress intensity factor, linear elastic and elastic-plastic fracture mechanics, fracture tests, fatigue crack initiation and propagation, environmental and corrosion effects, fatigue life prediction. *(Prerequisites: CHE 3260, CHE 3265, MAE 3083.)*

MAE 5470 PRINCIPLES OF COMPOSITE MATERIALS (3 credits). Particulate and fiber composites; forms, properties and processing of constitutent materials; manufacture of composites, interaction of constituents, micro- and macromechanics and design of composite materials; stress-strain tensors and their transformation; laminate theory of orthotropic materials; strength properties. *(Prerequisites: CHE 3260, CHE 3265; MAE 3083.)*

MAE 5480 STRUCTURAL DYNAMICS (3 credits). Principles of dynamics applied to structural analysis, analysis of continuous media and discretized models, free vibration and forced response of structures, modal analysis, energy methods and approximate methods, applications in structural design and experimentation.

MAE 5610 ADVANCED DYNAMICS (3 credits). Newtonian and analytical mechanics; rigid-body dynamics, Euler's equations and spinning bodies; Lagrange's equations, Routhian and Hamiltonian mechanics, canonical transformations and Hamilton-Jacobi theory; dissipative, gyroscopic and circulatory systems; applications of numerical methods to complex dynamics problems. *(Prerequisite: MAE 2082.)*

MAE 5630 MODELING AND SIMULATION OF DYNAMIC SYSTEMS (3 credits). A study of theoretical, experimental, and computer methods for characterizing dynamic behavior of various physical systems, including generalized approaches to modeling complex interactions between mechanical, electrical, fluid and thermal systems.

MAE 5640 ADVANCED KINEMATICS (3 credits). Provides a uniform presentation of the mathematical foundations for studying spatial motion. Specific topics include general rigid body motion invariants, instantaneous kinematics, finite position theory, bivectors and multivectors, screw theory, theory of Clifford Algebras, quaternions and dual quaternions and exponential coordinates. *(Prerequisite: MAE 3091.)*

MAE 5650 ROBOTICS (3 credits). Introduces the study of robotic manipulators. Topics include spatial rigid body displacement, Euler angles, Denavit-Hartenberg coordinate convection for kinematic analysis, forward and inverse kinematic analyses of serial and parallel chain manipulators, manipulator Jacobians and trajectory generation. *(Prerequisite: MAE 2082.)*

MAE 5660 ROBOT CONTROL (3 credits). An introduction to the control of robotic manipulators. Topics include Lyapunov control theory, independent joint control, set point and trajectory tracking control, inverse dynamics control, impedance control, force control, hybrid position/force control and robust control. *(Prerequisite: MAE 3091.)*

MAE 5670 SPATIAL MECHANISM DESIGN (3 credits). Advanced topics in spherical and spatial mechanisms. Approximate motion synthesis and quasi-position synthesis methodologies. Analysis techniques, with respect to force transmission, order, singularity avoidance and solution branching are included. Computer-aided design and visualization software is used.

MAE 5690 SELECTED TOPICS IN SYSTEMS AND DYNAMICS (3 credits). Addresses selected topics reflecting the current research interests of the faculty and visiting scholars. *(Prerequisite: Instructor approval.)*

MAE 5997 INDEPENDENT STUDY (1–3 credits). An individual study under the direction of a member of the MAE graduate faculty.

MAE 5998 NONTHESIS PROJECT (1–3 credits). A directed-study project under the direction of the student's committee. Upon satisfactory completion of the nonthesis project, a maximum of three credits may be applied as part of the requirements for the master of science degree (nonthesis option). Attendance at the weekly MAE Seminar is required.

MAE 5999 THESIS (0–6 credits). Individual work under the direction of a member of the MAE graduate faculty on a selected topic.

MAE 6120 THEORY AND MODELING OF TURBULENCE (3 credits). Covers statistical tools, averaging, mean and fluctuations; probability density functions; turbulence spectra; isotropic and homogeneous turbulence; turbulence modeling; predictive methods; vorticity dynamics and vortex stretching; instability and transition; and free- and wall-shear flows. *(Prerequisite: MAE 5130.)*

MAE 6130 EXPERIMENTAL METHODS IN TURBULENCE (3 credits). Physical description; hot-wire anemometry; correlation and spectrum analysis; fluctuating pressure and shear-stress measurements; use of laser Doppler velocimetry and particle velocimetry for fluid flow measurements; and flow visualization method. *(Prerequisite: MAE 5140.)*

MAE 6490 ADVANCED TOPICS IN SOLID MECHANICS, STRUCTURES AND MATERIALS (3 credits). Addresses advanced topics reflecting the current research interests of the faculty and visiting scholars. *(Prerequisite: Instructor approval.)*

MAE 6690 ADVANCED TOPICS IN SYSTEMS AND DYNAMICS (3 credits). The course addresses advanced topics reflecting the current research interests of the faculty and visiting scholars. *(Prerequisite: Instructor approval.)*

MAE 6999 DISSERTATION (0–3 credits). Research and preparation of the doctoral dissertation.

METEOROLOGY

MET 1999 WEATHER BRIEFING (1 credit.) This course is designed to stimulate discussion about recent, current and future weather using various data sources including satellite, surface observations, radar, model and upper air data. In part, this course attempts to underscore the importance of the human element in weather forecasting. Students attend a weekly weather briefing and participate in a national weather forecasting contest.

MET 3401 SYNOPTIC METEOROLOGY 1 (3 credits). Standard meteorological observational practice; data presentation; data analysis and display; data product transmission by facsimile and computer; and Internet connectivity; weather map discussions. *(Prerequisite: OCN 2407.)*

MET 3402 SYNOPTIC METEOROLOGY 2 (3 credits). Basic analysis techniques, scalar and vector fields, thermodynamic diagrams, synoptic calculations, 4-dimensional atmospheric structure, weather map discussions. *(Prerequisite: MET 3401.)*

MET 4233 REMOTE SENSING FOR METEOROLOGY (3 credits). Geostationary (GOES) and low-earth polar orbiting (NOAA) weather satellites, and the sensors system are studied. Operational atmospheric data and applications to numerical weather prediction are presented. Ground-based meteorological radar systems and applications are also covered. *(Prerequisite: PHY 2002.)*

MET 4305 ATMOSPHERIC DYNAMICS 1 (3 credits). A study of coordinate systems, balance of forces, equations of motion, continuity and energy, barotropic and baroclinic disturbances, geostrophy, atmospheric transport of energy. *(Prerequisites: OCN 2407, OCN 3430.)*

MET 4306 ATMOSPHERIC DYNAMICS 2 (3 credits). This course studies circulation and vorticity, scale analysis, friction and turbulence, sound, gravity and Rossby waves, instability, numerical weather prediction. *(Prerequisite: MET 4305.)*

MET 4310 CLIMATOLOGY (3 credits). Studies the distribution of weather elements globally, continental positioning, rain shields, hydrological cycle, meteorological databases, El Nino impacts on humans, global warming and the anthropogenic greenhouse effect. *(Prerequisites: MTH 2401, OCN 2407.)*

MET 5001 PRINCIPLES OF ATMOSPHERIC SCIENCE (3 credits). Survey of the atmosphere, atmospheric thermodynamics, extratropical disturbances, cloud physics, storms, radiative transfer, global energy balance, atmospheric dynamics, the general circulation.

MET 5233 ATMOSPHERIC REMOTE SENSING (3 credits). Nature of radiation, blackbody radiation laws, Maxwell's equations, radar equation, radiative transfer equation, inversion techniques. Applications from surface, aircraft and spacecraft observations using Doppler, Lidar, visible, infrared and microwave systems to infer synoptic atmospheric properties. *(Prerequisite: PHY 2002.)*

MET 5305 DYNAMIC METEOROLOGY 1 (3 credits). Dynamics of the atmosphere including coordinate systems, balance of forces, derivation of the equations of motion, continuity and energy; barotropic and baroclinic disturbances; geostrophy; and atmospheric transport of energy. *(Prerequisites: MTH 2201, OCN 2407 or instructor approval.)*

MET 5306 DYNAMIC METEOROLOGY 2 (3 credits). Dynamics of the atmosphere including theorems on circulation and vorticity; scale analysis; friction and turbulence; sound, gravity and Rossby waves; instability; numerical weather prediction. *(Prerequisite: MET 5305.)*

MILITARY SCIENCE

MSC 1001, 1002 MILITARY SCIENCE 1, 2 (1, 1 credit). A study of history, mission and organization of Army ROTC and the U.S. Army; customs, courtesies, squad organization and first aid; and leadership development through practical exercises. Academic classes meet one hour weekly. Leadership lab meets 1.5 hours weekly. Optional: Ranger Company, Cadet Club, Color Guard, Drill Team and field exercises.

MSC 1003, 1004 LEADERSHIP LABORATORY 1, 2 (1, 1 credit). Students engage in a minimum of 4.5 hours of basic military leadership and management techniques to include physical training, troop leading procedures, field training and individual and small unit tactics and training.

MSC 2001, 2002 MILITARY SCIENCE 2 (2, 2 credits). Land navigation and map reading; basic leadership and continued leadership development through practical exercises; Army communications procedures. Academic classes meet two hours weekly. Leadership lab meets 1.5 hours weekly. Optional: Ranger Company, Cadet Club, Color Guard, Drill Team and additional weekend field exercises.

MSC 3001, 3002 MILITARY SCIENCE 3 (3, 3 credits). Military estimates, operation orders and platoon tactics; weapons, land navigation, military skills and communications II; instructional techniques; and development of leadership through tactical exercises. Classes meet three hours weekly. Leadership

lab meets 1.5 hours weekly. Optional: Ranger Company, Cadet Club and additional weekend field exercises (attendance required). *(Prerequisites: MSC 1001, MSC 1002, MSC 2001, MSC 2002.)*

MSC 4001, 4002 MILITARY SCIENCE 4 (3, 3 credits). Military correspondence, staff functions and logistics; military history; military personnel management, military justice and advanced ethics; and continued leadership development through practical exercises. Classes meet three hours weekly. Leadership lab meets 1.5 hours weekly. Field exercises (attendance required). Optional: Ranger Company and Cadet Club. *(Prerequisites: MSC 3001, MSC 3002.)*

MATHEMATICS

MTH 1000 PRECALCULUS (3 credits). Algebra and trigonometry that are used to develop the skills needed in calculus. Required for students who have minimal algebra and/or trigonometry preparation, or whose placement test indicated such a need.

MTH 1001 CALCULUS 1 (4 credits). Functions and graphs, limits and continuity, derivatives of algebraic and trigonometric functions, chain rule; applications to maxima and minima and to related rates. Exponential logarithmic, circular and hyperbolic functions: their inverses, derivatives and integrals. *(Prerequisites: MTH 1000 or high school algebra, trigonometry and a passing score on the placement test.)*

MTH 1002 CALCULUS 2 (4 credits). Integration and applications of integration, further techniques of integration, improper integrals, limits, l'Hospital's rule, sequences and series, numerical methods, polar coordinates and introductory differential equations. *(Prerequisite: MTH 1001.)*

MTH 1101 INTERMEDIATE ALGEBRA (3 credits). Basic operations on real numbers, algebraic expressions, linear equations, inequalities, exponents, polynomials, factoring, rational functions, roots, radicals, quadratic equations and quadratic functions. Credit cannot be applied toward any Florida Tech degree.

MTH 1603 APPLIED CALCULUS AND STATISTICS (3 credits). Topics in derivatives and integrals and their applications, and probability and statistics and their applications. Credit cannot be applied toward any Florida Tech degree that requires MTH 1001. *(Prerequisite: MTH 1000.)*

MTH 1701 COLLEGE ALGEBRA (3 credits). Real-number system; arithmetic operations with polynomials, special products and factoring; linear, fractional and quadratic equations; inequalities, exponents, radicals and absolute values; functions and graphs; complex numbers, logarithms, logarithmic and exponential functions. Credit cannot be applied toward any Florida Tech degree except management, communication, humanities and psychology.

MTH 1702 APPLIED CALCULUS (3 credits). Elements of differential and integral calculus with application to business, economics, management and the social and life sciences, as well as maxima, minima, rates, exponential growth and decay and some techniques of integration. *(Prerequisite: MTH 1701.)*

MTH 1801 TRIGONOMETRY REVIEW (1 credit). Review of trigonometric topics necessary for calculus, including trigonometric functions, graphs, identities and solving trigonometric equations. It may be taken currently with MTH 1001. *(Prerequisites: High school trigonometry and appropriate score on placement test.)*

MTH 2001 CALCULUS 3 (4 credits). Cylindrical and spherical coordinates, vectors, functions of several variables, partial derivatives and extrema, multiple integral, vector integral calculus. *(Prerequisite: MTH 1002.)*

MTH 2051 DISCRETE MATHEMATICS (3 credits). Formulation of precise definitions and their negations using propositional and predicate logic; argument analysis and proof techniques including induction; number theory; and sets, relations, functions, directed graphs and elementary counting arguments. *(Prerequisite: MTH 1000 or MTH 1001 or MTH 1702 or passing score on placement test.)*

MTH 2201 DIFFERENTIAL EQUATIONS/LINEAR ALGEBRA (4 credits). First-order differential equations, linear differential equations with constant coefficients, first-order systems of differential equations with constant coefficients, numerical methods, Laplace transforms, series solutions, algebraic systems of equations, matrices, determinants, vector spaces, eigenvalues and eigenvectors. *(Prerequisite: MTH 1002.)*

MTH 2401 PROBABILITY AND STATISTICS (3 credits). Random variables, expectations, sampling and estimation of parameters, normal and other distributions and central-limit theorem, tests of hypothesis, linear regression and design experiments. *(Prerequisite: MTH 1002.)*

MTH 3051 COMBINATORICS AND GRAPH THEORY (3 credits). Elementary and advanced counting techniques including permutations, combinations, multisets, inclusion-exclusion, generating functions, recurrence relations and topics in graph theory including graphs, trees, binary tree, graph traversals and network flow. *(Prerequisites: MTH 1001, MTH 2051.)*

MTH 3101 COMPLEX VARIABLES (3 credits). Algebra of complex numbers, elementary analytic functions, complex integration, series representations for analytic functions, residue theory and conformal mapping and its applications. *(Prerequisite: MTH 2001.)*

MTH 3102 INTRODUCTION TO LINEAR ALGEBRA (3 credits). Topics include vectors and matrices, linear equations, vector spaces and subspaces, orthogonality, determinants, eigenvalues and eigenvectors, and linear transformations. Students are introduced to solution and manipulation of matrix equations using a standard package of mathematical software. *(Prerequisite: MTH 1002.)*

MTH 3201 BOUNDARY VALUE PROBLEMS (3 credits). Solutions of the heat, wave and potential equations by separation of variables; orthogonality; Fourier, Bessel and Legendre series; and properties of Bessel functions, Legendre polynomials and the gamma function. *(Prerequisites: MTH 2001, MTH 2201.)*

MTH 3301 FINITE DIFFERENCES AND FINITE ELEMENTS (3 credits). Numerical methods for BVPs in one and two dimensions; finite difference methods for solving PDEs, finite element methods, variational formulation and Galerkin approximations for ODEs and two-dimensional PDEs, and writing programs. *(Prerequisites: CSE 1502 or CSE 1503 or CSE 2050, MTH 3201.)*

MTH 3311 APPLIED NUMERICAL METHODS (3 credits). Numerical methods, use and modification of existing software and computer arithmetic, linear systems of equations, interpolation, numeric quadrature, linear least-squares data fitting, eigenvalues, solutions of nonlinear equations. *(Prerequisites: CSE 1502 or CSE 1503 or CSE 2050, MTH 1002.)*

MTH 3501 LINEAR ALGEBRA AND COMPLEX VARIABLES (3 credits). Linear algebra, including finite dimensional vector spaces; functions of complex variables; matrix methods; eigenvalue problems; solutions to Laplace's equation in a plane. Examples address applications in aerodynamics and stress-strain relations for elastic and viscous continua. *(Prerequisite: MTH 2001.)*

MTH 4051 ABSTRACT ALGEBRA (3 credits). Groups, cyclic groups, permutation groups, isomorphisms, cosets and Lagrange's theorem, rings, integral domains, vector spaces, and fields. *(Prerequisite: MTH 3102.)*

MTH 4101 INTRODUCTORY ANALYSIS (3 credits). Rigorous treatment of calculus. Topics include sequences and series of real numbers, limits of functions, topology of the real line, continuous functions, uniform continuity, differentiation, Riemann integration, sequences and series of functions, Taylor's theorem; uniform convergence and Fourier series. *(Prerequisite: MTH 2001 or MTH 2201.)*

MTH 4105 TOPOLOGY (3 credits). Metric and topological spaces, continuity, homeomorphism connectedness, compact spaces, separation axioms, product spaces, homeotypic and fundamental group. *(Prerequisites: MTH 2051, MTH 3102.)*

MTH 4201 MODELS IN APPLIED MATHEMATICS (3 credits). Allows students to formulate and construct mathematical models that are useful in engineering, physical sciences, biological sciences, environmental studies and social sciences. *(Prerequisites: MTH 2201, junior standing.)*

MTH 4311 NUMERICAL ANALYSIS (3 credits). Introduces numerical methods for solving equations in one variable, polynomial approximation, interpolation, numerical differentiation and integration, initial-value problems for ODE and direct methods for solving linear systems. *(Prerequisites: CSE 1502 or CSE 1503 or CSE 2050, MTH 2201.)*

MTH 4320 NEURAL NETWORKS (3 credits). Includes basic existence theory, differential and integral inequalities, qualitative and quantitative theory, and Lyapunov's second method. *(Prerequisites: CSE 1502 or CSE 1503 or CSE 2050, MTH 2201.)*

MTH 4801 ADVANCED GEOMETRY (3 credits). Topics in Euclidean and non-Euclidean geometry with an emphasis on proofs and critical thinking. Satisfies the state of Florida requirement for teacher certification in mathematics. *(Prerequisite: MTH 2001 or instructor approval.)*

MTH 4920 SPECIAL TOPICS IN APPLIED MATH (3 credits). Selected topics from mathematics. Content varies from year to year depending on the needs and interests of the students and expertise of the instructor. *(Prerequisite: Instructor approval.)*

MTH 4990 UNDERGRADUATE RESEARCH (3 credits). Student participate in research project under the direction of a faculty member. *(Prerequisite: Instructor approval.)*

MTH 5007 INTRODUCTION TO OPTIMIZATION (3 credits). An applied treatment of modeling, analysis and solution of deterministic (e.g., nonprobabilistic) problems. Topics include model formulation, linear programming, network flow, discrete optimization and dynamic programming. *(Prerequisite: At least one upper-level undergraduate mathematics course.)*

MTH 5009 INTRODUCTION TO PROBABILISTIC MODELS (3 credits). An applied treatment of modeling, analysis and solution of problems involving probabilistic information. Topics chosen from decision analysis, inventory models, Markov chains, queuing theory, simulation, forecasting models and game theory. *(Prerequisite: MTH 2401 or instructor approval.)*

MTH 5050 SPECIAL TOPICS (3 credits). Contents of this course may vary depending on the needs and interests of the students and the fields of expertise of the faculty. *(Prerequisite: Instructor approval.)*

