COLLEGE OF ENGINEERING

The College of Engineering offers undergraduate and graduate programs to prepare students for a broad spectrum of professional careers in engineering. The undergraduate programs of the College are designed to provide students with a sense of human values and the scientific/technical foundation necessary for a lifetime of continued learning.

The programs offered by the College of Engineering to meet the diverse requirements of the future cover the two areas of: *Professional Engineering* and *Applied Science.* The specific degrees and services offered are as follows.

Bachelor of Science in Chemical Engineering (B.S.Ch.E.)
Bachelor of Science in Civil Engineering (B.S.C.E.)
Bachelor of Science in Computer Engineering (B.S.Cp.E.)
Bachelor of Science in Electrical Engineering (B.S.E.E.)
Bachelor of Science in Industrial Engineering (B.S.I.E.)
Bachelor of Science in Mechanical Engineering (B.S.M.E.)
Bachelor of Science in Computer Science (B.S.C.S.)
Bachelor of Science in Information Systems (B.S.I.S.)

The Accreditation Board for Engineering and Technology, Inc. (ABET), formerly the Engineers' Council for Professional Development, has inspected and accredited the programs of the College of Engineering defined by the Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Industrial Engineering and Mechanical Engineering. The Bachelor of Science program in Computer Science is accredited by the Computer Science Accreditation Commission (CSAC) of the Computing Sciences Accreditation Board (CSAB).

The above spectrum of program offerings provides the prospective student with a choice of avenues depending upon individual interests, career objectives, and capabilities for a significant technological contribution. These programs are described in more detail under their respective catalog headings.

Laboratory experience as well as real-world participation in technological problem-solving is a key aspect of a professional engineer's college education. The College of Engineering, in implementing this need, augments its own modern laboratory and research facilities by close contact with the professional societies and the many industries in the metropolitan Tampa Bay area.

Students interested in particular programs offered by the College of Engineering should direct their inquiries to the College of Engineering Office of Advising.

PROFESSIONAL ENGINEERING

The College of Engineering recognizes that modern engineering solutions draw on knowledge of several branches of engineering. It also recognizes that future technological and societal developments will lead to shifting of the relative emphasis on various branches of engineering, triggered by new needs or a reassessment of national goals. For this reason the College's programs include a strong engineering foundation (core) portion, designed to equip the prospective engineer with a broad base of fundamental technical knowledge. To this foundation is added the student's specialization (option) of sufficient depth to prepare him/her to successfully embark on a professional career.

The Bachelor of Science degrees offered in various engineering fields provide the student a broad education with sufficient technical background to effectively contribute in many phases of engineering not requiring the depth of knowledge needed for advanced design or research. However, while the baccalaureate degree is considered the minimum educational experience for participating in the Engineering profession, and as such is the first professional degree, students interested in design and research are strongly encouraged to pursue advanced work beyond the baccalaureate either at this or other institutions. It is becoming increasingly evident that a large segment of today's engineering professionals are involved in some form of post baccalaureate study. Engineers are earning advanced degrees to obtain the information and training necessary to meet effectively tomorrow's technological challenges. All are faced with the continuing problem of refurbishing and updating their information skills and most are obtaining advanced information by means of formal graduate study, seminars, special institutes and other such systems designed for this purpose.

The Bachelor of Science degree program (in a designated engineering field requires 136 semester hours) and the Master of Science degree in the same field may be pursued simultaneously in a program of 166 semester hours called the 5-Year Program. These programs are specifically designed to prepare an individual for a professional career as an engineer. These programs have as their foundation a core of subject material encompassing Humanities, Social Science, Mathematics, Science, and Engineering which is required of all students. In addition to the core subject material, each student will complete specialization studies in a designated field under the direction of one of the administrative departments of the College.

The engineering programs of the College have been developed with an emphasis on three broad aspects of engineering activity: design, research, and the operation of complex technological systems. Students who are interested in advanced design or research should pursue the 5-Year Program leading to a Master of Science in Engineering degree.

Preparation for Engineering

Students planning to attend USF's College of Engineering should familiarize themselves thoroughly with the College's admissions standards and requirements, which are more stringent than the University's minimum entrance requirements.