MTH 5051 APPLIED DISCRETE MATHEMATICS (3 credits). Logic fundamentals, induction, recursion, combinatorial mathematics, discrete probability, graph theory fundamentals, trees, connectivity and traversability. Applications from several fields of science and engineering, including computer science, operations research, and computer and electrical engineering. *(Prerequisite: MTH 2051.)*

MTH 5101 INTRODUCTORY ANALYSIS (3 credits). Rigorous treatment of calculus. Topics include sequences and series of real numbers, limits of functions, topology of the real line, continuous functions, uniform continuity, differentiation, Riemann integration, sequences and series of functions, Taylor's theorem; uniform convergence and Fourier series. *(Prerequisites: MTH 2001, MTH 2201.)*

MTH 5102 LINEAR ALGEBRA (3 credits). Linear algebra, systems of linear equations and Gauss elimination method; inverses, rank and determinants; vector spaces; linear transformations, linear functional and dual spaces; eigenvalues, eigenvectors; symmetric, Hermitian and normal transformations; and quadratic forms. *(Prerequisite: Undergraduate course in multivariable calculus or linear algebra.)*

MTH 5107 OPTIMIZATION MODELS AND METHODS (3 credits). A survey of popular optimization models and algorithms. Topics chosen from linear, integer, nonlinear, dynamic and combinatorial optimization. *(Prerequisite: At least one upper-level undergraduate math course.)*

MTH 5111, 5112 REAL VARIABLES 1, 2 (3, 3 credits). A study of basic topology, continuous and semicontinuous functions, metric spaces, differentiation, measures, product measure, Lebesgue integration, Radon-Nikodym Theorem, Lp-spaces and measures on topological spaces. *(Prerequisite: MTH 5101.)*

MTH 5115 FUNCTIONAL ANALYSIS (3 credits). Banach spaces, Hilbert spaces, topological vector spaces, bounded and unbounded linear operators, spectral theory. *(Prerequisite: MTH 5101.)*

MTH 5120 CALCULUS OF VARIATIONS AND OPTIMAL CONTROL (3 credits). Topics include necessary conditions for smooth and nonsmooth problems, Euler-Lagrange equations, Pontryagin's maximum principle and its applications, elements of convex analysis, special problems and sufficient conditions and existence theory. *(Prerequisite: MTH 2201.)*

MTH 5125 APPLIED COMPLEX VARIABLES (3 credits). Analytic functions, Cauchy-Reimann equations, contour integration, Cauchy theorem, Cauchy integral formula, Taylor and Laurent series, residue theorem and applications, linear fractional transformations, conformal mapping, Schwarz-Christoffel transformation. Inversion integral for Laplace transform with complex argument; inverse Laplace transforms. *(Prerequisites: MTH 2001, MTH 2201.)*

MTH 5130 THEORY OF COMPLEX VARIABLES (3 credits). Topology of the complex plane, analytic functions, Cauchy's integral formula, Liouville's theorem, maximum modulus theorem, Taylor and Laurent series, singularities, residue theorem, analytic continuation, entire functions, infinite product representation and conformal mapping. *(Prerequisites: MTH 2201, MTH 4101.)*

MTH 5201 MATHEMATICAL METHODS IN SCIENCE AND ENGINEERING 1 (3 credits). Fourier series and their convergence properties; Sturm-Liouville eigenfunction expansion theory; Bessel and Legendre functions; solution of heat, wave and Laplace equations by separation of variables in Cartesian coordinates. *(Prerequisites: MTH 2001, MTH 2201.)*

MTH 5202 MATHEMATICAL METHODS IN SCIENCE AND ENGINEERING 2 (3 credits). Solution of heat, wave and Laplace equations by separation of variables in cylindrical and spherical coordinates. Associated Legendre functions, hypergeometric functions and spherical harmonics. Fourier tranforms and separation of variables for heat and wave equations on infinite intervals. Vector integral calculus. *(Prerequisite: MTH 5201.)*

MTH 5203 MATHEMATICAL METHODS IN SCIENCE AND ENGINEERING 3 (3 credits). General perturbation techniques for linear and nonlinear ordinary differential equations, boundary layer theory, WKB methods, multiple scale analysis, approximate methods of solution, asymptotic expansion of integrals, asymptotic power series solutions of linear ODEs near irregular singular points. *(Prerequisites: MTH 5201, MTH 5125.)*

MTH 5220 THEORY OF ORDINARY DIFFERENTIAL EQUATIONS (3 credits). Includes basic existence theory, differential and integral inequalities, qualitative and quantitative theory, and Lyapunov's second method. *(Prerequisites: MTH 2201, MTH 4101.)*

MTH 5230 PARTIAL DIFFERENTIAL EQUATIONS (3 credits). Includes the Hamilton-Jacobi equation; and elliptic, parabolic and hyperbolic problems, Green function methods, transform methods, maximum principle. *(Prerequisites: MTH 2001, MTH 2201, MTH 4101.)*

MTH 5301 NUMERICAL ANALYSIS (3 credits). Includes Gaussian elimination and solution of linear systems of equations, root finding methods, systems of nonlinear equations, interpolation, numerical integration, initial value problems for ODEs and fast Fourier transform. *(Prerequisites: CSE 1502 or CSE 1503 or CSE 2050, and MTH 2201.)*

MTH 5305 NUMERICAL LINEAR ALGEBRA (3 credits). Covers iterative methods of solution of systems of linear equations, numerical methods for computing eigenvalues and eigenvectors, and singular value methods for least squares problems. *(Prerequisite: MTH 5301.)*

MTH 5310 NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS (3 credits). Numerical methods for initial value problems, boundary value problems and eigenvalue problems for ordinary differential equations. Runge-Kutta methods, multistep and adaptive methods, stiff equations and A-stable methods, collocation. *(Prerequisite: MTH 5301.)*

MTH 5315 NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS (3 credits). Covers finite difference and finite element methods for partial differential equations. *(Prerequisites: MTH 3201, MTH 5301.)*

MTH 5320 NEURAL NETWORKS (3 credits). Introduction to architectures, algorithms and applications. Topics include single and multilayer perceptrons, counterpropagation, Kohonen self-organization, adaptive resonance theory, neocognitron, probabilistic neural networks and Boltzmann machines with and without learning, recurrent neural networks. *(Prerequisites: CSE 1502 or CSE 1503 or CSE 2050, MTH 2201.)*

MTH 5401 APPLIED STATISTICAL ANALYSIS (3 credits). Covers statistical distributions, statistical tests for data, least squares and regression, estimations, tests of hypotheses, analysis of variance, planning and designing research experiments, randomized blocks, Latin and Graeco-Latin squares and data reduction, analysis using ANOVA (analysis of variance) and other methods. *(Prerequisite: MTH 2001.)*

MTH 5411, 5412 MATHEMATICAL STATISTICS 1, 2 (3, 3 credits). Introductory survey of the basic concepts of probability and statistics. Topics include sample spaces, random variables and distributions, moments, statistics, estimation, tests of hypotheses and regression analysis. *(Prerequisite: Undergraduate courses in multivariable calculus and linear algebra.)*

MTH 5420 THEORY OF STOCHASTIC PROCESSES (3 credits). Course includes discrete- and continuous-time stochastic processes, point and counting processes and Poisson counting process; as well as compound Poisson process, nonstationary Poisson process, renewal theory, regenerative processes and Markov chains. *(Prerequisite: MTH 5411.)*

MTH 5425 THEORY OF STOCHASTIC SIGNALS (3 credits). A study of the Wiener process, stationary and weakly stationary processes, white noise processes, stochastic differential equations, spectral theory of stationary processes, linear filtering problems, Hilbert spaces, autoregressive processes and mean square error prediction. *(Prerequisite: Instructor approval.)*

MTH 5430 QUEUING THEORY (3 credits). Includes queuing processes: imbedded and continuous time parameter processes; Markov, semi-Markov and semi-regenerative processes; single-server and multiserver queues; and processes of servicing unreliable machines. Controlled stochastic models. *(Prerequisite: MTH 5411.)*

MTH 5999 THESIS (0–6 credits). Individual work under the direction of a member of the graduate faculty, on a selected topic in the field of mathematics. *(Prerequisite: Instructor approval.)*

MTH 6050 RESEARCH IN APPLIED MATHEMATICS (1–6 credits). Research is conducted under the guidance of a member of the faculty in a selected area of mathematics. *(Prerequisite: Instructor approval.)*

MTH 6100 SELECTED TOPICS IN NONLINEAR ANALYSIS (3 credits). Advanced topics in nonlinear analysis with emphasis on recent developments. The contents of this course may vary depending on the needs and interests of the student and the fields of expertise of the faculty. *(Prerequisite: Instructor approval.)*

MTH 6200 SELECTED TOPICS IN APPLIED ANALYSIS (3 credits). Advanced topics in applied analysis with emphasis on recent developments. Contents vary depending on the needs and interests of the student and the fields of expertise of the faculty. *(Prerequisite: Instructor approval.)*

MTH 6300 SELECTED TOPICS IN NUMERICAL AND COMPUTATIONAL MATHEMATICS (3 credits). Advanced topics in numerical and computational mathematics with emphasis on recent developments. Contents may vary depending on the needs and interests of the student and the fields of expertise of the faculty. *(Prerequisite: Instructor approval.)*

MTH 6350 SPECIAL TOPICS IN PARALLEL PROCESSING (3 credits). Specific contents may vary, but the focus will be on selected aspects of parallel processing algorithms and architectures. *(Prerequisite: Instructor approval.)*

MTH 6999 DISSERTATION RESEARCH (0–6 credits). The student researches and prepares the doctoral dissertation. *(Prerequisite: Instructor approval.)*

OCEAN ENGINEERING

OCE 1001 INTRODUCTION TO OCEAN ENGINEERING (3 credits). Applications of engineering methods to ocean engineering design case studies and problem solving, which involve the computer as an aid. This course includes individual and team approaches and student presentations of case studies.

OCE 2002 COMPUTER APPLICATIONS IN OCEAN ENGINEERING 1 (3 credits). An introduction to state-of-the-art technologies, tools and methods used in ocean engineering and the marine sciences. Topics include computer tools for planning, developing and designing. Modern and classical methods of design, statistical analysis and evaluation are introduced along with associated computer tools.

OCE 3011 ENGINEERING MATERIALS (3 credits). An introduction to engineering materials. The study of atomic structures, controlling microstructure and mechanical properties of materials such as ferrous alloys, nonferrous alloys, polymers, composites, concrete, wood and asphalt.

OCE 3012 ENGINEERING MATERIALS LAB (1 credit). Measurement techniques, materials testing and engineering applications. *(Prerequisite: PHY 2091; corequisite: OCE 3011.)*

OCE 3030 FLUID MECHANICS (3 credits). In this course students study the basic properties of fluids; statics and kinematics; integral expressions for the conservation of mass, momentum, angular momentum and energy; dynamic similitude and dimensional analysis; boundary layer principles; pipe flow; lift and drag. *(Prerequisites: MAE 2082, PHY 2002.)*

OCE 3033 FLUID MECHANICS LAB (1 credit). Experiments in fundamental and applied fluid mechanics. This course includes viscosimetry, stability of floating objects, vorticity, gravity waves and Reynolds experiment; experiments in applied fluid mechanics; open-channel flow and pipe flow; and the drag on plates and hulls. *(Corequisite: OCE 3030.)*

OCE 3521 HYDROMECHANICS AND WAVE THEORY (3 credits). Introductory hydromechanics and linear wave theory. Includes derivation of basic equations for time-dependent flows, development and solutions of the linear boundary value problems for water waves and engineering application results. *(Prerequisite: OCE 3030.)*

OCE 3522 WATER WAVE LAB (1 credit). Students make measurements of fluid kinematic and dynamic properties of water waves and compare results to linear wave theory. Experiments are conducted in both laboratory wave channels and in the local coastal ocean. *(Corequisite: OCE 3521.)*

OCE 4518 PROTECTION OF MARINE MATERIALS (3 credits). A study of the factors affecting the corrosion with regards to electrode potentials, polarization and passivity. Students learn designing to minimize the deleterious effects on metals, concrete and woods.

OCE 4523 COASTAL ENGINEERING: PROCESSES (3 credits). Introduction to physical processes of sandy beaches and the nearshore including coastal sediments, surf zone waves and currents, behavior of beach profiles, cross-shore and longshore sand transport and the reaction of beaches to storms, coastal structures and sea-level rise. *(Prerequisite: OCE 3521.)*

OCE 4525 COASTAL ENGINEERING: STRUCTURES (3 credits). The design of nearshore and shorefront structures including seawalls, rubble-mound structures and beach nourishment. Also included is the study of bay inlet systems and dredging technology.

OCE 4531 INSTRUMENTATION DESIGN AND MEASUREMENT ANALYSIS (3 credits). A broad introduction to geophysical instrumentation design and analysis, including simple DC and AC circuit designs, use of transducers common to geophysical monitoring, and the basic principles of digital data logging and microcontroller programming. *(Prerequisites: CSE 1502 or CSE 1503, PHY 2002.)*

OCE 4541 OCEAN ENGINEERING DESIGN (3 credits). A study of the engineering design of equipment to be used in the ocean. The course will be conducted using a project approach covering the integration of the following topics: weight, buoyancy calculations; corrosion, fouling and selection of materials; pressure hull design; and life support and power for an ocean system. *(Prerequisite: Junior standing.)*

OCE 4542 OCEAN ENGINEERING SYSTEMS DESIGN (3 credits). The engineering fundamentals that are applied to the design of ocean-related systems, including a study of the design process and related topics, such as optimization techniques, reliability predictions and simulation techniques. *(Prerequisites: OCE 3521, OCE 4541, OCE 4571.)*

OCE 4545 HYDROACOUSTICS (3 credits). The theoretical study of the fundamental relations of energy transmission in the ocean. This course includes detailed coverage of components of stress, strain and motion, waves of finite amplitude, ray characteristics, refraction of dispersive wave train, boundary conditions, ray solutions and surface image solutions. *(Prerequisites: MTH 2201, OCE 3030.)*

OCE 4550 HYDROGRAPHIC SURVEYING (3 credits). Nautical charting including survey design, map projections and scales, marine positioning, echo sounding, tidal datums, photogrammetry, horizontal and vertical geodetic control, data archiving and compilation; includes field experience with boat sheets, tide gauges, navigation, seamanship and vessel operation. *(Prerequisites: CVE 2080 or OCE 4911 or OCN 4911, and OCN 3401.)*

OCE 4555 COMPUTER APPLICATIONS IN OCEAN ENGINEERING 2 (3 credits). The use of computers to collect and analyze ocean-related data. Introduction to CAD, Digital Signal Processing, UNIX; the use of simulation to investigate underwater vehicle systems, access, retrieval and display of online oceanographic data; and the use of computer programming. *(Prerequisites: CSE 1502 or CSE 1503, and MTH 2201, PHY 1001.)*

OCE 4561 FUNDAMENTALS OF OFFSHORE ENGINEERING (3 credits). Includes fixed and floating structures and their interactions with the ocean environment, buoy systems and their dynamics, cables and mooring systems, dynamic positioning and model testing of offshore structures. *(Prerequisites: MAE 3083, OCE 3030.)*

OCE 4571 FUNDAMENTALS OF NAVAL ARCHITECTURE 1 (3 credits). The theory of ship calculations. This course includes loading and hydrostatic analysis, inclining experiment, subdivision and damaged stability; model testing and performance prediction; calculation of resistance and powering; propeller design; and elements of ship dynamics and control. *(Prerequisites: MAE 3083, MTH 2201.)*

OCE 4573 SHIP DESIGN (3 credits). The process of preliminary design; hull form parameters satisfying the design requirements; performance estimation; and weights and volumes. Given owners general requirements, the student evaluates basic design characteristics for the ship. *(Prerequisite: OCE 4571.)*

OCE 4574 STRUCTURAL MECHANICS OF MARINE VEHICLES (3 credits). Topics include the ship hull girder, longitudinal bending moment in still water and waves, application of probabilistic concepts to predict bending moment in irregular waves, local and transverse strength, criteria of failure and vibration of ships. *(Prerequisite: OCE 4571.)*

OCE 4575 DESIGN OF HIGH-SPEED SMALL CRAFT (3 credits). Students learn to design features for small-high-speed hulls; requirements for preliminary design study; selection of hull type and proportion; space; layout; weight estimates; layout of the lines; powering calculations; and hydrodynamic considerations. *(Prerequisite: Instructor approval.)*

OCE 4591, 4592, 4593 SPECIAL TOPICS IN OCEAN ENGINEERING (1, 2, 3 credits). Special topics to suit individual or small-group requirements. The courses are intended to cover material not included in another course in the established curriculum. *(Prerequisite: Instructor approval.)*

OCE 4594 SENIOR PROJECT 1 (1 credit). Research and planning for students working toward the selection of a senior project. A formal proposal is prepared and submitted for adviser approval during the ninth week. *(Prerequisites: Senior standing and program chair approval.)*

OCE 4595, 4596 SENIOR PROJECT 2, 3 (2, 3 credits). These courses involve student analysis, design, construction, installation and operation of equipment in the ocean to perform a designated task. Data are collected and results are compiled as a finished report. *(Prerequisite: OCE 4594.)*

OCE 4911, 4912, 4913 MARINE FIELD PROJECTS (1, 2, 3 credits). Field-oriented programs, including both classroom and laboratory work, involving biological, chemical, physical, geological oceanography and coastal engineering. Approximately one semester of the course involves a group engineering project. *(Prerequisites: Senior standing and OCE 4541, OCN 3401.)*

OCE 5515 MATERIALS FOR MARINE APPLICATIONS (3 credits). Topics include materials: metals/reinforced concrete, wood/polymers, and FRP; properties: physical, mechanical and chemical; environmental effects: corrosion, biofouling, thermal and applications: materials selection for ocean engineering design.

OCE 5519 CORROSION ENGINEERING (3 credits). Corrosion and materials deterioration impacts engineering activities. This course includes theory, types and economics of corrosion. Case Studies are used to demonstrate corrosion prevention by the use of cathodic protection, coatings and inhibitors, and materials selection and design. *(Prerequisite: Background in chemistry and materials, or instructor approval.)*

OCE 5525 COASTAL PROCESSES AND ENGINEERING (3 credits). Topics include an analysis of coastal processes (waves, tides, currents, wind and nearshore circulation) and resulting sedimentary deposits in the beach, inlet and nearshore wave-shelf environment as related to coastal engineering problems. Students study shorefront structures and system, as well as dredging technology.