The high school student anticipating a career in engineering should elect the strongest academic program that is available while in high school. Four years each of English, mathematics and science (preferably including Chemistry and Physics), as well as full programs in the social sciences and humanities, are most important to success in any engineering college.

Prospective students considering engineering at the University of South Florida who lack certain preparation in high school must elect to follow a program to overcome their deficiencies. One alternative might be that such a student take some remedial work and a less accelerated program as a Pre-Engineering student. The University of South Florida generally offers most required pre-engineering courses every semester. As another alternative, students may wish to avail themselves of the State's system of junior/community colleges which offer a wide range of remedial coursework, and many of which also offer full programs in pre-engineering (first two years' coursework).

Junior/community college students planning to transfer to the University of South Florida's engineering program at the junior level from a State of Florida operated college or university should follow a pre-engineering program leading to an A.A. degree. All transfer students should complete as much of the mathematics, science and engineering core coursework as is available to them. Transfer students should be aware that the College expects them to meet its admission requirements listed in this section under college regulations for graduation just as it expects its own students to meet these requirements. Junior/community college transfer students should note that in addition to freshman and sophomore level courses, required junior level courses are given each semester thus permitting full continuity in studies for the student. Junior/community college students intending to pursue an engineering program at USF should contact the adviser at their institution and request a course equivalency list.

Although it is not mandatory, the College strongly recommends acquisition or personal access to a personal computer. For further details, contact the Associate Dean of Engineering - Computing Services.

The College of Engineering can assist students who are planning to obtain an Engineering degree from the University of South Florida and who have started their studies elsewhere in formulating a sound total program. Interested students should contact the College's Advising Office (813/974-2684) furnishing sufficient details to permit meaningful response.

Undergraduate Admission to the College

Students may apply to the College of Engineering upon initial entry to the University by declaring Engineering as their intended major on their admissions application. Upon acceptance to the University, engineering will review necessary credentials and notify applicant of Engineering status.

USF students may apply through the Advising Office, in the College of Engineering. To be considered for admission to the College, an applicant must be accepted by the University as a degree-seeking student and be academically in good standing.

Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL score must be 550.

Engineering Admission Requirements

1. Freshmen:
   a. Test Scores:
      SAT--composite of 1050 minimum with a minimum quantitative of 550.
      ACT--composite of 25 minimum and mathematics of 25 minimum.
   b. High School Mathematics: Should include sufficient algebra and trigonometry to enter Engineering Calculus I. Math Placement Test must be passed to enter Calculus I.
   c. High School Grade Point Average of 2.5/4.0.
2. Transfer Students:
   Transfer students should complete the following *prerequisite courses* listed below at the lower level prior to entering the University. If these courses are not taken at the community college. they must be completed before the degree is granted. Unless stated otherwise, a grade of "C" is the minimum acceptable grade.

CHM X045/X045L	General Chemistry I (with lab)
CHM X046/X046L	General Chemistry II (with lab)
PHY X048/X048L	General Physics and Laboratory I
PHY X049/X049L	General Physics and Laboratory II
MAP X302	Differential Equations
EGS 1113	Introduction to Design Graphics
MAC X281	Engineering Calculus I
or MAC X311	
MAC X282	Engineering Calculus II
or MAC X312	
MAC X283	Engineering Calculus III
or MAC X313	

Admission to Programs in Engineering

Once a student has been admitted to the College of Engineering, he/she must then seek admission into one of the specific departments.

The minimum requirements for acceptance by the departments administering the Engineering programs in Chemical, Civil, Computer, Electrical, Industrial and Mechanical Engineering are:

1. Completion of English, Calculus, Differential Equations, Physics and Chemistry requirements.
2. Satisfactory completion of EGN 1002 - Engineering Orientation.
3. Completion of the following courses with either: a cumulative grade point average of 2.0 in these courses based on all attempts.
   EGN 2210 - Computer Tools for Engineers
   EGN 3311 - Statics
   EGN 3343 - Thermodynamics I
   EGN 3443 - Engineering Statistics I
   EGN 3373 - Introduction to Electrical Systems I

The minimum requirements for admission to the Computer Engineering program offered by the Computer Science and Engineering Department are completion of sections 1 and 2 above and:

1. Completion of:
   COP 2002 & COP 2000L - Intro to Computer Science and Lab
   EGN 3311 - Statics
   EGN 3343 - Thermodynamics I
   EGN 3373 - Introduction to Electrical Systems I
   EGN 3443 - Engineering Statistics I
   with a minimum of 2.0 based on all attempts.
2. The minimum requirements for admission to the Computer Science program offered by the Computer Science and Engineering Department are completion of sections 1 and 2 above and completion of
   COT 3100 - Discrete Structures
   EGN 3373 - Introduction to Electrical Systems I
   STA 4442 - Introduction to Probability
   COP 2002 & COP 2000L - Intro to Computer Science and Lab
3. The minimum requirements for admission to the Information Systems program offered by the Computer Science and Engineering Department are completion of sections 1 and 2 above and the completion of:
   COP 2002 & COP 2001 - Intro to Computer Science and Lab
   COT 3100 - Discrete Structures
   COP 2120 - COBOL I
   EGN 2210- Computer Tools for Engineers
   STA 2023 - Introduction to Statistics

   Students who fail to obtain a "C" grade on the first attempt must obtain a cumulative 2.0 G.P.A. based on all attempts.

Prior to being admitted to a department, a student may be permitted to take no more than two departmental engineering courses.

A student can have his or her academic records housed in a department and be advised by the department advisor prior to completing requirements for department admission if he or she so chooses. This type of student must still comply with all of the above-listed requirements prior to official acceptance by the department.

Engineering Advising

Effective pursuit of engineering and engineering related studies requires careful attention to both the sequence and the type of courses taken. The engineering curriculum differs in key respects from the study plans of other majors - even in the freshmen year. It is, therefore, important, and the College requires, that each student plan his/her academic program and have it approved by a designated adviser in the College of Engineering.

New students must attend the University's Orientation program. They are assigned an engineering adviser during this program and receive advisement for their first semester at that time.

The student and adviser jointly work out a plan of study which meets both the student's career objectives and the College of Engineering's degree requirements. The advisers maintain the College of Engineering's student records.

Students not yet meeting departmental admissions requirements may elect to be advised by the general engineering advising office or the department of their intended specialization.

While the College provides advising services to assist students with academic planning, *the responsibility for seeing that all graduation requirements are met rests with the students. *A copy of the Student Academic Support System (SASS) report may be had upon request.*

*The College of Engineering requires all undergraduates to apply for graduation the semester prior to the anticipated graduation term. Necessary forms and instructions can be obtained in the Advising Office.

Departments & Programs

The supervision of the academic programs for the College is the function of the six administrative departments together with several coordinators. The departments are responsible for the professional programs in engineering and engineering science. Each department is responsible for programs, faculty, laboratories and students assigned to it.

Chemical Engineering

This department offers coursework and study in all areas fundamental to Chemical Engineering. Topics included are thermodynamics, fluid flow, heat transfer, mass transfer, separation processes, chemical reactors, instrumentation and process control, economics optimization, computer methods, computer aided design techniques, and process plant design. These courses, together with mathematics, physics, chemistry, other interdisciplinary engineering fundamentals, English, and liberal arts courses, provide the basis for long range professional progress. Because of the many professional areas available for employment to the chemical engineer, the students are also required to take a number of electives from areas such as biotechnology, materials, and environmental engineering. These electives are designed to broaden the experience, and, therefore, the employment possibilities of our graduates. The department administers the Bachelor of Science in Chemical Engineering (B.S.Ch.E.), the Master of Science in Chemical Engineering (M.S.Ch.E.), the Master in Chemical Engineering (MCHE), the Master of Engineering (M.E.), the Master of Science in Engineering (MSE), and the Doctor of Philosophy (Chemical and Engineering Science) (Ph.D.) degrees. The Chemical Engineering Department also offers a sequence of courses in Chemical Engineering Science, biotechnology and biomedical engineering.

Biotechnology And Biomedical Engineering

A sequence of courses in the engineering aspects of biotechnology is currently available within the Chemical Engineering program. Topics include applied microbiology, fermentation, enzyme technology, and pharmaceutical engineering.