OCE 5526 ADVANCED COASTAL ENGINEERING STRUCTURES (3 credits). Topics include seawalls, bulkheads, jetties and breakwaters; sand bypassing systems, protective beach and dune construction-stabilization; prediction of forces, lifetime estimation, maintenance expectations, material selection and construction methods. *(Prerequisites: OCE 4525 and instructor approval.)*

OCE 5542 OCEAN ENGINEERING SYSTEMS (3 credits). This course is designed to systematically find an optimum solution for ocean-related engineering problems. Concepts of a system, man-ocean systems and systems engineering are discussed. Basic techniques of systems engineering. Each student is required to do a case study of an ocean engineering system. *(Prerequisite: Instructor approval.)*

OCE 5550 BATHYMETRY (3 credits). Determination of coastal and deep-sea bottom topography using modern techniques of remote sensing, GIS, swath and side-scan sonar, marine geodesy, computerized data acquisition and archiving, hydroacoustics and survey vessel design; includes field experience with offshore and harbor survey vessels. *(Prerequisite: Surveying experience.)*

OCE 5563 PORT AND HARBOR ENGINEERING (3 credits). A study of port and harbor hydrodynamics, planning, layout and construction; dredging technology; and berthing maneuvers. *(Prerequisite: OCE 3030.)*

OCE 5570 MARINE HYDRODYNAMICS AND WAVE THEORY (3 credits). A study of the motion of ideal fluid; damping and added mass; wave motions encountered in the ocean; surface gravity waves, internal waves and long waves in a rotating ocean; the motion of viscous fluid; the Navier-Stokes equations; boundary layer; and model testing. *(Prerequisite: MTH 2201.)*

OCE 5571 NAVAL ARCHITECTURE (3 credits). The theory of naval architecture, elements of ship design; ship lines, hydrostatic analysis, intact and damaged stability, strength, dimensional analysis, ABS rules, propulsion, steering, ship and platform motion, resistance, model testing; and design project. *(Prerequisite: Instructor approval.)*

OCE 5573 DYNAMICS OF MARINE VEHICLES (3 credits). A study of regular and irregular wave data as applied in ship dynamics. Topics include uncoupled heaving, pitching and rolling motion equations; calculation of the added mass and damping coefficients; strip method; coupled motions; nonlinear roll motion; dynamic effects related to motions; and wave loads. *(Prerequisites: MAE 3083, MTH 2201, OCE 3030.)*

OCE 5575 APPLIED MARINE HYDRODYNAMICS (3 credits). A background for the calculation of hydrodynamic forces, forces due to waves in inviscid fluid, effect of viscosity, hydrodynamic modeling, wave drift forces and forces due to current on moored and dynamically positioned floating structures, hydrodynamic impact and its prediction, flow-induced vibration. *(Prerequisite: OCE 3030.)*

OCE 5586 OCEAN ENGINEERING DATA ANALYSIS (3 credits). Ocean monitoring requires measurement, analysis and description of processes in random seas. Students produce, from measurements, the statistical distributions of waves, parametric and spectral sea-state descriptions, directional wave spectra, ocean engineering design criteria and linear responses of ocean structures and systems. *(Prerequisite: Instructor approval.)*

OCE 5901, 5902, 5903 SPECIAL TOPICS IN OCEAN ENGINEERING (1, 2, 3 credits). Advanced topics in selected areas of ocean engineering not covered in the regular curriculum. These courses are offered on occasion to specific student groups. *(Prerequisite: Instructor approval.)*

OCE 5990 OCEAN ENGINEERING SEMINAR (0 credit). Presentation of technical papers and progress in research by staff, students and invited speakers.

OCE 5999 THESIS RESEARCH (0-3 credits). Individual work under the direction of a member of the graduate faculty on a selected topic in the field of ocean engineering. *(Prerequisite: Admission to master's degree program.)*

OCE 6993 RESEARCH IN OCEAN ENGINEERING (1–3 credits). Research under the guidance of a member of the graduate faculty. It is repeatable as required.

OCE 6999 DISSERTATION RESEARCH (0–6 credits). Individual work under the direction of a member of the graduate faculty on a selected topic in the field of ocean engineering. *(Prerequisite: Admission to candidacy for the doctoral degree.)*

OCEANOGRAPHY

OCN 1010 OCEANOGRAPHY (3 credits). A survey of oceanography including biological, chemical, geological and physical processes in the ocean. Field trips are included.

OCN 2407 METEOROLOGY (3 credits). Introduces meteorological phenomena and principles, including descriptive weather elements, general atmospheric circulation, air-sea interaction and the physical mechanisms that create atmospheric motions, mixing and transfer of momentum, mass and heat. *(Prerequisite: MTH 1001.)*

OCN 2602 ENVIRONMENTAL GEOLOGY (3 credits). Reviews the internal and external processes that have shaped the earth's surface and how an understanding of these processes can be utilized to successfully manage modern problems of organization and mineral exploration. Successful management of environmental and geological hazards relies upon an understanding of the basic principles of physical geology.

OCN 3101 BIOLOGICAL OCEANOGRAPHY (3 credits). Topics include relationships of biological, chemical, geological and physical aspects of the oceans to biological oceanography. *(Prerequisites: BIO 1010 or BIO 1020, and CHM 1102, PHY 2002.)*

OCN 3111 BIOLOGICAL OCEANOGRAPHY LABORATORY (1 credit). Students receive field and laboratory experience in the use of equipment and methods in biological oceanography studies. *(Corequisite: OCN 3101.)*

OCN 3201 MARINE AND ENVIRONMENTAL CHEMISTRY (3 credits). Topics include a systematic examination of seawater and its constituent parts; problems associated with ocean chemistry; interaction of chemical parameters with other ocean studies; and an evaluation of the ocean as an environment. *(Prerequisite: CHM 1102 or instructor approval.)*

OCN 3211 MARINE AND ENVIRONMENTAL CHEMISTRY LABORATORY (1 credit). Field and laboratory exercises are designed to provide practical experience in the use of equipment and methods for measuring common chemical parameters in marine and environmental chemistry. *(Corequisite: OCN 3201.)*

OCN 3301 GEOLOGICAL OCEANOGRAPHY (3 credits). An introduction to geological oceanography; origin and evolution of ocean basins; a survey of major neritic and oceanic sediment patterns and the processes that control their distribution over time and space; and paleoceanography. *(Prerequisites: OCN 1010, OCN 2602.)*

OCN 3311 GEOLOGICAL OCEANOGRAPHY LABORATORY (1 credit). Field and laboratory exercises provide experience in the use of equipment and methods relevant to geologic investigations of the ocean. *(Corequisite: OCN 3301.)*

OCN 3401 PHYSICAL OCEANOGRAPHY (3 credits). Water structure and circulation of the world ocean and local areas will be studied by simple dynamical and descriptive models; and tides, wave motion and coastal processes. *(Prerequisite: PHY 2002.)*

OCN 3411 PHYSICAL OCEANOGRAPHY LABORATORY (1 credit). Field and laboratory exercises provide experience in the use of equipment and methods in physical oceanography. *(Corequisite: OCN 3401.)*

OCN 3430 FUNDAMENTALS OF GEOPHYSICAL FLUIDS (3 credits). A study of the basic properties of earth's fluids; statics and kinematics; integral expressions for the conservation of mass, momentum, angular momentum and energy; dynamic similitude, dimensional analysis and boundary-layer principles; applications to meteorology, oceanography and geophysics. *(Prerequisites: MTH 2201, PHY 2002.)*

OCN 3433 GEOPHYSICAL FLUIDS LABORATORY (1 credit). Experiments in fundamental and applied fluid mechanics; includes viscosimetry, stability of flows, vorticity, gravity waves and Reynolds stresses; physical models in meteorology, oceanography and other geophysical fluid flows. *(Corequisite: OCN 3430.)*

OCN 3911 MARINE FIELD PROJECTS: PROPOSAL (1 credit). Preparations are made for the Summer Research Program (Marine Field Projects). Students are guided through the process of selecting, designing and proposing research projects to be carried out during the Summer Marine Field Project. *(Prerequisite: Junior standing in oceanography.)*

OCN 4102 MARINE AND ESTUARINE PHYTOPLANKTON (3 credits). Systematic and ecological studies of marine phytoplankton; discussions of environmental parameters that affect primary production and plankton distribution; and collection, sampling, culturing methods, laboratory techniques and field trips. *(Prerequisite: OCN 3101 or instructor approval.)*

OCN 4103 MARINE AND ESTUARINE ZOOPLANKTON (3 credits). Systematic and ecological studies of marine zooplankton; discussions of parameters that affect secondary production; phytoplankton-zooplankton relationships, patchiness, migration and distribution; and collection, sampling, laboratory techniques and field trips. *(Prerequisite: OCN 3101 or instructor approval.)*

OCN 4104 MARINE AND ESTUARINE BENTHOS (3 credits). A study of population and community ecology of marine soft-sediment systems from shallow water and deep sea; rocky intertidal ecology; and ecology of seagrass systems. *(Prerequisite: OCN 3101 or instructor approval.)*

OCN 4105 SURVEY OF FLORIDA REEF SYSTEMS (2 credits). See OCN 5105. *(Prerequisites: OCN 3101, OCN 3301, or instructor approval.)*

OCN 4106 MITIGATION AND RESTORATION OF COASTAL SYSTEMS (3 credits). Introduction to current activities in mitigation and restoration of coastal systems. Lectures, guest speakers, and field trips are integrated in a case-study format to demonstrate the process of restoration planning. Students develop a mitigation plan for a hypothetical development project. *(Prerequisite: Senior standing.)*

OCN 4204 MARINE AND ENVIRONMENTAL POLLUTION (3 credits). A holistic approach to the study of pollution. Pollutant, quantities and sources defined; and impacts discussed; past and present waste disposal techniques, and proposed alternatives will be considered. *(Prerequisites: CHM 1102, and OCN 1010 or OCN 3201, or instructor approval.)*

OCN 4405 GENERAL DYNAMIC OCEANOGRAPHY (3 credits). Currents and current systems in the world oceans based on the principles of fluid dynamics; geostrophy, the role of friction and inertia; vortex theory, and the conservation theorems in circulation theory; and dimensional analysis. Treatments of surface waves and certain meteorological phenomena are given. *(Prerequisites: OCN 3401, OCN 3430.)*

OCN 4704 REMOTE SENSING FOR OCEANOGRAPHY (3 credits). Interaction of radiation with water environments; radiative processes in the atmosphere; spectral characteristics of plankton, sediments, land and water; applications to sea surface temperature, heat flux, color, dynamic topography, surface winds and weather prediction; instrumentation and computer-assisted image analysis. *(Prerequisite: PHY 2002.)*

OCN 4901, 4902, 4903 SPECIAL TOPICS IN OCEANOGRAPHY (1,2, 3 credits). Special topics not covered in the regular curriculum that are offered to specific student groups. *(Prerequisite: Instructor approval.)*

OCN 4911, 4912, 4913 MARINE FIELD PROJECTS 1, 2, 3 (1, 2, 3 credits). In-depth field/laboratory study of important facets of the Indian River lagoon and/or nearshore waters. Student teams are specifically configured to accomplish the desired objectives. Oceanographic data are collected by using standard instrumentation and devices. *(Prerequisite: Senior standing in oceanography or instructor approval.)*

OCN 4991, 4992, 4993 UNDERGRADUATE RESEARCH IN OCEANOGRAPHY (1, 2, 3 credits). Student planning and research on a project using equipment and techniques in oceanography. Projects may be done by an individual or a group. The project requires an individual proposal and results written as a formal report. *(Prerequisite: Senior standing in oceanography.)*

OCN 5001 PRINCIPLES OF OCEANOGRAPHY (3 credits). A comprehensive survey of the ocean and coastal zone. This course is an integrated study of the relationships and applications of chemical, biological, geological, physical and meteorological sciences to oceanography and ocean engineering.

OCN 5101 PRINCIPLES OF BIOLOGICAL OCEANOGRAPHY (3 credits). Topics include biological aspects of the marine environment, physicochemical parameters and interrelationships between organisms and these parameters. Pollution and productivity are also discussed.

OCN 5102 MARINE PHYTOPLANKTON (3 credits). Detailed studies of phytoplankton and physical and chemical factors that affect plankton production and distribution; sampling, culturing methods and laboratory familiarization of organisms; and field trips.

OCN 5103 MARINE ZOOPLANKTON (3 credits). Detailed studies of zooplankton and relations to selected aspects of biological oceanography; study of phytoplankton-zooplankton relationships and sampling methods; laboratory familiarization of organisms; and field trips.

OCN 5104 MARINE BENTHOS (3 credits). An analysis of the environments, populations and communities of the deep sea and estuaries; sampling methods and laboratory familiarization of faunal components; and field trips. *(Prerequisite: OCN 5101 or instructor approval.)*

OCN 5105 REEF SYSTEMS OF THE FLORIDA KEYS (2 credits). Lectures and field studies on the biological, geological and physical aspects of coral reef systems in the Florida Keys. Conducted in the Florida Keys.

OCN 5106 MITIGATION AND RESTORATION OF COASTAL SYSTEMS (3 credits). This course is designed to introduce students to current activities in mitigation and restoration of coastal systems. Lectures, guest speakers, and field trips will be integrated in a case-study format to demonstrate the process of restoration planning. Students will develop a mitigation plan for a hypothetical development project.

OCN 5203 ADVANCED CHEMICAL OCEANOGRAPHY (3 credits). An in-depth discussion of advanced chemical concepts of the oceans, such as element speciation, the physical chemistry of seawater, interactions at the air-sea interface, absorption, diffusion and radiochemistry. *(Prerequisite: OCN 5210.)*

OCN 5204 MARINE POLLUTION (3 credits). This discussion course integrates political and social concepts into the scientific study of pollution. Topics include definitions of pollution, toxicity of contaminants and a number of case studies of significant marine pollution events. *(Prerequisite: Instructor approval.)*

OCN 5210 MARINE AND ENVIRONMENTAL CHEMISTRY (3 credits). The chemical composition and important reactions along the global water cycle including rain, soil and groundwater, rivers, lakes estuaries and seawater. Specific areas of focus include weathering, redox processes, carbonate equilibria and nutrients. Laboratory exercises are included.

OCN 5301 PRINCIPLES OF GEOLOGICAL OCEANOGRAPHY (3 credits). An introduction to the origin and evolution of the ocean basins. General biological, chemical and physical processes of the coastal and open ocean are reviewed with emphasis on how they contribute to marine sedimentation and stratigraphy. The course includes field trips.

OCN 5304 COASTAL AND ESTUARINE PROCESSES (3 credits). Study of physical, biogenic and sedimentation processes in coastal and estuarine environments. Processes include shoaling waves, tides and tidal currents, estuarine circulation, storm processes and transient currents. Implications for coastal engineering and coastal zone management are included. *(Prerequisite: OCN 5301 or instructor approval.)*

OCN 5315 MARINE GEOCHEMISTRY (3 credits). A study of the sources, transport and deposition of sediments. Land-derived sediments undergo certain alterations in saline water, and the cause and nature of the modifications are examined, as well as marine sediments that are generated by the biota and from the water column. *(Prerequisite: OCN 5210.)*

OCN 5401 PRINCIPLES OF PHYSICAL OCEANOGRAPHY (3 credits). Introduction to physical oceanography including the properties of seawater, basic concepts of fluid dynamics; heat budget; atmospheric circulation; structure and circulation of the ocean; tidal and wave motion.

OCN 5402 TRANSPORT PROCESSES IN THE MARINE ENVIRONMENT (2 credits). A survey of transport processes. The course describes the physical processes associated with larval transport, nutrient transport and suspended sediment transport in estuarine and continental shelf waters. Noncredit for physical oceanography majors.

OCN 5403 OCEAN WAVE THEORY (3 credits). See OCE 5570.

OCN 5405 DYNAMIC OCEANOGRAPHY (3 credits). An introduction to geophysical fluid dynamics and its application to the study of ocean currents. This course includes linear and nonlinear models, vorticity theory and critical discussion of classical papers on ocean circulation. *(Prerequisites: MTH 2201, OCN 5401.)*

OCN 5407 MARINE METEOROLOGY (3 credits). The application of the basic laws of thermodynamics and geophysical fluid dynamics to the behavior and circulation of the atmosphere-ocean system.

OCN 5409 GEOPHYSICAL FLUID DYNAMICS (3 credits). Advanced analytical and numerical models of ocean and atmospheric mesoscale, macroscale, and global-scale flows with diagnostic and prognostic applications, including coupled air/sea circulation physics. *(Prerequisite: MET 5305 or OCN 5405 or instructor approval.)*

OCN 5704 OCEANIC REMOTE SENSING (3 credits). Radiative processes, remote sensors and sensor platforms; photogrammetry, radiometry and multi-spectral pattern recognition; image interpretation, data processing and applications. Ocean research examples from aircraft and spacecraft are also included.

OCN 5709 NUMERICAL ANALYSIS OF BIOLOGICAL DATA (3 credits). Application of statistical methods and computer programs to biological studies. Topics also include experimental designs appropriate for statistical applications.

OCN 5801 COASTAL SYSTEMS PLANNING (3 credits). Systems theory is used to describe the physical and biological character of the coastal zone. Concepts and techniques in planning and management are the basis for the study of our use of coastal resources for recreation, transportation and waste disposal. *(Prerequisite: Graduate standing in science or engineering or instructor approval.)*

OCN 5901, 5902, 5903 SPECIAL TOPICS IN OCEANOGRAPHY (1, 2, 3 credits). Special course topics not covered in the regular curriculum. This course is offered on occasion to specific student groups. *(Prerequisite: Instructor approval.)*

OCN 5990 OCEANOGRAPHY SEMINAR (0 credit). Presentations on research and review of areas of interest by staff, students and invited speakers in the field of oceanography. *(Prerequisite: Graduate standing in oceanography.)*

OCN 5996 INTERNSHIP (0–3 credits). Application of coastal zone management principles to involve the student in actual experience with planning or other related agencies. It includes on-campus preparation, off-campus work experience and a final on-campus debriefing. *(Prerequisite: Graduate standing in oceanography.)*

OCN 5999 THESIS RESEARCH (0–3 credits). Individual work under the direction of a member of the graduate faculty on a selected topic in the field of oceanography.

OCN 6993 RESEARCH IN OCEANOGRAPHY (1–3 credits). Research under the guidance of a member of the graduate faculty. The course is repeatable as required.

OCN 6999 DISSERTATION RESEARCH (0–6 credits). Individual work under the direction of a member of the graduate faculty on a selected topic in the field of oceanography.

OPERATIONS RESEARCH

ORP 5001 DETERMINISTIC OPERATIONS RESEARCH MODELS (3 credits). An applied treatment of modeling, analysis and solution of deterministic operations research problems. Topics include model formulation, linear programming, network flow and transportation problems and algorithms, integer programming and dynamic programming. *(Prerequisite: At least one upper-level undergraduate math course.)*

ORP 5002 STOCHASTIC OPERATIONS RESEARCH MODELS (3 credits). An applied treatment of modeling, analysis and solution of probabilistic operations research problems. Topics chosen from decision analysis, game theory, inventory models, Markov chains, queuing theory, simulation, forecasting models. *(Prerequisite: At least one upper-level undergraduate math course, preferably probability and statistics.)*

ORP 5003 OPERATIONS RESEARCH PRACTICE (3 credits). Lecture topics include the OR methodology, how an OR analyst interacts with clients, and preparation and presentation of oral reports. Students form teams to analyze real cases where each student gets an opportunity to be a team leader and present oral reports. *(Prerequisites: ORP 5001, ORP 5002.)*

ORP 5010 MATHEMATICAL PROGRAMMING (3 credits). A survey of popular optimization techniques. Topics chosen from linear, integer, nonlinear, dynamic and network flow programming; combinatorial graph algorithms. *(Prerequisite: MTH 5102 or ORP 5001 or instructor approval.)*

ORP 5011 DISCRETE OPTIMIZATION (3 credits). A study of combinatorial optimization and integer programming. *(Prerequisites: MTH 5051, ORP 5001.)*

ORP 5020 THEORY OF STOCHASTIC PROCESSES (3 credits). This course introduces to stochastic models, discrete- and continuous-time stochastic processes, point and counting processes, Poisson counting process, compound Poisson processes, nonstationary Poisson processes, renewal theory, regenerative processes and Markov chains. *(Prerequisite: MTH 5411 or instructor approval.)*

ORP 5021 QUEUING THEORY (3 credits). Topics include queuing processes; imbedded and continuous time parameter processes; Markov, semi-Markov and semi-regenerative processes; single-server and multiserver queues; processes of servicing unreliable machines and computer applications; and controlled stochastic models. *(Prerequisite: MTH 5411 or instructor approval.)*

ORP 5030 DECISION ANALYSIS (3 credits). Covers normative models of decisions under certainty, risk and uncertainty; assessment of subjective probability and utility functions; Bayesian decision analysis and the value of information; influence diagrams; and descriptive aspects of decision making. *(Prerequisite: Undergraduate statistics course.)*

ORP 5031 MULTIOBJECTIVE DECISION ANALYSIS (3 credits). Covers normative models of decisions considering multiobjective and multiattribute models. Topics include multiattribute utility theory, the analytical hierarchy process, linear multiobjective programming and goal programming. *(Prerequisites: ORP 5001, ORP 5030.)*

ORP 5040 QUALITY ASSURANCE (3 credits). Covers the principles and application of statistical quality control and statistical process control. *(Prerequisite: Undergraduate statistics course.)*

ORP 5041 RELIABILITY ANALYSIS (3 credits). Covers the principles of reliability analysis and assessment; reliability probability models; combinatorial and system reliability; and reliability estimation. *(Prerequisite: MTH 5411 or instructor approval.)*

ORP 5042 RELIABILITY, AVAILABILITY AND MAINTAINABILITY (3 credits). Discussion of maintainability concepts relating to system effectiveness and support-system design. Topics include basic mathematical concepts, design concepts and data analysis used in quantifying availability, maintainability and reliability as measures of operational readiness and system effectiveness. *(Prerequisite: ORP 5041.)*

ORP 5050 DISCRETE SYSTEM SIMULATION (3 credits). Covers the principles of building and using a discrete event simulation; construction and statistical testing of random variate generators; statistical analysis and validation of results; design of simulation projects; and variance reduction methods. *(Prerequisite: MTH 5411 or instructor approval.)*

ORP 5051 APPLIED EXPERT SYSTEMS (3 credits). Covers the concepts and methods of rule-based expert systems; methods of knowledge representation; and use of an expert system shell to build a small expert system. Noncredit for computer science majors.

ORP 5070 SEQUENCING AND SCHEDULING (3 credits). This course bridges the gap between scheduling theory and its application in manufacturing and service environments. It emphasizes basic scheduling principles and will use selected readings and case studies to illustrate the use of these concepts in industrial environments.

ORP 5090, 5091 SPECIAL TOPICS IN OPERATIONS RESEARCH 1, 2 (3, 3 credits). Content variable depending on the fields of expertise of the faculty and the desire and needs of the students.

ORP 5999 THESIS RESEARCH (0–6 credits). Individual research under the direction of a major adviser approved by the chairman of the program. A maximum of six credits may be credited toward the master's degree.

ORP 6010 ADVANCED TOPICS IN MATHEMATICAL PROGRAMMING (3 credits). An overview of selected topics in the theory of optimization. The objective is to unify much of the field by use of a few principles of linear vector space theory. The concepts of distance, orthogonality and convexity play fundamental roles in this development. *(Prerequisites: MTH 5101, MTH 5102, ORP 5010.)*

ORP 6030 ADVANCED TOPICS IN DECISION MODELS (3 credits). Discussion of current methods and research in decision analysis. Typical topics include large-scale multicriteria decision analysis, behavioral analysis of decision making, methods of uncertainty representation and decision making in the public domain. *(Prerequisite: ORP 5031 or instructor approval.)*

ORP 6095 PREPARATION FOR CANDIDACY/OPERATIONS RESEARCH (1–6 credits). Research, under the guidance of a member of the operations research faculty in a selected area of operations research. Repeatable as required. *(Prerequisite: Program chair approval.)*

ORP 6999 DISSERTATION RESEARCH (0–6 credits). Research and preparation for the doctoral dissertation. *(Prerequisite: Admission to candidacy for the doctoral degree.)*

PHYSICAL EDUCATION

PED 1010 INTRODUCTION TO ROWING AND SCULLING (1 credit). An overview of the fundamentals of rowing with an emphasis on techniques.

PED 1020 INTRODUCTION TO SAILING (1 credit). An introduction to sailing small boats, and acquaints beginners with boat and sail forms, and to racing.

PED 1021 ADVANCED SAILING (1 credit). Examines advanced techniques of racing, spinnaker setting and seamanship. *(Prerequisite: PED 1020.)*

PED 1035 INTRODUCTION TO ARCHERY (1 credit). Emphasizes target shooting with information about its history, shooting techniques, equipment and safety.

PED 1046 INTRODUCTION TO WEIGHT LIFTING (1 credit). Provides a source of information about safe and reliable habits of weight training to help the student plan a personalized fitness program.

PED 1050 INTRODUCTION TO FENCING (1 credit). Introduces the fundamentals of fencing, including the basic elements of footwork, attack and defense.

PED 1053 INTRODUCTION TO ATHLETIC TRAINING (1 credit). Introduces the basic knowledge and skills needed in the prevention and care of athletic injuries.

PED 1060 INTRODUCTION TO TENNIS (1 credit). This course is designed to develop basic tennis skills. It includes a study of performance and the application of basic skills, rules and etiquette.

PED 1062 ADVANCED TENNIS (1 credit). Teaches the development of advanced tennis skills, including a study of performance and the application of advanced skills, rules and etiquette.

PED 1071 INTRODUCTION TO DANCE AEROBICS (1 credit). This is an activity course that incorporates aerobic conditioning, muscle toning and flexibility exercises that are choreographed with simple dance movements. It also provides practical information to develop and maintain good habits of fitness.

PED 1080 INTRODUCTION TO GOLF (1 credit). Designed for beginning golfers and teaches the fundamentals of golf. Emphasis is placed on stance, swing and grip of the various clubs (wood, iron and putters). Rules, strategy and scoring are also studied.

PED 1081 ADVANCED GOLF (1 credit). Emphasizes course play and stroke refinement.

PED 1086 INTRODUCTION TO FLAG FOOTBALL (1 credit). An activity course with emphasis on developing skills and knowledge of flag football as a recreational sport.

PED 1090 INTRODUCTION TO KARATE (1 credit). Teaches the basics of Korean Karate (Tang Soo Do), including basic hand technique, foot technique, noncontact sparring and philosophy, with emphasis on self-defense.

PED 1091 ADVANCED KARATE (1 credit). Advanced course offers additional training in hand technique, foot technique and self defense. Emphasis is placed on mental aspects and defense against weapons, as well as board-breaking.

PED 1154 INTRODUCTION TO OPEN-WATER DIVING (.5 credits). An introductory certification course in scuba diving that includes studies in diving physics, physiology, environment and dive safety.

PED 1155 ADVANCED OPEN-WATER DIVING (.5 credits). A continuing education certification course for certified divers. Topics include compass and natural navigation, search and recovery, spring, drift and deep diving. *(Prerequisite: PED 1154.)*

PED 1156 RESCUE DIVER (.5 credits). Teaches diver rescues, managing diving accident situations, first aid and qualifying for dive master training. *(Prerequisite: PED 1155.)*

PED 1159 INTRODUCTION TO WRECK DIVING (.5 credits). Provides the skills and knowledge needed to gain experience and minimize risks in wreck diving. *(Prerequisite: PED 1155.)*

PHYSICS

PHY 1001 PHYSICS 1 (4 credits). Topics include a study of vectors; mechanics of particles; Newton's laws of motion; work, energy and power; impulse and momentum; conservation laws; mechanics of rigid bodies, rotation, equilibrium; fluids, heat and thermodynamics; and periodic motion. *(Prerequisite: MTH 1001; corequisite: MTH 1002.)*

PHY 1050 PHYSICS AND SPACE SCIENCE SEMINAR (1 credit). Introduces some of the major contemporary problems and research areas in physics and space sciences.

PHY 2002 PHYSICS 2 (4 credits). Topics include electricity and magnetism, Coulomb's law, electric fields, potential capacitance, resistance, D.C. circuits, magnetic fields, fields due to currents, induction, magnetic properties; and wave motion, vibration and sound, interference and diffraction. *(Prerequisite: PHY 1001.)*

PHY 2003 MODERN PHYSICS (3 credits). Topics include quantum mechanics of atoms, molecules, nuclei, solids and fundamental particles. Planck and de Broglie's laws, the Bohr model of hydrogen, elementary examples of Schroedinger's equation, relativity, elementary particles and symmetry, quantum electrodynamics and chromodynamics. *(Prerequisites: MTH 2001 or MTH 2201, PHY 2002.)*

PHY 2091 PHYSICS LABORATORY 1 (1 credit). Experiments to elucidate concepts and relationships presented in PHY 1001, to develop understanding of the inductive approach and the significance of a physical measurement, and to provide some practice in experimental techniques and methods. *(Corequisite: PHY 1001.)*

PHY 2092 PHYSICS LABORATORY 2 (1 credit). A continuation of Physics Laboratory 1, including experiments pertaining to PHY 2002. *(Prerequisite: PHY 2091; corequisite: PHY 2002.)*

PHY 3011 PHYSICAL MECHANICS (4 credits). Fundamental principles of mechanics and applications in physics. Topics include Newton's Laws, equations of motion, types of forces, Conservation Laws, potential functions, Euler and Lagrange Equations and Hamilton's Principle. *(Prerequisites: MTH 2001, MTH 2201, PHY 2002.)*

PHY 3030 INTRODUCTION TO COMPUTATIONAL PHYSICS (3 credits). Numerical experimentation is an increasingly powerful tool for exploring nature, complementing theory and laboratory experiments. Course topics include finite difference equations, sports physics, oscillatory motion and chaos, orbital mechanics, Monte Carlo methods, quantum mechanics, self-organized criticality. *(Prerequisites: MTH 1002, PHY 2002.)*

PHY 3035 QUANTUM MECHANICS (4 credits). Schrodinger equation, the uncertainty principle, one-dimensional potentials, harmonic oscillator, operator methods, tunneling, angular momentum and spin. Three-dimensional problems, such as one-electron atom and N-particle systems are discussed. Approximation techniques are introduced, including perturbation theory. *(Prerequisites: MTH 2201, PHY 2003.)*

PHY 3060 THERMODYNAMICS, KINETIC THEORY AND STATISTICAL MECHANICS (4 credits). Topics include temperature, heat and heat engines, work, internal energy, entropy, laws of thermodynamics, thermodynamic potentials, equations of state, phase changes, viscosity, thermal conductivity, diffusion, Boltzmann, Fermi-Dirac and Bose-Einstein statistics and partition functions. *(Prerequisite: PHY 2003.)*

PHY 3152 ELECTRONIC MEASUREMENT TECHNIQUES (4 credits). Includes modern electronic measurement and data collection methods, circuit analysis, integrated and digital circuits, noise reduction techniques, signal conditioning in experimental physics and computer interfacing. This course includes a laboratory section considering the design, construction and testing of analog and digital circuits. *(Prerequisite: PHY 2002.)*

PHY 3440 ELECTROMAGNETIC THEORY (3 credits). Topics include geometry of static electric and magnetic fields, electric charges and currents, calculating electric and magnetic fields from potentials, static electric and magnetic fields inside matter, Faraday's Law of Induction and Maxwell's Equations and propagation and radiation of electromagnetic waves. *(Prerequisites: MTH 2001, PHY 2002.)*

PHY 4020 OPTICS (3 credits). Applications to physics, space sciences, and engineering. Topics include geometrical optics (briefly), physical optics, including Fraunhofer and Fresnel diffraction; interactions with dielectric materials; and Fresnel equations; and applications include lasers, holography, polarization and nonlinear optics materials. *(Prerequisites: MTH 2201, PHY 2002 or instructor approval.)*

PHY 4021 EXPERIMENTS IN OPTICS (1 credit). Experiments include basic optical systems, interference and diffraction. Interferometers, spectrometers, lasers and detectors will be studied. Enrollment will be limited to Physics and Space Sciences majors, and on a space-available basis to Electrical Engineering majors with an emphasis in electrooptics. *(Corequisite: PHY 4020.)*

PHY 4030 INTRODUCTION TO SUBATOMIC PHYSICS (3 credits). Introduces elementary particles, fundamental forces, nuclear structure and reactions. Topics include classification and properties of particles (the Standard Model) and nuclei, particle interactions, nuclear models, nuclear decays, radiation and particle detection. *(Prerequisite: PHY 3035.)*

PHY 4033 INTRODUCTION TO SOLID STATE PHYSICS (3 credits). Topics include crystal structure, crystal diffraction and the reciprocal lattice, crystal binding; lattice vibrations, phonons, thermal properties of insulators; free electron Fermi gas, energy bands in metals; and Fermi surfaces. *(Prerequisites: PHY 3035, PHY 3060.)*

PHY 4071 SENIOR LABORATORY 2 (2 credits). Experiments in optics, atomic, nuclear and solid state physics. *(Prerequisite: Senior standing in physics or space sciences.)*

PHY 4200, 4210 SENIOR SEMINAR 1, 2 (1, 1 credit). Reports and discussions on selected topics in contemporary experimental and theoretical physics and space sciences. *(Prerequisite: Student must be within three semesters of graduation.)*

PHY 4201 SPECIAL TOPICS IN PHYSICS (3 credits). Topics are announced prior to each course offering. *(Prerequisite: Department head approval.)*

PHY 4301 INDEPENDENT STUDIES (3 credits). Individual study of specific problems in physics. *(Prerequisite: Department head approval.)*

PHY 4901, 4902 UNDERGRADUATE RESEARCH (3, 3 credits). Individual research directed by a faculty member. *(Prerequisite: Department head approval.)*

PHY 5015 ANALYTICAL MECHANICS 1 (3 credits). A general treatment of dynamics of particles and rigid bodies, rotational dynamics, potential theory; Hamilton's principle and principle of least action, Lagrange's equations; applications. *(Prerequisite: PHY 3011.)*

PHY 5016 ANALYTICAL MECHANICS 2 (3 credits). Continuation of PHY 5015: canonical transformations, Poisson brackets, Hamilton-Jacobi equation with applications; and relativistic mechanics. *(Prerequisite: PHY 5015.)*

PHY 5020 OPTICS (3 credits). See PHY 4020. Additional graduate-level projects will be assigned including computer ray tracing and computer lens design.

PHY 5030, 5031 QUANTUM MECHANICS 1, 2 (3, 3 credits). Schroedinger equation, discrete and continuous eigenfunctions and eigenvalues, collision theory, matrix mechanics, angular momentum perturbation and other approximation methods, identical particles and spin, semiclassical theory of radiation, atomic structure. *(Prerequisites: MTH 5201, MTH 5202, PHY 3035.)*

PHY 5034 SEMICONDUCTOR PHYSICS (3 credits). Covers the physical principles of semiconductor devices. Topics include basic solid-state physics, drift and diffusion of carriers, p-n junctions, surface effects, BJTs, FETs, superlattices, quantum dots and wires, and resonant tunneling devices; as well as other quantum devices and related physics. *(Prerequisites: PHY 3035, PHY 3060.)*

PHY 5035 SOLID STATE PHYSICS 1 (3 credits). Topics include crystal structure, crystal diffraction and the reciprocal lattice, crystal binding, lattice vibrations, phonons, Brillouin zones, thermal properties of insulators, free electron Fermi gas, energy bands in metals and Fermi surfaces. *(Prerequisites: PHY 3035, PHY 3060.)*

PHY 5036 SOLID STATE PHYSICS 2 (3 credits). A continuation of PHY 5035; semiconductors, plasmons, optical properties of solids, dielectrics, magnetism, defects and superconductivity. *(Prerequisite: PHY 5035.)*

PHY 5045 INTRODUCTION TO ELEMENTARY PARTICLE PHYSICS (3 credits). The fundamental laws and principles governing the behavior and structure of matter on the subatomic scale. Topics include definition and classification of elementary particles and fundamental forces; properties of elementary particles and their experimentally observable behavior; symmetries and invariance principles; Feynman diagrams; interaction of particles with bulk matter.