Biomedical Engineering is a highly interdisciplinary program, drawing from all engineering disciplines, biology, physical sciences, biomedical and clinical sciences. An undergraduate Certificate in Biomedical Engineering is available to students in all areas of engineering. This Certificate is designed with two main objectives: 1) to prepare interested students for admission into medical school, and 2) to prepare students for graduate work in either Biomedical Engineering, other engineering disciplines, or the Biomedical Sciences. Opportunities for students to gain research experience exist within the College of Engineering and the Health Sciences Center.

Please see the certificate programs section of this catgalog for more information on these programs.

Civil and Environmental Engineering

This department offers course work and study pertinent to Civil Engineering, Engineering Mechanics, Material Science, and Environmental Engineering. Areas of concentration are structural engineering, engineering mechanics, geotechnical engineering, transportation engineering, water resources engineering, materials and corrosion engineering, and environmental engineering. The department has a policy of mandatory academic advising of students for each school term. The department offers the undergraduate degree, Bachelor of Science in Civil Engineering (BSCE) and the following graduate degrees: Master of Science in Civil Engineering (MSCE), Master or Science in Engineering (MSE), Master of Science in Environmental Engineering (MSEV), Master of Cilvil Engineering (MCE), Master of Engineering (ME), Master of Environmental Engineering (MEVE), and Doctor of Philosophy (Ph.D.).

Computer Science and Engineering

This department offers coursework and study in all areas fundamental to Computer Science, Computer Engineering, and Information Systems. Topics dealt with are computer architecture and hardware design, software engineering, computer system organization, operating systems, algorithms and data structures, computer graphics, user interface, computer networks, database systems, theory of computation and artificial intelligence.

The Department administers the baccalaureate degree programs in Computer Science, Computer Engineering and Information Systems; Master of Science degree programs in Computer Science and in Computer Engineering; and Ph.D. program in Computer Science and Engineering. Our research areas of faculty concentration are 1) computer architecture and VLSI design/testing, 2) artificial intelligence and expert systems, 3) graphics/image processing/computer vision, 4) database, 5) networks.

Computing facilities available to students in the Department include several microprocessor and design laboratories for hardware-oriented studies, personal computer laboratories for general use in programming assignments, and networked SUN and DEC workstations for use by majors. The Department also runs a research-oriented network consisting of an Intel Hypercube, a number of SUN, DEC, and IBM workstations, and special purpose image and graphics processors. In addition, the Department has access to a large IBM mainframe facility run by the University Computing Center.

Electrical Engineering

This department offers study in all areas fundamental to Electrical Engineering and the electrical sciences: circuit analysis and design, electronics, communications, electromagnetics, controls, solid state, systems analysis, digital circuit design, etc. Basic concepts are augmented with well-equipped laboratories in networks, electronics, digital systems, microwave techniques and communications. In addition, a general purpose computer facility, a microprocessor laboratory and a microelectronics fabrication laboratory are available to undergraduate and graduate students. The department administers the Bachelor of Science in Electrical Engineering (B.S.E.E.) degree program, as well as the Master of Science in Electrical Engineering (M.S.E.E.) and Master of Electrical Engineering (M.E.E.) programs which are also available to evening and off-campus students. As applicable, the department administers the M.E., M.S.E.S. and the Ph.D. in Electrical Engineering programs.

Industrial and Management Systems Engineering

This department offers study pertinent to the design, evaluation and operation of a variety of industrial systems, ranging from the analysis of public systems to the operation of manufacturing plants. Topics include production planning and control, production and plant design, applied statistics, operations research, human factors and productivity, manufacturing, and automation. The department has excellent laboratory facilities which support class projects and research in microcomputer applications, computer-aided manufacturing, automation, and applications of robotics. The department administers the Bachelor of Science in Industrial Engineering (B.S.I.E.) degree program, as well as the Master of Science in Industrial Engineering (M.S.I.E.), Master of Industrial Engineering (M.I.E.) and Ph.D. in Industrial Engineering. Evening and off-campus programs are available through the Master of Science in Engineering Management (M.S.E.M.) program. The department also administers the Industrial option in the M.S.E., M.E., and M.S.E.S. programs, as well as the manufacturing option in the M.S.E. program.