PHY 5054 FOURIER OPTICS (3 credits). Analysis of two-dimensional linear systems, scalar diffraction theory, Fresnel and Fraunhofer diffraction, Fourier transforming and imaging properties of lenses, spatial frequency analysis of optical imaging systems, coherence, image processing and holography. *(Prerequisite: PHY 4020.)*

PHY 5070 SPECIAL TOPICS IN PHYSICS (3 credits). Topics are announced prior to each course offering. *(Prerequisite: Department head approval.)*

PHY 5080 THERMODYNAMICS (3 credits). Principles and applications of modern thermodynamics with emphasis on complex physical and chemical systems, both homogeneous and heterogeneous, and irreversible processes. *(Prerequisite: PHY 3060.)*

PHY 5081 STATISTICAL MECHANICS (3 credits). Transport theory, diffusion, irreversible thermodynamics, Fermi-Dirac and Bose-Einstein statistics, radiation, chemical reactions and equilibrium specific heat theory. *(Prerequisite: PHY 3060.)*

PHY 5088, 5089 GRADUATE LABORATORY (3, 3 credits). Experimental laboratory work under individual faculty supervision. *(Prerequisite: Department head approval.)*

PHY 5095, 5096 ADVANCED LABORATORY (3, 3 credits). Experimental work at the research level in faculty research labs. *(Prerequisite: Department head approval.)*

PHY 5999 THESIS (0–6 credits). Individual work under the direction of a member of the graduate faculty on a selected topic in physics. *(Prerequisite: Department head approval.)*

PHY 6001 INDIVIDUAL STUDIES (1–3 credits). Individual studies under faculty supervision. *(Prerequisite: Department head approval.)*

PHY 6090 RESEARCH (1–3 credits). Research leading to the doctoral dissertation. *(Prerequisite: Department head approval.)*

PHY 6999 DISSERTATION (0–6 credits). Preparation of doctoral dissertation. *(Prerequisites: Admission to candidacy for the doctoral degree and department head approval.)*

FORENSIC PSYCHOLOGY

PSF 2551 SURVEY OF FORENSIC PSYCHOLOGY (3 credits). A survey of the psychological theories and methods pertinent to the legal and criminal justice systems. Topics include victimization, reliability of eyewitness testimony, jury selection, treatment vs. incarceration, insanity, family and drug court issues, and trial testimony. Research and training roles are explored in relation to the justice system. *(Prerequisites: PSY 1411, SOC 1551, SOS 1552.)* (SS)

PSF 3511 INTRODUCTION TO CRIME ANALYSIS (3 credits). The techniques, materials and methods of analysis of crime and criminal activity are presented. Concentration areas include analyzing crime, forecasting criminal occurrences, mapping techniques, crime patterns, suspect identification and monitoring crime trends. *(Prerequisites: BUS 2703, PSF 2551, PSY 2511.)* (SS)

PSF 3512 FORENSIC BEHAVIOR INVESTIGATION AND IDENTIFICATION (3 credits). Behavior of victims, suspects and witnesses of crime is explored with respect to the psychological principles used in investigation; in particular kinesics, interview techniques, reliability of recall and legal implications of interview techniques. *(Prerequisite: PSF 2551.)*

PSF 3515 SPECIAL TOPICS IN FORENSIC PSYCHOLOGY (1 credit). Topics of particular general interest in forensic psychology, criminal justice or criminology are offered when student interest and staffing permit. May be repeated. *(Prerequisite: PSF 2551.)*

PSF 3551 INTEGRATED THEORIES OF CRIME (3 credits). Basic questions concerning human nature, human behavior, crime and criminality are explored from the perspectives of sociological, psychological and criminological theories. *(Prerequisite: PSF 2551.)* (SS)

PSF 4515 ADVANCED SPECIAL TOPICS IN FORENSIC PSYCHOLOGY (1 credit). Topics of particular general interest in forensic psychology, criminal justice or criminology are offered when student interest and staffing permit. May be repeated. *(Prerequisite: PSF 3511.)*

PSF 4551 PRINCIPLES OF INDIVIDUAL AND COMMUNITY ADVOCACY (3 credits). The response to crime by law enforcement, the court system, social services and victim advocates is explored. The primary focus is on advocacy for individuals and the community. Domestic violence, crime prevention, delinquency, hate crimes and substance abuse are examined in terms of best practices from the field. *(Corequisite: PSF 3551.)*

PSYCHOLOGY

PSY 1400 FRESHMAN SEMINAR (1 credit). This seminar offers discussions by members of the faculty about various areas of research in and practice of psychology to give freshmen an overview of the nature of the field and the people in it. *(Prerequisite: Must be enrolled in the School of Psychology.)*

PSY 1401 PSYCHOLOGICAL RESOURCES (1 credit). This course teaches skills needed for successful performance in upper level psychology courses, including accessing and reading primary literature, producing reports in American Psychological Association format, using computer application programs, and using Internet resources. *(Prerequisites: CSE 1301, PSY 1400, PSY 1411.)*

PSY 1411 INTRODUCTION TO PSYCHOLOGY (3 credits). An overview of psychological processes, including both areas in which psychology is a natural science (physiological psychology, sensation and perception, basic learning and cognition) and a social science (motivation, human development, personality, social interaction, psychopathology and psychotherapy). (SS)

PSY 1461 PSYCHOLOGY OF ADJUSTMENT AND PERSONAL GROWTH (3 credits). An examination of the relevance of psychological understanding in personal and interpersonal situations, including definitions and discussions of human adjustment factors, such as anxiety, stress, coping mechanisms, and psychological adaptation. (SS)

PSY 1462 SUBSTANCE ABUSE (3 credits). An examination of experimental evidence on the physical, physiological, and psychological effects of drug use and conclusions relating to the real vs. alleged effects of drugs. (SS)

PSY 1463 HUMAN SEXUALITY (3 credits). Biological, psychosocial, and cultural aspects of human sexuality are integrated and presented within the context of the most recent research findings. (SS)

PSY 2413 RESEARCH EXPERIENCE (1 credit). This course offers research experience under the direction of a member of the psychology faculty, generally in the context of programmatic research teams. *(Prerequisite: PSY 1411.)*

PSY 2441 CHILD AND ADOLESCENT DEVELOPMENT (3 credits). An overview of psychological principles, theories and research pertaining to the developing child from conception through adolescence. It includes biological and environmental influences on affective, cognitive, moral, social and personality development. *(Prerequisite: PSY 1411.)* (SS)

PSY 2442 ADULT DEVELOPMENT AND AGING (3 credits). Introduces current information and psychological research on aspects of adult development, old age and aging. The intellectual, motivational, psychobiological, social, performance and personality changes that occur in adulthood and old age are examined. *(Prerequisite: PSY 1411.)* (SS)

PSY 2443 PSYCHOLOGY OF EDUCATION (3 credits). This course presents psychological perspectives on educational philosophies and practices. Theories developed by psychologists are reviewed with respect to their application to educational processes and their applicability to enhancing the teacher-learning process. *(Prerequisite: PSY 1411.)* (SS)

PSY 2444 CROSS-CULTURAL AND ETHNIC PSYCHOLOGY (3 credits). Examines the relationship between cultural variables and psychological processes from both a psychological and an anthropological perspective. Cultural, international and ethnic issues are addressed. *(Prerequisite: PSY 1411.)* (SS)

PSY 2445 PSYCHOLOGY OF WOMEN (3 credits). Examines the way gender differences affect the lives of women. Biological, cultural and social factors are studied in terms of their direct effects on women, and in terms of the psychological and cultural bases of prejudice and discrimination. *(Prerequisite: PSY 1411.)* (SS)

PSY 2446 SPORT PSYCHOLOGY (3 credits). This course surveys the theory, research and applications of psychology pertaining to exercise and sports. Current topics and issues relevant to sport psychology will be presented. *(Prerequisite: PSY 1411.)* (SS)

PSY 2511 INTRODUCTION TO RESEARCH METHODS FOR PSYCHOLOGY (3 credits). Introduces basic research concepts and methods in psychological research, including research design, validity, measurement, data analysis and interpretation. Teaches skills required for research and term paper preparation, including use of software, writing in APA format and presentation of results. *(Prerequisites: PSY 1400, PSY 1411.)* (CL)

PSY 3400 JUNIOR SEMINAR (1 credit). This seminar offers discussions by members of the faculty about new developments in psychology and career opportunities in the field. *(Prerequisite: Junior standing in psychology.)*

PSY 3412 PSYCHOLOGICAL RESEARCH METHODS (4 credits). Presents the fundamentals of research design and analysis in psychology and includes laboratory experience with various methodologies. Experiments are conducted, analyzed and written in standard scientific format. *(Prerequisites: BUS 2703, PSY 1401, PSY 1411, and an additional 9 credits of PSY courses.)*

PSY 3413 SPECIAL TOPICS IN PSYCHOLOGY (3 credits). Topics of special interest when student interest and staffing permit. *(Prerequisite: PSY 1411.)*

PSY 3414 SPECIAL TOPICS IN PSYCHOLOGY (1 credit). Topics of special interest when student interest and staffing permit. *(Prerequisite: PSY 1411.)*

PSY 3421 PSYCHOLOGY OF LEARNING AND MOTIVATION (3 credits). A study of the principles of learning and motivation based primarily on infrahuman studies in classical and instrumental conditioning. The course focuses on procedures, theories and applications. *(Prerequisite: PSY 1411.)* (SS)

PSY 3422 COGNITIVE AND PERCEPTUAL PSYCHOLOGY (3 credits). Surveys the theoretical development of research on human perception and cognition, and examines current trends. Interrelationship between physiological and psychological factors are addressed, as well as the processes and consequences of complex mental activity. *(Prerequisite: PSY 1411.)* (SS)

PSY 3423 PHYSIOLOGICAL PSYCHOLOGY (3 credits). A study of the biological bases of human behavior, including in-depth treatment of nervous system anatomy and physiology, and the biological concepts underlying emotion, motivation, learning and memory. *(Prerequisites: BIO 1020 or EDS 1032, and PSY 1411.)*

PSY 3441 SOCIAL PSYCHOLOGY (3 credits). Provides a survey of the areas of social psychology as it has evolved in American Psychology, including its history, methods and theories of intrapersonal, interpersonal and group behavior. Sociological approaches to social psychology and cultural processes that affect social phenomena are reviewed. *(Prerequisite: PSY 1411.)* (SS)

PSY 3442 PSYCHOLOGY OF PERSONALITY (3 credits). An overview of the major theoretical approaches to personality development and research in the field. *(Prerequisite: PSY 1411.)* (SS)

PSY 3511 ADVANCED RESEARCH METHODS FOR PSYCHOLOGY (3 credits.) A lecture/laboratory class that emphasizes performing and reporting empirical research, including conceptualization and design of studies, research procedures, data analysis using professional software tools, report writing in APA format, and presentation of results. *(Prerequisites: BUS 2703 or MTH 2401, and PSY 2511.)*

PSY 3512 INTERVIEWING AND ASSESSMENT TECHNIQUES (3 credits). Theory, application and interpretation of interviewing and objective testing methods used in clinical, industrial and forensic settings. An overview of measurement theory is presented as the basis for objective testing. *(Prerequisites: BUS 2703, PSY 2511.)*

PSY 4400 SENIOR SEMINAR (1 credit). Readings from primary sources within a topical area determined by the seminar leader. Students gain familiarity with the research and/or theoretical base of an area of psychology and with the procedures of the American academic seminar. *(Prerequisite: Psychology major with at least 12 credits of PSY courses completed.)*

PSY 4411, 4412 INTERNSHIP (3, 3 credits). These courses offer a 15-week field placement under supervision to provide students with an opportunity for direct experience in an area of applied psychology. *(Prerequisites: Senior standing.)*

PSY 4413, 4414 UNDERGRADUATE RESEARCH (3, 3 credits). These courses offer research experience under the direction of a member of the psychology faculty. *(Prerequisites: PSY 3412 and instructor approval.)*

PSY 4415, 4416 SENIOR THESIS (3, 3 credits). Students who choose to conduct an honors thesis will develop, execute and write an original empirical research project following guidelines similar to those of a master's thesis. *(Prerequisite: PSY 3412.)*

PSY 4441 INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY (3 credits). A study of the application of psychological principles and methods to industry, and the motivational, physical and leadership factors that influence behavior within organizations. *(Prerequisites: PSY 3441 and a statistics course.)* (SS)

PSY 4461 ABNORMAL PSYCHOLOGY (3 credits). An examination of psychological disorders, including theories of their development, symptomology and systems of classification. *(Prerequisite: PSY 3442.)* (SS)

PSY 4462 CLINICAL AND COMMUNITY PSYCHOLOGY (3 credits). An overview of the areas of clinical psychology and community psychology. Methods of clinical assessment and treatment of behavioral disorders are reviewed. The concepts of community psychology as they have developed from the fields of psychology, social work and public administration are presented. *(Prerequisite: PSY 4461.)* (SS)

PSY 4463 BASIC COUNSELING SKILLS (3 credits). Basic counseling skills for human services and mental health paraprofessionals. Basic concepts, skills and techniques of major theories of therapeutic psychology and interpersonal dynamics are studied. *(Prerequisite: PSY 4461.)*

PSY 4465 INTRODUCTION TO APPLIED BEHAVIOR ANALYSIS (3 credits). The application of operant and respondent conditioning processes to the modification of human behavior in business, community, education and clinical settings. Topics include analysis of situational components, measurement of behavior, application of behavior change techniques and understanding the significance of results. *(Prerequisite: PSY 3421.)*

PSY 4466 BEHAVIOR TRAINING TECHNIQUES IN CLINICAL AND EDUCATIONAL SETTINGS (3 credits). The application of operant and respondent conditioning processes and skill training to the modification of patient behavior in residential treatment and school settings. Topics include analysis of the situational components, measurement of behavior, and application of behavior change techniques. *(Prerequisites: PSY 4461, PSY 4465.)*

PSY 4511 PRINCIPLES OF PROGRAM DEVELOPMENT AND EVALUATION (3 credits). The psychological principles, methods and techniques used to assess, develop and evaluate the effectiveness of programs. Topics include needs assessment methods, principles of program design, gaining support for programs and general methods for evaluating programs. *(Prerequisite: PSY 3511.)*

PSY 5000 CLINICAL COLLOQUIUM (0 credit). This course provides speakers from the faculty, community and student body, covering a wide spectrum of psychological topics and areas of interest. All Psy.D. students are required to take this course each fall and spring semester of their enrollment, with the exception of the internship year.

PSY 5001 PRE-PRACTICUM (0 credit). Serves as an adjunct to Clinical Skills and Techniques 1 and 2 (PSY 5541/5442), and as a prerequisite for clinical practicum. Helps prepare Psy.D. students for their first practicum by addressing both clinical skills and administrative issues.

PSY 5101 STATISTICAL RESEARCH METHODS 1 (3 credits). Introduces psychological research methods and designs, including analysis and interpretation of simple correlational and experimental designs.

PSY 5102 STATISTICAL RESEARCH METHODS 2 (3 credits). An analysis of multifactor research designs using analysis of variance and related techniques, including the use of computerized statistical packages and data analysis. *(Prerequisite: PSY 5101.)*

PSY 5104 LEARNING AND MEMORY (3 credits). Combines a survey of stimulus-response learning approaches with modal and network theories of memory. Part one concentrates on classical and operant learning principles, and their application to human behavior. Part two studies the structure of memory, as well as topics such as repressed memory and aging and memory.

PSY 5105 BIOLOGICAL FOUNDATIONS OF BEHAVIOR (3 credits). Emphasizes physiology and pharmacology of the synapse, neuroanatomy, sensory system and complexly motivated behavior. Views normal and abnormal behavior within the biological context and also addresses ethnic, racial, gender and sex-role diversity.

PSY 5106 LIFE-SPAN DEVELOPMENT (3 credits). An overview of psychological principles, theories and research pertaining to human development from conception to death. A study of physical, cognitive, emotional, social and personality development with emphasis on theories, empirical data, research methods, and current issues will be included.

PSY 5108 HEALTH PSYCHOLOGY (3 credits). An overview of the application of psychological theory and technology to the understanding of etiology and treatment of disease, to the maintenance of health, and to the role of the psychologist within the health care system. Attention is given to prevention and wellness programs and to emerging theoretical models of the psychophysiological connection.

PSY 5111 COGNITION (3 credits). Topics in cognitive psychology relating to the nature of thought. The implications of evolutionary theory for human information processing in a technological age, perception and attention, memory, language, decision making, judgment, problem solving and comprehension are considered.

PSY 5113 PROGRAM EVALUATION (3 credits). Tactics of scientific research, particularly as they apply to conducting and evaluating psychological service programs. *(Prerequisites: PSY 5101, PSY 5102.)*

PSY 5114 SUBSTANCE ABUSE: RESEARCH AND TREATMENT (3 credits). An overview of substance abuse. Theories of etiology and current models of detection, diagnosis and treatment modalities in the treatment of substance abuse. Examines environmental, biological, family and social interactions. *(Prerequisites: PSY 5501, PSY 5502.)*

PSY 5120 CULTURE AND PSYCHOLOGY (3 credits). This course presents a theoretical basis for understanding the relationship between psychology and cultural studies. Theory and research from cross-cultural psychology, psychological anthropology, cultural psychology, psychological sociology and ethnic studies are presented.

PSY 5190 CURRENT TOPICS IN PSYCHOLOGY (1 credit). Discussion and reports on a selected topic of contemporary interest in psychological research and practice. May be repeated for a total of four credits. *(Prerequisite: Instructor approval.)*

PSY 5191 DIRECTED READINGS IN PSYCHOLOGY (1–3 credits). Selected readings in a specific topic under the direction of a faculty member. May be repeated for a total of three credits. *(Prerequisite: Program chair approval.)*

PSY 5192 SEMINAR IN PSYCHOLOGY (1 credit). Reports and discussion on current research and practice by students, faculty and visiting psychologists. May be repeated for a total of four credits. *(Prerequisite: Instructor approval.)*

PSY 5194 SEMINAR IN PLAY THERAPY (1 credit). This course will provide students with a knowledge of the theory and purpose of play therapy, as well as basic skills in techniques of play therapy. An exploration of the research on the efficacy of play therapy as a treatment for children's disorders will also be included. *(Prerequisite: PSY 5595.)*

PSY 5198 SUPERVISED RESEARCH (1–3 credits). Directed research under the supervision of a member of the psychology faculty in a selected area of psychology. May be repeated for a maximum of nine credits. *(Prerequisite: Program director approval.)*

PSY 5231 BASIC CONCEPTS AND PRINCIPLES OF BEHAVIOR ANALYSIS (4 credits). Covers basic concepts and principles derived from the experimental analysis of behaviors and their relation to the profession of applied behavior analysis. Includes laboratory experience.

PSY 5232 APPLIED BEHAVIOR ANALYSIS 1 (4 credits). Basic characteristics of applied behavior analysis (ABA), selecting and defining target behaviors and outcomes, indirect assessment, and descriptive and functional analysis. Introduction to direct measurement techniques, graphing data, visual inference, single-subject research methodology, and ethical issues in ABA.

PSY 5233 APPLIED BEHAVIOR ANALYSIS 2 (4 credits). Covers behavior change procedures, maintenance and generalization of behavior change, and emergency interventions. The course also provides an introduction to ethical and legal issues related to behavioral intervention, and social and cultural issues. *(Prerequisite: PSY 5232.)*

PSY 5234 RESEARCH METHODS IN APPLIED BEHAVIOR ANALYSIS (4 credits). Covers direct measurement, graphing data, visual inference, single-subject research methodology, program monitoring and evaluation, and ethical issues in ABA research. *(Prerequisite: PSY 5231.)*

PSY 5235 ETHICAL AND PROFESSIONAL STANDARDS AND SOCIAL ISSUES IN APPLIED BEHAVIOR ANALYSIS (1 credit). Covers the behavioral analyst code of ethics, position papers of various professional organizations related to ethical issues in ABA, legal issues for practicing behavior analysts in Florida and other states, issues related to standards of practice, and cultural and social issues. *(Prerequisites: PSY 5231, PSY 5232.)*

PSY 5236 BEHAVIOR ANALYSIS IN AUTISM AND OTHER DEVELOPMENTAL DISABILITIES (2 credits). Covers behavioral assessment and treatment techniques used with individuals with autism and related developmental disabilities. Sample topics include assessment and treatment of self-injurious behavior and teaching functional communication. *(Prerequisite: PSY 5232.)*

PSY 5238 ADVANCED ABA TREATMENT PLANNING (3 credits). Recognizing and responding to factors that affect the application of behavior analysis principles within and across community settings. Designing intervention plans to fit characteristics of the social and physical context, e.g., families and family homes; schools, service agencies and facilities; and places of employment, recreation, and commerce. *(Prerequisites: PSY 5231, PSY 5233.)*

PSY 5240 B.F. SKINNER AND RADICAL BEHAVIORISM (2 credits). This course covers B.F. Skinner's *Science and Human Behavior* (1953) and some of his seminal articles on radical behaviorism. Articles by some of Skinner's followers are also covered. Topics include determinism, private events, contingency-shaped versus rule-governed behavior, and a radical behaviorist perspective on culture and society.

PSY 5241 LEGAL ISSUES AND GUIDELINES FOR THE ETHICAL PRACTICE OF ABA (1 credit). This course covers the Behavior Analyst Certification Board's *Guidelines for Responsible Conduct for Behavior Analysts*, legal issues, Florida Statutes and Rules regulating practice, position papers of various professional organizations related to ethical issues in ABA, basic ethical issues that cut across human service professions, and social and cultural issues.

PSY 5242 ETHICAL AND PROFESSIONAL STANDARDS IN CLINICAL BEHAVIOR ANALYSIS (1 credit). Topics covered include defining acceptable treatment environments, rights to effective treatment and education, balancing the rights to habilitation and personal liberties, least restrictive alternatives, punishment and aversive control, emergency interventions and other ethical issues related to clinical populations.

PSY 5250 INTRODUCTION TO ORGANIZATIONAL BEHAVIOR MANAGEMENT (3 credits). Performance analysis, cause analysis, and intervention selection, design and implementation. Evaluation of past and current research on improving workplace productivity, quality, efficiency, cost-effectiveness, safety, etc. Topics address behavior principles as they are applied in business and industry. *(Prerequisites: PSY 5231, PSY 5232.)*

PSY 5251 ADVANCED ORGANIZATIONAL BEHAVIOR MANAGEMENT (3 credits). Examination of human behavior in organizations from a behavior analytic perspective. The interface between OBM and I/O psychology, pay for performance, motivation, performance improvement techniques, compensation, quality, job satisfaction and its relation to productivity, and the ethics of personnel management. *(Prerequisites: PSY 5233, PSY 5250.)*

PSY 5252 TECHNIQUES IN PERFORMANCE MANAGEMENT (3 credits). This course stresses the integration of behavior analysis and performance management applied to the design, creation and management of human performance in business settings. Students analyze complex systems, develop alternative systems, and develop objective measures to determine their effectiveness. *(Prerequisites: PSY 5233, PSY 5250.)*

PSY 5260 SEMINAR IN CONCEPTUAL ISSUES IN BEHAVIOR ANALYSIS (1 credit). Conceptual issues in behavior analysis and in radical behaviorism. Topics include a Skinnerian analysis of verbal behavior, free will, determinism, coercion and aversive control. Students read books and articles, participate in class discussion, and write and/or present papers. May be repeated for a total of two credits, provided different topics are selected.

PSY 5261 SEMINAR IN METHODOLOGICAL ISSUES IN ABA (1 credit). This seminar covers methodological issues in behavior analysis. Students read books and articles, participate in class discussion and write and/or present papers. Topics include low tech and high tech research-based methods, computerized data-collection systems and graphing data. May be repeated for a total of two credits, provided different topics are selected.

PSY 5262 SEMINAR IN THE EXPERIMENTAL ANALYSIS OF BEHAVIOR (EAB) (1 credit). Basic EAB research and seminal articles in the field are covered. Topics include basic operant processes, the matching law, higher-order response classes, stimulus equivalence, scheduled-induced behavior, behavioral contrast and behavioral momentum. May be repeated for a total of two credits, provided different topics are selected.

PSY 5263 SEMINAR IN EDUCATIONAL BEHAVIOR ANALYSIS (1 credit). This seminar covers current topics in educational applications in ABA. Topics include programmed instruction and PSI, precision teaching and direct instruction, evidence-based practice, training teachers to manage classroom behavior and to teach children with autism and related disabilities. May be repeated for a total of four credits, provided different topics are selected.

PSY 5264 SEMINAR IN CLINICAL BEHAVIOR ANALYSIS (1 credit). This seminar covers current topics such as parent training, teaching verbal behavior to children with autism, home and school-based programs, positive behavioral supports, and treating self-injurious behavior. May be repeated for a total of four credits, provided different topics are selected.

PSY 5265 SEMINAR IN ORGANIZATIONAL BEHAVIOR MANAGEMENT (1 credit). This seminar covers current topics in OBM applications. Methods of improving performance using functional assessment, performance feedback and reinforcement are stressed. Pay-for-performance structures, systems analysis and behavior-based safety specialty areas are discussed. May be repeated for a total of four credits, provided different topics are selected.

PSY 5296 PRACTICUM IN CLINICAL BEHAVIOR ANALYSIS (1–3 credits). Students perform functional assessments, develop and implement individual behavior plans, train others to implement programs, monitor program implementation, and collect and graph data and otherwise systematically evaluate behavior changes and outcomes. May be repeated for 1–3 credits per semester. *(Prerequisites: PSY 5231, PSY 5233, PSY 5241).*

PSY 5297 PRACTICUM IN PERFORMANCE MANAGEMENT (1–3 credits). Behavioral assessments, performance management protocols, providing training to managers, monitoring implementation, collecting and graphing data and otherwise systematically evaluating improvements in performance and outcomes. May be repeated for 1–3 credits per semester. (*Prerequisites: PSY 5231, PSY 5233, PSY 5241.)*

PSY 5401 INTRODUCTION TO INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY (3 credits). Introduces major topics in personnel psychology and organizational behavior, including job analysis, personnel selection, training and performance appraisal, social influences on work behavior, job satisfaction, worker motivation, leadership and organizational communication.

PSY 5402 TESTS AND MEASUREMENTS (3 credits). Introduces psychometric theory, survey of psychological testing and applications to business and industry.

PSY 5403 APPLIED RESEARCH METHODS (3 credits). Experience in the research methodology as applied to workplace problems. Emphasis on correlational and regression analysis, survey methodology and problems encountered analyzing real-world data.

PSY 5411 PERSONNEL SELECTION (3 credits). Examines current approaches to selection in industry. The focus is on attracting, selecting and placing personnel.

PSY 5412 PERFORMANCE APPRAISAL (3 credits). Application, research, and theory in the performance appraisal area are studied in this course. Special emphasis is placed on appraisal skills.

PSY 5413 PERSONNEL LAW (3 credits). Presents ethical guidelines and legal requirements in general and as they apply to I/O psychology.

PSY 5414 APPLIED PSYCHOLOGY IN PERSONNEL MANAGEMENT (3 credits). Surveys the application of principles from industrial/organizational psychology to actual managerial decisions. It deals with ethical, legal and psychological issues involved in decisions made with respect to hiring, firing and promoting.

PSY 5415 ORGANIZATIONAL PSYCHOLOGY (3 credits). An overview of organizational theories and their relationship to organizational effectiveness. Topics include work motivation, organizational attitudes, group processes, leadership and organizational theory.

PSY 5420 ORGANIZATIONAL CHANGE AND TRANSFORMATION (3 credits). This course is designed to provide students with an overview of the incremental evolutionary and discontinuous aspects of organizational change. In addition to reviewing modern transformational theories, students will gain practical experience in conducting organizational change interventions.

PSY 5421 INDUSTRIAL TRAINING (3 credits). Examines the methods and applications of training in industry from an integrated systems approach.

PSY 5422 GROUP AND TEAM DEVELOPMENT (3 credits). A survey of major interventions associated with group and team development within organizations. Interventions include group and team assessment, creative problem solving, decision making, resolving conflicts and management by objectives.

PSY 5424 EMPLOYEE ASSISTANCE PROGRAMS (3 credits). A comprehensive survey of the field of employee assistance programs (EAP) with emphasis on current trends in the management of EAP programs.

PSY 5492 CURRENT TOPICS IN I/O PSYCHOLOGY (1 credit). Focuses on current practice and research by visiting faculty in the areas of industrial/organizational psychology, including job analysis, stress and outplacement counseling.

PSY 5494 SEMINAR IN CLINICAL-ORGANIZATIONAL/INDUSTRIAL PSYCHOLOGY (1 credit). Examination of the common processes and functions in clinical and I/O psychology, as well as the differing approaches to those functions represented by clinical I/O methodologies.

PSY 5496 PRACTICUM IN I/O PSYCHOLOGY (1–6 credits). Supervised work in appropriate I/O setting. *(Prerequisite: Program chair approval.)*

PSY 5501 PERSONALITY AND PSYCHOTHERAPY (3 credits). A survey and evaluation of the major theories of personality and psychotherapy with a didactic introduction to the basic principles of case conceptualization and psychological treatment.

PSY 5502 PSYCHOPATHOLOGY (3 credits). Introduces the classification and diagnosis of the major forms of behavioral and mental pathology and their relationship to models of psychotherapy.

PSY 5503 FAMILY PSYCHOLOGY (3 credits). This course covers theory, assessment, intervention, technique, ethics and research on the 12 major theories of family systems. There are both didactic and experiential components designed to teach the student to conceptualize systematically, and to design and implement appropriate interventions.

PSY 5506 ADMINISTRATION OF MENTAL HEALTH SERVICES (3 credits). Coordination of mental health services in federal, state and community facilities. The course surveys the services rendered by type of facility.

PSY 5511 CLINICAL PSYCHOPHARMACOLOGY (3 credits). The role of drugs in the modification of behavior. Sites of drug action, the systems affected and the rationale for drug therapy are examined. *(Prerequisites: PSY 5105, PSY 5502.)*

PSY 5513 LABORATORY IN FAMILY PSYCHOLOGY (1 credit). Provides the student with role-playing experience behind the one-way mirror from a variety of theoretical orientations including communications, multigenerational, structural, strategic-systemic, family reconstruction and Adlerian perspectives. *(Corequisite: PSY 5503.)*

PSY 5521 ASSESSMENT OF INTELLIGENCE (3 credits). Familiarizes the student with the major intellectual assessment instruments currently in use, with emphasis on the administration, scoring and interpretation of the Wechsler Scales. Special attention will be given to historical, cross-cultural and ethnic minority issues and controversies involved in the assessment of intelligence. *(Corequisite: PSY 5522.)*

PSY 5522 LABORATORY IN ASSESSMENT OF INTELLIGENCE (1 credit). Training in scoring and interpretation of intellectual assessment instruments covered in PSY 5521. *(Corequisite: PSY 5521.)*

PSY 5524 LABORATORY IN ASSESSMENT OF PERSONALITY (1 credit). Training in scoring and interpretation of personality assessment instruments covered in PSY 5523. *(Corequisite: PSY 5528.)*

PSY 5526 ASSESSMENT OF CHILD AND ADOLESCENT PERSONALITY (3 credits). Covers the administration, scoring, and interpretation of several of the major current objective and projective personality assessment techniques suitable for application with children and adolescents. It also offers an overview of the assessment process with children and adolescents. *(Prerequisite: PSY 5527.)*

PSY 5527 OBJECTIVE PERSONALITY ASSESSMENT (3 credits). Introduction to current major self-report personality tests with emphasis on administering, scoring and interpreting the MMPI-2/MMPI-A and familiarity with MCMI-III, NEO-PI-R, PAI, 16PF and various checklists. Includes test development issues, ethical standards, test feedback and report-writing skills. *(Prerequisites: PSY 5501, PSY 5521.)*

PSY 5528 PROJECTIVE PERSONALITY ASSESSMENT (3 credits). Introduction to semistructured and projective techniques with emphasis on administering, coding and interpreting the Rorschach (Exner System) and exposure to the TAT, sentence completion methods and projective drawing techniques. Includes exposure to dynamic/content analysis and integration of multiple sources of test data. *(Prerequisite: PSY 5527; corequisite: PSY 5524.)*

PSY 5541 CLINICAL SKILLS AND TECHNIQUES 1 (3 credits). Provides theory and experience in basic attending, listening, responding, personalizing and initiating skills. Students learn interviewing strategies, risk assessment, crisis intervention and integration of observational data with case conceptualization and treatment planning. Two credits of didactic and one of experiential laboratory.

PSY 5542 CLINICAL SKILLS AND TECHNIQUES 2 (3 credits). Provides advanced training in psychotherapeutic techniques and case conceptualization skills necessary for effective psychotherapeutic treatment planning and interventions. Two credits of didactic and one of experiential laboratory. *(Prerequisite: PSY 5541.)*

PSY 5543 PSYCHOTHERAPY WITH CHILDREN (3 credits). A study of the treatment of emotional, social and intellectual problems of children. *(Prerequisite: PSY 5561.)*

PSY 5544 COGNITIVE-BEHAVIORAL APPROACHES TO TREATMENT (3 credits). Examines the theory and application of cognitive behavioral models of therapy. Although didactic, this course will begin at the theoretical level and move toward application with an emphasis on the practical application of cognitive behavioral techniques. *(Prerequisite: PSY 5501.)*

PSY 5545 CLINICAL HYPNOSIS (3 credits). This introductory course is a journeyman's guide to the various applications of hypnosis in psychotherapy. It focuses on tests for suggestibility, techniques for trance induction, age regression and hypnotic procedures with a variety of clinical problems to include anxiety disorders, habit disorders, sexual dysfunction and psychosomatic disorders. *(Prerequisite: PSY 5501.)*

PSY 5547 DYNAMICS OF GROUP PSYCHOTHERAPY (3 credits). This course studies group psychotherapy from the perspective of research on group dynamics. The course considers the history and major types of group therapy, and provides an experiential component. *(Prerequisite: PSY 5501.)*

PSY 5548 EXPERIENTIAL GROUP PSYCHOTHERAPY (1 credit). Participation in weekly group therapy facilitated by a non-faculty practitioner with the community.

PSY 5549 PSYCHOTHERAPY TECHNIQUES (3 credits). Introduction to specific psychotherapy techniques presented with theory, research, demonstration and student practice. Techniques selected from various schools of psychotherapy to include, but not limited to, behavior, cognitive and psychodynamic models. *(Prerequisite: PSY 5542.)*

PSY 5551 FEMINIST APPROACHES TO EATING DISORDERS (1 credit). Emphasizes individual and group consciousness of eating problems within the context of historical and cultural influences. Literature on eating disorders as well as personal experiences are explored.

PSY 5552 ADVANCED TREATMENT ISSUES IN EATING DISORDERS (1 credit). This advanced seminar studies the didactic literature on treatment, experiential approaches and perspectives from people who have undergone outpatient and inpatient treatment. Experiential exercises, role playing and contribution to a prevention project are included. *(Prerequisite: PSY 5551.)*

PSY 5561 CHILDREN'S BEHAVIOR DISORDERS (3 credits). A study of the nature, etiology, characteristics and assessment of emotional, social and intellectual problems of children.

PSY 5570 MULTICULTURAL PSYCHOTHERAPY (3 credits). This applied clinical course provides an overview of the major theoretical models of multicultural psychotherapy. In addition, the course is designed to encourage the student to develop skill in utilizing a multicultural orientation to guide the diagnosis, assessment and treatment of psychological disorders. *(Prerequisite: PSY 5120.)*

PSY 5583 CLINICAL PRACTICE: CURRENT AND FUTURE TRENDS (3 credits). Familiarizes students with contexts, trends, dilemmas, cautions and possibilities of clinical practice in the 21st century. Surveys current realities and issues in health care and other systems, and considers creative models for the future. *(Prerequisite: Instructor approval.)*

PSY 5591 SEMINAR IN PROFESSIONAL STANDARDS AND ETHICAL PRINCIPLES IN PSYCHOLOGY (1 credit). A discussion of professional ethics and standards in psychology. Required for all first-year clinical students.

PSY 5592 SEMINAR IN PROFESSIONAL STANDARDS AND ETHICAL PRINCIPLES IN PSYCHOLOGY 2 (1 credit). Discussion and implementation of professional ethics and standards in psychology and one's own professional development. Required for all second-year clinical students. *(Prerequisite: PSY 5591.)*

PSY 5593 SEMINAR IN PROFESSIONAL STANDARDS AND ETHICAL PRINCIPLES IN PSYCHOLOGY 3 (1 credit). Discussion of professional ethics and standards in psychology. Required for all third-year clinical students. *(Prerequisite: PSY 5592.)*

PSY 5595 PRACTICUM (1–6 credits). Supervised clinical work in an approved on-campus or off-campus setting. Placement at sites is determined by the Office of Clinical Training. Experiences will vary among sites to include assessment, intervention, cumulative and supervisory experiences. *(Prerequisites: PSY 5501, PSY 5502, PSY 5521, PSY 5527, PSY 5541, PSY 5542 and approval of the clinical director.)*

PSY 5596 SUPERVISED CLINICAL EXPERIENCE (1 credit). Experience in clinical settings, providing supervised psychological services to specialized populations. This course is seen as a pre-practicum experience and therefore, does not fulfill supervised practical experience requirements of the program.

PSY 5990 RESEARCH PROJECT (1–6 credits). Includes the preparation and submission of a research project that, in scope and complexity, is judged to be equivalent to a research master's thesis. This course is required of all students entering with a psychology master's degree awarded without a thesis requirement. *(Prerequisites: PSY 5101, PSY 5102.)*

PSY 5999 THESIS (0–6 credits). Includes the preparation and submission of a research thesis, the quality of which is judged acceptable by the School of Psychology and Graduate School. *(Prerequisites: PSY 5101, PSY 5102.)*

PSY 6102 FORENSIC PSYCHOLOGY (2 credits). The interaction of psychology and the law; emphasis is placed on the psychologist as an expert witness and as consultant to attorneys and the court; and an evaluation of the rights of psychiatric patients under the law.

PSY 6103 INTRODUCTION TO FORENSIC PSYCHOLOGY (3 credits). Application of the science and practice of psychology to questions and issues relating to law and the legal system. The role of psychology in the legal system, evaluation and assessment, expert testimony, consultation and training, mediation and conflict resolution, and research.

PSY 6198 DOCTORAL SUPERVISED RESEARCH (1–3 credits). Directed research, under the supervision of a member of the psychology faculty. May be repeated for a maximum of nine credits.

PSY 6401 ORGANIZATIONAL LEADERSHIP (3 credits). This course offers an extensive review of the major theories and applications of organizational leadership. Special emphasis is placed on current self-monitoring theories of leader behavior. In addition, students are exposed to the most recent research examining cultural and gender-based factors in leadership.

PSY 6402 CHAOS THEORY IN ORGANIZATIONS (3 credits). This course covers the application of nonlinear dynamics to work and organizations, including recent advances in mathematics and experimental design, and integrates those topics into models of organizational change. Special emphasis is placed on the role of nonlinear dynamics in creativity and innovation.

PSY 6404 INDIVIDUAL ASSESSMENT TECHNIQUES (3 credits). This course focuses on the use of extensive psychological assessment in the selection and career counseling of management executives. Assessment center techniques, as well as in-depth profiling, are discussed. Practical student exercises provide hands-on experience in these and other assessment techniques.

PSY 6405 MULTIVARIATE STATISTICS (3 credits). Students are encouraged to use rigorous methodology in the study of organizational issues. Multivariate statistical methods are taught through the use of multiple computer exercises, keeping mathematical details to a minimum. Coverage of both exploratory and confirmatory factor analysis is extensive.

PSY 6406 STRUCTURAL EQUATION MODELING (2 credits). A review of correlation and covariance among variables is followed by path analysis techniques to provide a basis for structural equation modeling. A nonmathematical introduction to SEM using LISREL and SIMPLIS is presented. Students are instructed in the applied uses of SEM, such as scale development and organizational modeling.

PSY 6408 CULTURAL SEMINAR IN I/O PSYCHOLOGY (3 credits). Cultural and multicultural issues in industrial/organizational psychology are discussed in a research seminar format. May be repeated with instructor's permission.

PSY 6409 CULTURAL RESEARCH APPLICATIONS IN I/O PSYCHOLOGY (3 credits). Supervised research in cultural applications to industrial/organizational psychology. Topics are chosen by the student and supervisor. May be repeated with instructor's permission.