Mechanical Engineering

The department offers courses leading to the degrees of Bachelor of Science in Mechanical Engineering (B.S.M.E.), Master of Science in Mechanical Engineering (M.S.M.E.), Master of Mechanical Engineering (M.M.E.), Master of Science in Engineering (M.S.E.), and Doctor of Philosophy (Ph.D.). Coursework includes basic science and mathematics, thermal and fluid sciences, material science, solid mechanics, dynamics, machine design, vibrations, instrumentation and automatic control.

Graduates of this program are employed in research, design, production, marketing, service, installation (contracting), maintenance and operation in such industries as mining, petroleum, paper, food, power, manufacturing, air-conditioning, de-

fense systems, aerospace, data processing, communications, and automotive.

Laboratories are available for basic instrumentation, thermal and fluid sciences, solid mechanics, data acquisition and control, CAD/CAE, vibrations, and aerodynamics.

Students pursuing the B.S.M.E. degree are required to take the Fundaments of Engineering examination as the first step towards professional engineering registration.

Engineering **C***ore*

Both the four-year and five-year curricula of the College of Engineering Bachelor of Science programs are founded on a common core of coursework which is required of all students. This coursework is designed to give each student a thorough foundation of knowledge on which specialization studies and a professional career can be based. Emphasis is placed on five key elements; development of communication skills, familiarity with the social sciences and humanities, a solid base in science and mathematics, a strong foundation in basic engineering sciences and applications and design experience in a field of specialization.

Each degree-granting department has developed a list of courses to provide key elements for the degree offered. While the specific courses will vary slightly from one department to another, the hours in each category will be approximately as follows:

Non-technical Courses (Social Sciences, Humanities, Communications)	34 Sem. Hrs.
Mathematics, Chemistry and Physics (Minimum)	35 Sem. Hrs.
Basic Engineering Science (Minimum)	36 Sem. Hrs.
Department Specialization	31 Sem. Hrs.
	136 Sem. Hrs

Special requirements exist for Chemical Engineering. Students selecting this field should make sure they familiarize themselves with these. Detailed information can be obtained from the responsible department or the College's Advising Office.

1. **N***on***-T***ec***h***nical* **R***equ**ire**m**en**ts*

Prospective Engineering majors must take six hours of Freshman English (ENC 1101, 1102) in their first two semesters.

Additional coursework in the non-technical portion of the General Education requirements is required as specified in the individual curricula printed on pages which follow. In no case will credits be allowed for courses taken on an S/U basis.

A minimum of eight credit hours of non-technical General Education courses must be of 2000-level or higher.

Student should pick at least three hours of work which will satisfy 6A-10.30 (the "Gordon Rule"). It is required that non-technical studies have at least two courses (6 hours) taken in the same subject area, at least one of which must be at the 2000-level or higher, in either Humanities/Fine Arts or Social Sciences. Students transferring from other colleges without having met ABET depth and breadth requirements must take additional Social Sciences/Humanities courses at USF to meet this requirement.

It is desirable that at least 24 hours of this coursework be taken in the first two years. Students are responsible for checking with their advisers to be sure that the specific courses they are taking meet the requirements of the Bachelor of Science in Engineering degree program. Students who transfer from a State of Florida community college with an Associate of Arts degree who have met that college's General Education Requirement will normally find that their General Education coursework satisfies the major portion - but not all - of the Social Sciences and Humanities core requirement.

Credit by Examination can be obtained for some of this coursework. CLEP General Examination credit, acceptable to the University, is accepted for the areas of English Composition, Humanities and Social Sciences. Credit for CLEP Subject Examinations and CEEB Advanced Placement Tests can be accepted when the subject covered is recognized to be equivalent to USF courses on the College of Engineering "Approved Social Sciences and Humanities Courses" list. Questions in this area should be directed to the Coordinator of Engineering Advising in the College's Advising Office.

2. **M***ath***em***at**ics and Science* **C***ore* **R***equ**ire**m**en**ts*

The student with a satisfactory high school preparation must take 35 credit hours of mathematics and science coursework. (Some credit towards this core requirement can be obtained by passing applicable CEEB Advanced Placement Tests or CLEP Subject Examinations.)