PSY 6410 ORGANIZATIONAL SURVEY METHODS (3 credits). An introduction to designing, conducting and interpreting organizational surveys. Focusing on the most recent survey technology and applications, the student learns to apply new survey methodology to organizational and individual research questions. The use of qualitative research methods in organizations is also covered.

PSY 6492 ADVANCED RESEARCH IN I/O PSYCHOLOGY (1 credit). Focuses on current research methods and their application by visiting faculty in various areas of industrial/organizational psychology, highlighting theoretical and practical issues in contemporary research design and analytical techniques.

PSY 6512 ALCOHOLISM (3 credits). An overview of the area of alcohol abuse and alcoholism. Emphasis is placed on theoretical models, detection and diagnosis, treatment modalities, and individual and societal problems associated with heavy alcohol intake. *(Prerequisites: PSY 5501, PSY 5502.)*

PSY 6514 AGING AND DEVELOPMENT: CLINICAL THEMES (3 credits). Reviews adult development and aging from several vantages, including health care, social/cultural trends and ageism. Adopts a developmental perspective with clinical implications from Erikson, Levinson and others. Considers psychosocial, medical, spiritual, cognitive, loss and systemic issues.

PSY 6515 CENTRAL NERVOUS SYSTEM DISORDERS (3 credits). A study of the latest findings and developments in the field of neurocerebral impairment and its manifestations. Emphasis is placed on diagnosis and treatment planning. *(Prerequisites: PSY 5105, PSY 5502.)*

PSY 6521 PSYCHODIAGNOSTICS (3 credits). Teaches students how to integrate historical, interview, behavioral observations and test data into a clear, accurate and effective psychological report. Weekly test batteries help the student maximally use all available data to address referred questions and cogently communicate results in written format. *(Prerequisites: PSY 5502, PSY 5521, PSY 5227.)*

PSY 6522 NEUROPSYCHOLOGY AND NEUROPSYCHOLOGICAL ASSESSMENT (3 credits). An examination of the neuroanatomical correlates of psychological functioning, including assessment and treatment techniques for neuropsychological disorders. *(Prerequisite: PSY 5105.)*

PSY 6526 NEUROPSYCHOLOGY LABORATORY (1 credit). Laboratory in neuropsychology assessment training and administration, scoring, battery selection and interpretation. *(Corequisite: PSY 6522.)*

PSY 6541 BRIEF PSYCHOTHERAPIES (3 credits). Theory, research and approaches in the practice of brief psychotherapy, psychodynamic, cognitive systemic-strategic, behavioral medicine and existential applications are addressed. Research on negative effects and trends of fiscal realities are reviewed. Common therapeutic qualities across settings and approaches are traced.

PSY 6542 COUPLES THERAPY (3 credits). Examines three major contemporary theoretical approaches to marital therapy. Provides role-play opportunities to practice techniques associated with each. Gender-sensitivity training, values clarification regarding relationships, divorce and remarriage and couples therapy with specialized populations (i.e., gay, cross-cultural, etc.) is also covered. *(Prerequisite: PSY 5503.)*

PSY 6546 POST-TRAUMATIC STRESS DISORDER (3 credits). Surveys clinical issues in the assessment and treatment of PTSD with a specific focus on the combat veteran. *(Prerequisites: PSY 5501, PSY 5502, PSY 5527.)*

PSY 6549 LABORATORY IN COUPLES THERAPY (1 credit). Provides role-play experience in divorce intervention, premarital counseling, marriage enrichment and premarital therapy from a variety of theoretical orientations. *(Corequisite: PSY 6542.)*

PSY 6580 CONSULTATION (3 credits). This course examines the profession and practice of consultation. Models and applications include education and training, clinical, mental health, behavioral, organizational and program approaches. Common processes, principles and practices of the consulting psychologist are reviewed. *(Prerequisite: Admission to candidacy for the doctoral degree.)*

PSY 6582 NEUROPSYCHOLOGY CASE CONFERENCE (1–4 credits). Current neuropsychological and medical referrals, plans and implementations. Uses a group collaborative and supervisory approach, supplemented by clinical resources. Requires permission of the instructor and access to clinical cases. *(Prerequisites: PSY 5521, PSY 5527, PSY 5595.)*

PSY 6583 SUPERVISION IN PSYCHOTHERAPY TRAINING (3 credits). Considers various processes that influence the development of a psychotherapist. Implications of research on: psychotherapy outcome, the process of supervision, predictable stages as a therapist, options of techniques in supervision, and career-long issues are considered.

PSY 6584 BEHAVIORAL MEDICINE CASE CONFERENCE (1–3 credits). Surveys behavioral medicine and health systems, referrals, plans and implementations. Uses a group collaborative and supervisory approach, supplemented by clinical resources and consideration of expanded roles for psychologists in health and medical psychology. *(Prerequisites: PSY 5595, and PSY 5108 or PSY 6515 or PSY 6522, and instructor approval.)*

PSY 6595 INTERNSHIP (9 credits). This course involves 2,000 clock hours of supervised psychological activities in an APA-approved internship setting. *(Prerequisites: Completion of all academic and practicum course work requirements, successful completion of comprehensive examinations, and clinical training director approval.)*

PSY 6596 INTERNSHIP/PART-TIME DOCTORAL (5 credits). Two thousand clock hours of supervised psychological activities in an APA approved internship setting, completed on a part-time basis. *(Prerequisites: completion of all academic and practicum course work requirements; successful completion of comprehensive examinations; clinical training director approval.)*

PSY 6999 DISSERTATION (0–6 credits). Preparation of doctoral dissertation. *(Prerequisites: Admission to candidacy for the doctoral degree and department head approval.)*

SOCIOLOGY

SOC 1551 INTRODUCTION TO AMERICAN CRIMINAL JUSTICE (3 credits). The philosophy and history of the American criminal justice system. Interrelationships among system components are explored, including police, courts, institutional corrections, community-based corrections and the juvenile justice system. Contemporary issues such as discretion in the administration of criminal justice, race, due process, and search and seizure are discussed. (SS)

SOC 1552 CRIME AND SOCIETY (3 credits). A broad overview of the nature, extent and impacts of crime on society is provided. Various sociological and criminological theories are introduced in examining crime, victimology and delinquency. Specific crimes are discussed and reviewed. (SS)

SOC 2541 JUVENILE DELINQUENCY (3 credits). The prevalence and patterns of juvenile delinquency are explored with emphasis on causal factors, control and prevention. The roles of family, peers, school, community, gender and other social regulators of delinquency are examined. The juvenile justice system is introduced. *(Prerequisites: PSY 1411, SOC 1551, SOC 1552.)* (SS)

SPACE SYSTEMS

SPC 5001 INTRODUCTION TO SPACE SYSTEMS (3 credits). Includes systems engineering, space flight history, space environment, astrodynamics, rocket propulsion, launch vehicle selection, space telecommunications, remote sensing, spacecraft configuration, structures, materials, power and thermal systems, launch and space mission operations, spacecraft navigation, guidance, control and military space applications.

SPC 5002 INTRODUCTION TO SPACE ENVIRONMENT (3 credits). Introduces properties of the space environment, particularly those important to space system design and operations. Includes microgravity, high vacuum, excited molecular species, space debris, the heliosphere, solar and cosmic radiation, solar-planetary interactions, planetary magnetospheres, trapped radiation and planetary ionospheres and thermal plasmas.

SPC 5004 SPACE PROPULSION SYSTEMS (3 credits). Topics include principles of rocket propulsion, liquid and solid chemical rockets, throttling and thrust vectoring, electric and electromagnetic propulsion, solar sailing, space tethers and nuclear radioisotope, fission reactor and fusion propulsion systems. *(Prerequisite: SPC 5001.)*

SPC 5005 SPACE POWER SYSTEMS (3 credits). Includes energy conversion and storage in space; chemical, mechanical and thermal energy storage; fuel cell types; photovoltaic cells, thermionic, thermoelectric and radioisotope thermoelectric generators; power generators; space nuclear technology; and space station energy system design. *(Prerequisite: SPC 5001.)*

SPC 5006 SPACE COMMUNICATIONS AND DATA SYSTEMS (3 credits). Reliable spacecraft telecommunication systems via radio frequency links with small performance margins. Digital modulation techniques, noise temperature, channel capacity and data/waveform coding techniques for BER improvement. Methods of data acquisition, storage and processing. *(Prerequisite: SPC 5001.)*

SPC 5009 SPACE STRUCTURES AND MATERIALS (3 credits). Design of structures of adequate strength and stability with little weight margin. Tension, torsion, compound stresses, simple and composite beams, thin- and thick-walled cylinders and buckling. Properties of space-qualified materials, deterioration, damage, outgassing, oxidation, radiation resistance. *(Prerequisite: SPC 5001.)*

SPC 5010 SPACECRAFT GUIDANCE, NAVIGATION AND CONTROL (3 credits). The principles and practice of electronic, inertial, and stellar navigation, onboard and ground-controlled; attitude control methods and systems; and orbital guidance technology and systems. *(Prerequisite: SPC 5001.)*

SPC 5011 HUMAN SPACE SYSTEMS (3 credits). The role of astronauts in space. Astronaut and cosmonaut achievements in space research, extravehicular activity, long-duration space flight and lunar exploration. The space shuttle, space stations, future space habitats, lunar bases and expansion into heliocentric space. *(Prerequisite: SPC 5001.)*

SPC 5013 SPACE SYSTEMS ASTRODYNAMICS (3 credits). Topics include two- and three-body orbital problems, sun-synchronous mapping orbits, geostationary orbit and perturbations, out-of-plane orbital transfers, orbital rendezvous, ballistic missile problems and patched conic and gravity-assist interplanetary trajectories.

SPC 5017 AEROSPACE REMOTE SENSING SYSTEMS (3 credits). Principles and applications of remote sensing from the atmosphere and space; sensors for various wavelengths, imaging systems, data handling, image reconstruction and processing; contemporary remote sensing applications; geographic information systems and nonterrestrial atmospheres. *(Prerequisite: SPC 5001.)*

SPC 5018 LAUNCH AND SPACE MISSION OPERATIONS (3 credits). Overviews typical mission operations, from prelaunch through launch, tracking, orbit modification, spacecraft deployment and checkout. Range tracking, telemetry, safety instrumentation, transition to on-orbit communications and Tracking and Data Relay Satellite System. *(Prerequisite: SPC 5001.)*

SPC 5065 SPACE SYSTEMS FOR REMOTE OPERATIONS (3 credits). Principles of robotics, artificial intelligence and remotely controlled exploration, operation, observation and manipulation. Design of equipment for processing, manufacturing, maintaining and repairing equipment in space, and in lunar and planetary environments. *(Prerequisite: SPC 5001.)*

SPC 5066 SPACEFLIGHT HUMAN PHYSIOLOGY (3 credits). Emphasis is on the physiologic capabilities and limitations of astronauts. Data from both the United States and Russian space programs are reviewed for each phase of space flight. Human participation in long-duration space station, lunar and planetary missions are previewed. *(Prerequisite: Graduate standing.)*

SPC 5080 SPACE MISSIONS (3 credits). The competitive design, by student teams, of a space mission specified by the instructor. Candidate mission subjects include astronomy, communications, human space missions, planetary and interplanetary robotic exploration and remote sensing. *(Prerequisite: Completion of six required space systems courses with a GPA of at least 3.0.)*

SPC 5090, 5091, 5092 SPECIAL TOPICS IN SPACE SYSTEMS 1, 2, 3 (3, 1, 2 credits). Individual study of specific problems in space systems. *(Prerequisite: Department head approval.)*

SPC 5999 THESIS (0–3 credits). Individual work, under the direction of a member of the graduate faculty, on a selected topic in the field of space systems. *(Prerequisites: Completion of 18 semester hours in space systems, and department head approval.)*

SPACE SCIENCES

SPS 1010 INTRODUCTION TO ASTRONOMY (3 credits). A descriptive survey of astronomical topics suitable for both majors and nonmajors in the space sciences. Topics include properties of light, astronomical instrumentation, stellar structure and evolution, the interstellar medium, galactic formation and evolution, large-scale structure and cosmology.

SPS 1020 INTRODUCTION TO SPACE SCIENCES (3 credits). A study of the solar system and its member planets, moons, rings and small bodies; their formation, dynamic, chemistry, atmospheres, surface features, interiors and magnetic fields. Results of recent space probes are presented in a comparative study of the solar system's members.

SPS 2010 OBSERVATIONAL ASTRONOMY (3 credits). The course combines lecture and observational labs to provide an introduction to the techniques of observational astronomy. Topics include celestial coordinate systems, time, apparent stellar motions, constellations, the use of star charts and catalog, and visual CCD photometry. *(Prerequisites: MTH 1001, SPS 1010.)*

SPS 3010 GEOPHYSICS (3 credits). Introductory study of the structure, internal constitution, deformation and dynamics of the solid earth as revealed by surface geophysical manifestations (gravity, magnetic, electrical, seismic). Topics include heat flow, electromagnetic induction, tides, the gravitational field and magnetic field. *(Prerequisites: MTH 2001, PHY 2002.)*

SPS 3020 METHODS AND INSTRUMENTATION (3 credits). A detailed introduction to the techniques and instrumentation used in modern observational astronomy and space science. Topics include astronomical sources, observational limits, telescopes, atmospheric effects, spectrographs, single-channel detectors and advanced solid-state detectors of all types. *(Prerequisite: PHY 2002.)*

SPS 3030 ORBITAL MECHANICS (3 credits). This course provides the foundations of basic gravitation and orbital theory. Topics include coordinate and timekeeping systems, the two-body problem, particle dynamics and motion under inverse square forces, particularly as applied to spacecraft orbit determinations, trajectories, time of flight and maneuvers. *(Prerequisite: PHY 3011.)*

SPS 3040 FUNDAMENTALS OF REMOTE SENSING (3 credits). History, measurement philosophy, orbits, vehicles, the nature of electromagnetic radiation (EMR), blackbodies, Maxwell's equations, interaction of EMR with matter, polarization, radiance, irradiance, radiative transfer and an overview of ultraviolet, visible, infrared and microwave radiometry and instrumentation. *(Prerequisite: PHY 2002.)*

SPS 4010 ASTROPHYSICS 1: INTRODUCTION TO STELLAR STRUCTURE AND EVOLUTION (3 credits). An introduction to the physics of the sun and stars. Topics include properties of E&M radiation, stellar distances and magnitudes, radiative transfer, the Sun, the ISM and star formation, stellar evolution, stellar endpoints and variable stars. *(Prerequisites: MTH 2201, PHY 3060.)*

SPS 4020 ASTROPHYSICS 2: GALACTIC STRUCTURE AND COSMOLOGY (3 credits). Topics include galactic coordinates, galactic rotation curve, N-body concepts and the virial theorem, Galactic formation and evolution, external galaxies, galaxy cluster evolution, Hubble's law and the distance scale, large-scale structure, cosmology and the particle physics connection. *(Prerequisite: SPS 4010.)*

SPS 4025 INTRODUCTION TO SPACE PLASMA PHYSICS (3 credits). The physics of ionized gases is introduced beginning with the subjects of singe-particle motion, collection of particles, fluid description of plasmas and magnetohydrodynamics. The role of plasmas in solar-terrestrial space physics is emphasized. Heliospheric, magnetospheric and ionospheric topics are included. *(Prerequisite: PHY 3440.)*

SPS 4030 PHYSICS OF THE ATMOSPHERE (3 credits). A study of the behavior of Earth's lower atmosphere, including an introduction to comparative planetology, atmospheric evolution, thermodynamics, dynamics, waves and turbulence clouds, hurricanes, global circulation and global change *(Prerequisites: MTH 2201, PHY 3060.)*

SPS 4035 COMPARATIVE PLANETOLOGY (3 credits). A comprehensive survey. Observations from both space-based and Earth-based experimentation is incorporated with the major planetary bodies, asteroids, comets and other small orbitals. The topics of both planetary interiors surface features and atmospheres will be discussed. *(Prerequisites: PHY 3060, SPS 1020.)*

SPS 4110 SENIOR LABORATORY 2 (2 credits). Students conduct experiments in optics, atomic structure, nuclear and solid state physics that are basic to observations in space sciences. *(Prerequisite: Senior standing in space sciences.)*

SPS 4200, 4210 SENIOR SEMINAR 1, 2 (1, 1 credit). This seminar includes reports and discussions on selected topics in contemporary, experimental and theoretical physics and space sciences. *(Prerequisite: Must be within three semesters of graduation.)*

SPS 4201 SPECIAL TOPICS IN SPACE SCIENCES (3 credits). Specific problems of space sciences are studied. *(Prerequisite: Department head approval.)*

SPS 4301 INDEPENDENT STUDIES (3 credits). Individual study of specific problems in space sciences. *(Prerequisite: Department head approval.)*

SPS 4400 SPACE LAUNCH SYSTEMS (3 credits). The assembly, preparation and checkout for launch of several space-launch systems built by different manufacturers. Students review the actual procedures, hardware and facilities used. *(Prerequisite: Instructor approval or senior standing.)*

SPS 4401 MATERIAL PERFORMANCE (3 credits). Special requirements for materials used in space flight hardware, including characterizing and evaluation of performance and failure analysis of the components. The materials analytical facilities at NASA/KSC will be used. *(Prerequisite: Instructor approval or senior standing.)*

SPS 4402 TELEMETRY AND SPACE COMPUTER SYSTEMS (3 credits). This course is concerned with the transmitted data stream from and to a typical space vehicle during its mission. Students also study the computer software and systems used to control the vehicle. *(Prerequisite: Instructor approval or senior standing)*

SPS 4403 SMALL SATELLITE/PAYLOAD INTEGRATION AND MISSION ANALYSIS (3 credits). A course on payload integration in conjunction with actual Shuttle payload activities at NASA/KSC. Classes center on vehicle and payload systems as they are being prepared for launch, including spacecraft power, attitude control, communications, etc. *(Prerequisite: Instructor approval or senior standing)*

SPS 4901, 4902 UNDERGRADUATE RESEARCH (3, 3 credits). Individual research directed by a faculty member. *(Prerequisite: Department head approval.)*

SPS 5010 ASTROPHYSICS 1: STELLAR STRUCTURE AND EVOLUTION (3 credits). Introduces basic interior structural equations, energy generation processes, opacity, and energy transport; radiation transport in stellar atmospheres, star formation, late stages of stellar evolution, stellar binaries and clusters. Special emphasis is placed on analytic and numerical models relevant to the sun. *(Prerequisites: PHY 3060, SPS 1010.)*

SPS 5011 ASTROPHYSICS 2: GALACTIC STRUCTURE AND COSMOLOGY (3 credits). Topics include formation and evolution of the Galaxy, including stellar populations and kinematics, spiral density theory; extragalactic astronomy, active galactic nuclei, Hubble's law, large-scale structure; and cosmology, including inflationary cosmology and the particle physics connection. *(Prerequisite: SPS 5010.)*

SPS 5020 SPACE PHYSICS 1: THE LOW-ENERGY UNIVERSE (3 credits). An introduction to low-energy space plasma physics including the statistical behavior of plasmas, kinetic theory and magnetohydrodynamics. Emphasis is on solar system space plasma physics and the Sun-Earth connection including magnetospheric physics. *(Prerequisite: ECE 5410.)*

SPS 5021 SPACE PHYSICS 2: THE HIGH-ENERGY UNIVERSE (3 credits). The theoretical background and methods for observing gamma rays, X-rays, high-energy electrons, heavy particles, cosmic rays, neutrons and gravitational waves from both spacecraft and Earth. *(Prerequisite: SPS 5020 or instructor approval.)*

SPS 5030 PLANETARY SCIENCE 1: INTERIORS (3 credits). Mechanical and thermal processes governing the interior structure and surfaces of the major and minor planetary bodies of the solar system. Topics include the planetary crust, mantle, core, core-mantle interface, seismicity, density and elastic constants. *(Prerequisite: SPS 3010 or instructor approval.)*

SPS 5031 PLANETARY SCIENCE 2: ATMOSPHERES (3 credits). Principles governing the evolution, composition and retention of planetary atmospheres and the interplanetary environment. Topics include the neutral atmosphere, photochemical processes, diffusion dynamics and planetary ionospheres and magnetospheres. *(Prerequisite: SPS 4030.)*

SPS 5050 ASTRODYNAMICS (3 credits). Topics include the gravitational force, circular restricted three-body problem, many-bodies problem, perturbation theory, rocket dynamics, transfer orbits, motion of an artificial satellite and interplanetary trajectories. *(Prerequisite: SPS 3030.)*

SPS 5088, 5089 SPECIAL TOPICS IN SPACE SCIENCES (3, 3 credits). Investigation of specific problems in the space sciences. *(Prerequisite: Department head approval.)*

SPS 5090, 5091 SPECIAL TOPICS IN OBSERVATIONAL ASTRONOMY 1, 2 (3, 3 credits). Participation in advanced observing programs at the university's observatories. *(Prerequisite: Department head approval.)*

SPS 5999 THESIS (0–6 credits). Individual work under the direction of a member or members of the graduate faculty on a selected topic in space sciences. *(Prerequisite: Department head approval.)*

SPS 6001 INDIVIDUAL STUDIES (1–3 credits). Preparation for doctoral qualifying examination by individual studies under faculty supervision. *(Prerequisite: Department head approval.)*

SPS 6090 RESEARCH (1–3 credits). Research leading to the doctoral dissertation. *(Prerequisite: Department head approval.)*

SPS 6999 DISSERTATION (0–6 credits). Preparation of doctoral dissertation. *(Prerequisites: Admission to candidacy for the doctoral degree and department head approval.)*

SOFTWARE ENGINEERING

SWE 5001 SOFTWARE ENGINEERING 1 (3 credits). The application of engineering rigor to all phases of the software development life cycle: requirements elicitation and analysis, software architecture, software design and construction, software integration and test, and software maintenance. Students develop a software system from an initial problem statement through release of the completed product. *(Prerequisites: CSE 2010, MTH 2051.)*

SWE 5002 SOFTWARE ENGINEERING 2 (3 credits). The use of engineering rigor and team coordination to develop a software product. Based on an initial problem statement, teams create and document disciplined procedures for each phase of the software development life cycle, then develop the software according to their documented processes, and finally provide in-depth critiques of the processes they followed. *(Prerequisite: SWE 5001.)*

SWE 5110 REQUIREMENTS ENGINEERING (3 credits). This course provides an in-depth study of software requirements, engineering tools and techniques. Topics will include gathering user requirements, formal specification of system behavior, system interfaces, end-user and system documentation and validation techniques. The end-user aspect of gathering and formalizing or user requirements is emphasized. *(Prerequisite: SWE 5001.)*

SWE 5310 INTERFACE DEVELOPMENT (3 credits). This course focuses on a specific class of software for which special engineering consideration must be given: software interfaces. The four major categories to be explored (human interfaces, file/database interfaces, APIs and real-time interfaces) and techniques to read from and write to these interfaces are given. *(Prerequisite: SWE 5001.)*

SWE 5320 WINDOWS SYSTEMS PROGRAMMING (3 credits). Focuses on programming for Windows 32- and 64-bit operating systems. Windows handling of processes, threads and memory management with emphasis on writing programs to optimally use these resources. Use of and programming for UNICODE, dynamic link libraries and the WIN32 API. Students write substantial programs in Visual C++.

SWE 5411 SOFTWARE TESTING 1 (3 credits). Explores functional (black box) methods for testing software systems, reporting problems effectively and planning testing projects. Students apply what they have learned, throughout the course, to a sample application that is commercially available or under development. The choice of sample application changes from term to term. *(Prerequisites: CSE 2410 or SWE 5001, MTH 2051, MTH 2401.)*

SWE 5415 SOFTWARE TESTING 2 (3 credits). Explores structural (glass box) methods for testing software. Testing of variables in simultaneous and sequential combinations, application programmer interfaces, protocols, design by contract, coverage analysis, testability, diagnostics, asserts and other methods to expose errors, regression test frameworks, test-first programming. *(Prerequisites: CSE 2410 or SWE 5001.)*

SWE 5430 SOFTWARE TESTING TOOLS (3 credits). This project-oriented course requires students to perform a survey of existing testing tools and to test a featured software product. Students are responsible for assessing functionality of testing tools and working with tool vendors to acquire and deploy a number of tools to test a real software application.

SWE 5440 INTRODUCTION TO SOFTWARE ARCHITECTURE (3 credits). This course presents the role of software architecture in the software engineering life cycle. It covers techniques for design to meet functional requirements; analysis with respect to desired attributes such as performance, reliability and maintainability; and improvement to better satisfy desired attributes while still meeting functional requirements. *(Prerequisite: SWE 5001.)*

SWE 5460 COMPUTER AND INFORMATION SECURITY (3 credits). An examination of concepts of modern computer security from a practical point of view. Topics include secure system design, system vulnerability, threat assessment, intrusion detection, cryptography, and legal and ethical issues in computer security. Emphasis on software engineering applications of security and implementation of a secure computer system.

SWE 5510 SOFTWARE MAINTENANCE (3 credits). This course describes abstraction techniques to extract specifications and design from existing code. The use of these techniques in debugging, re-engineering and software enhancement is discussed. *(Prerequisite: SWE 5001.)*

SWE 5621 SOFTWARE METRICS AND MODELING (3 credits). This course examines common software metrics, axiomatic foundations of measurement, validity of measurements and measurement dysfunction, and some statistical and modeling approaches to help students make their software measurements meaningful. *(Prerequisite: CSE 2410 or SWE 5001, MTH 2401.)*

SWE 5630 SOFTWARE TOOLS AND TECHNOLOGY (3 credits). This course presents the tools and techniques that support software engineering at all levels. Computer-aided software engineering is assessed in terms of development support at the technical level (decomposition, analysis, design and implementation support, and verification/validation capabilities) and at the management level. *(Prerequisites: SWE 5001.)*

SWE 5640 STATISTICAL METHODS FOR SOFTWARE ENGINEERING (3 credits). Statistical techniques with application in software engineering. Methods include multiple analysis of variance, multiple linear regression, factorial designs, logistic regression, Bayesian models and stratified testing.

SWE 5900 SPECIAL TOPICS IN SOFTWARE ENGINEERING (1–3 credits). Selected topics of current interest in software engineering. Material varies according to faculty and student interest. This course may be repeated for credit. *(Prerequisite: Instructor approval.)*

SWE 5999 THESIS (0–3 credits). This course is individual work under the direct guidance of a faculty member, culminating in the formal defense of a written thesis. *(Prerequisite: Permission of the instructor.)*

SYSTEMS ENGINEERING

SYS 5001 RESEARCH METHODS IN SYSTEMS ENGINEERING PREPARATION (1 credit). Preparation for SYS 5370, providing an overview of probability and statistics, including summary measures of a sample, data representation and probability distributions. Data analysis and interpretation is discussed, including hypothesis formulation, sampling and statistical inference. This credit cannot be used to fulfill graduation requirements.

SYS 5002 SYSTEM LIFE CYCLE COST ESTIMATION PREPARATION (1 credit). Preparation for SYS 5385, including an overview of current methodologies and tools for estimating the costs of all phases of the system life cycle, including both research and development. Topics include fundamentals of cost estimation techniques and cost-benefit analysis. This credit cannot be used to fulfill graduation requirements.

SYS 5003 COMPUTER NETWORK ARCHITECTURE PREPARATION (1 credit). Preparation for ECE 5595, including an overview of basic theory, design and analysis of computer communications in systems. Topics include fundamentals of TCP/IP, Internet, the World Wide Web, ISO-OSI network architecture and LANs. This credit cannot be used to fulfill graduation requirements.

SYS 5004 MILITARY OPERATIONS RESEARCH PREPARATION (1 credit). Preparation for SYS 5375, including an overview of optimization modeling techniques and operations research fundamentals. Topics include a review of linear programming, nonlinear programming and goal programming. This credit cannot be used to fulfill graduation requirements.

SYS 5005 SPECIAL TOPICS IN COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE PREPARATION (1 credit). Preparation for ECE 5272, including an overview of broad C3I areas such as sensor data fusion, estimation, tracking, probability and statistical models and optimization. This credit cannot be used to fulfill graduation requirements.

SYS 5310 SYSTEMS ENGINEERING PRINCIPLES (3 credits). This course introduces the fundamental principles in systems engineering (SE) that deal with system life cycle phases, emphasizing requirement and design methodologies. Key topics include SE definition; life cycle methodologies, tools and techniques; evaluation of system and technology alternatives, reliability and maintainability, trade off models and SE management tools and techniques.

SYS 5350 SYSTEMS MODELING AND ANALYSIS (3 credits). System simulation modeling and analysis tools and techniques, covering issues such as variability, covariance and correlation. Key topics include management of simulation and modeling projects, verification and validation techniques, variance reduction techniques, animation, continuous system simulation, and creativity and innovation through modeling.

SYS 5365 DECISIONS AND RISK ANALYSIS (3 credits). Analytical methods to solve decision problems that involve uncertainties, opposing objectives and limited or excessive information. Key topics include structuring decision, expected opportunity loss, expected value of imperfect information, Bayesian analysis, utility curves, decision trees, risk analysis/mitigation tools and techniques, and risk profiles.

SYS 5370 RESEARCH METHODS IN SYSTEMS ENGINEERING (3 credits). Systematic measurement and analysis of data to improve decision accuracy. Scientific approaches to SE problems, hypothesis testing, data collection issues such as survey data, reliability, accuracy of measured data, data measurement tools and techniques, statistical process control, design of experimental methods, full and fractional designs, multiple regression analysis.

SYS 5375 MILITARY OPERATIONS RESEARCH (3 credits). Quantitative methods used in support of military decisions at strategic and tactical levels. Key topics include operations research concepts, quantitative evaluation of military alternatives, resource allocation models (linear and nonlinear programming), assignment problems, transportation modeling (deployment, airlifting, mobility), inventory models and limited area/limited time operations.

SYS 5380 SYSTEMS ENGINEERING DESIGN PROJECT ((3 credits). This team-oriented capstone course in the graduating semester enables the student to integrate learning from all MSSE courses in a real-life project setting. Day-to-day progress is monitored by a company supervisor, with weekly status reports turned in to the supervisor and the instructor. Input from the company supervisor is a factor in the final grade.

SYS 5385 SYSTEM LIFE CYCLE COST ESTIMATION (3 credits). Tools and techniques used in estimating cost for all phases of a system. Total system cost including research and development, investment and operation. System life cycle (SLC) cost estimation, SLC cost estimation models including discounted cash flow analysis, activity-based costing and cost-benefit calculations, cost scenario sensitivity analysis and design-to-cost concepts.

SYS 5999 THESIS RESEARCH IN SYSTEMS ENGINEERING (3 credits). Individual research under the direction of a member of the graduate faculty in a selected systems engineering topic. May be repeated for a maximum of six credits. *(Prerequisite: Thesis adviser approval.)*

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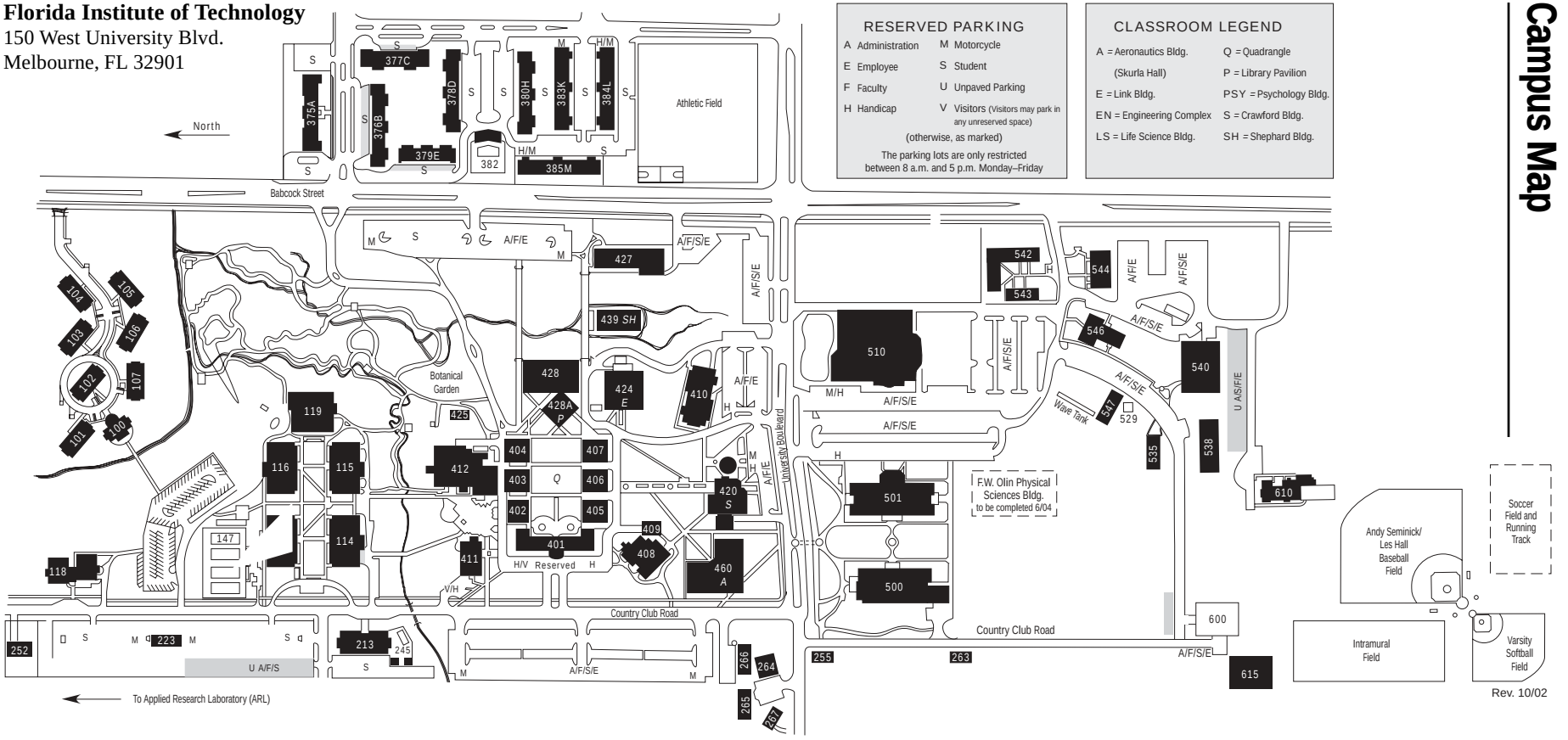

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Chemical Engineering	7033	8033	9033
Civil Engineering	7043	8045	9043
Computer Engineering	7042	8040	9040
Electrical Engineering	7041	8042*	9042
Engineering Management		8075*	
Mechanical Engineering	7131	8131*	9131
Ocean Engineering	7084	8084	9084
Software Engineering	7075	8050*	
Systems Engineering		8097	
APPLIED SCIENCE			
Computer Sciences			
Computer Science	7071	8071*	9071
Information Systems	7074	8072*	
Environmental Sciences			
Environmental Resource Management		8135	
Environmental Science	7222	8128	9128
Meteorology	7223	8223	
OCEANOGRAPHY	7080		9081
Biological Oceanography		8081	
Chemical Oceanography		8082	
Coastal Zone Management		8087	
Geological Oceanography		8088	
Physical Oceanography		8083	

**Programs also offered at off-campus sites*

SCHOOL OF AERONAUTICS

	B.S.	M.S.	M.S.A.
Aeronautical Science	7103		
Flight Option	7102		
Aviation			
Airport Development and Management			8214
Applied Aviation Safety			8205
Aviation Computer Science	7104		
Aviation Human Factors		8229	
Aviation Management	7114		
Flight Option	7113		
Aviation Meteorology	7106		
Flight Option	7105		

SCHOOL OF MANAGEMENT

	B.S.	M.B.A.
Accounting	7267	
Business Administration	7067	8300
Business and Environmental Studies	7167	
Information Systems in Business	7567	
Management Information Systems	7467	

SCHOOL OF PSYCHOLOGY

	B.A.	B.S.	M.S.	Psy.D.	Ph.D.
Applied Behavior Analysis			8147*		
Clinical Psychology				9144	
Forensic Psychology	7146				
Industrial/Organizational Psychology			8145		9145
Psychology	7144	7141			

**Program also offered at off-campus sites*

NONDEGREE PROGRAMS

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General Science	7050
General Studies	7060
Continuing Education	0100

COLLEGE OF SCIENCE AND LIBERAL ARTS

SCIENCE	B.A.	B.S.	M.A.T.	M.S.	Ed.S.	Ed.D.	Ph.D.
Biochemistry		7028					
Biological Sciences							9021
Aquaculture		7026					
Biotechnology				8024			
Cell/Molecular Biology				8022			
Ecology		7021		8021			
General Biology		7022					
Marine Biology		7023		8023			
Molecular Biology		7025					
Preprofessional Biology		7024					
Chemistry				8031			9031
Chemical Management		7032					
General Chemistry		7031					
Premedical Chemistry		7036					
Research Chemistry		7034					
Interdisciplinary Science		7035					
Military Science		7037					
Physics		7101		8101			9101
Preprofessional Physics		7135					
Space Sciences		7132		8132			9132
Astronomy/Astrophysics		7136					
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Applied Mathematics		7073		8073			9073
Operations Research				8074*			9074
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Technical and Professional Communication				8180			
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Computer Education				8129			
Environmental Education				8119			
Mathematics Education		7150		8127	8927	9150	9127
Science Education				8120	8900	9120	9124
Biology		7121					
Chemistry		7122					
Computer Science		7128					
Earth/Space Science		7129					
General Science		7124					
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Teaching			8150				

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	P.M.B.A.	M.P.A.	M.S.
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Business Administration	8391		
eBusiness	8356		
Human Resources Management	8400		8350
Information Systems	8396		
Logistics Management			8322
Management			8381
Acquisition and Contract Management			8403
eBusiness			8404
Human Resources Management			8405
Information Systems			8406
Logistics Management			8407
Transportation Management			8408
Materiel Acquisition Management			8320
Project Management			8357
Information Systems			8358
Operations Research			8359
Public Administration		8401	
Space Systems			8137
Space Systems Management			8315
Systems Management			8330
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