In mathematics this coursework consists of a Calculus for Engineers sequence (or a calculus sequence of equivalent level), Differential Equations, and additional hours of designated courses supportive of the student's selective field of specialization, as specified by the department. In the science coursework students must take the Physics with Calculus sequence and the General Chemistry sequence.

Students whose high school preparation is insufficient to enter the Calculus for Engineers are required to take supplementary algebra and trigonometry prior to being considered for acceptance into the College. All students must take the math placement test.

3. *Engineering* **C***ore* **R***equ**ire**m**en**ts*

The prospective engineering major must take a minimum of 35 credit hours of engineering core (foundation) coursework drawn from the major disciplines. This coursework is designed to equip the student with a sound technical foundation for later, more advanced specialized coursework and the eventual formation of professional judgment. This coursework includes introductory studies in such areas as engineering analysis and computation, statistics, electrical engineering principles, thermodynamics, statics, dynamics, fluids, and properties of materials.

All but 6 credit hours of the engineering core are common to all areas of the Bachelor of Science in a Designated Engineering Field degree programs. The remaining 6 credit hours of coursework must be chosen with the concurrence of the departmental adviser to fit the field selected by the student. Details on this selection are available in the departmental office of the field selected, or in the College's Advising Office.

■ FOUR-YEAR PROGRAM -- BACHELOR OF SCIENCE IN DESIGNATED ENGINEERING FIELD DEGREE

These engineering degrees are awarded upon successful completion of a program consisting of the required three areas of core coursework--minimum of 101 credit hours--which are described above, and an additional 35 credit hours of coursework in a designated field of specialization. Details covering specific fields are available on request from the responsible department, or from the College's Advising Office.

Programs are offered in the following disciplines of Engineering:

1. **Ch***em**ical Engineering*

Students pursuing the Bachelor of Science in Chemical Engineering take coursework in advanced chemistry, thermodynamics, fluids, heat, and mass transfer, separation processes, reacting systems, instrumentation, and control. Students must also satisfactorily complete a design project as part of their program. Students seeking the biotechnology/biomedical certificate are also required to take additional courses in general biology, microbiology, and biochemistry. Special characteristics of the Chemical Engineering curriculum make it imperative that the students retain close contact with their adviser.

Students completing this program normally initiate their careers in process/manufacturing industries. Chemical engineers are found in administrative, technical, and research positions in these industries. Main products of these industries

are petrochemicals, polymers, fibers, natural and synthetic fuels, electronic materials, fertilizers, pharmaceuticals, etc.

Solution of modern societal and scientific problems often require the use of chemical engineering skills. A course sequence for chemistry majors, (ECH 3702, ECH 4123C and ECH 4415C), as well as physics majors, (ECH 3702, ECH 3264C, and ECH 4265C), is suggested. These courses will add a strong chemical engineering science background to those degrees. Chemical Engineering students are expected to have access to an IBM compatible personal computer during their last two years of study. Those who do not own one will be severely disadvantaged.

The schedule which follows indicates how a serious student who can devote full time to coursework can satisfy requirements in four academic years. Students without a solid foundation and those who cannot devote full time to academics should plan a slower pace.

Bachelor's Curriculum - Chemical Engineering

Semester **I**

ENC 1101	Freshman English I	3
MAC 2281	Engineering Calculus I	3
CHM 2041	General Chem. I	3
EGN 1002	Engineering Orientation	0
*Historical Perspectives Elective		3
*Fine Arts Elective		3
		15

Semester **II**

ENC 1102	Freshman English II	3
MAC 2282	Engineering Calculus II	3
CHM 2046	General Chem. II	3
CHM 2045L	Gen Chem I Lab	1
PHY 2048	General Physics I	3
PHY 2048L	Gen. Physics Lab I	1
*ALAMEA Perspective Elective		3
		17

Summer Term

MAC 2283	Engineering Calculus III	3
EGN 3311	Statics	3
CHM 2046L	Gen. Chem II Lab	1
PHY 2049	Gen. Physics II	3
PHY 2049L	Gen. Physics Lab II	1
		11

Semester **III**

MAP 2302	Differential Equations	3
EGN 3373	Electrical Systems I	3
EGN 2210	Computer Tools for Engineers	3
EGN 3343	Thermodynamics I	3
EGN 3443	Statistics	3
*Social Science Elective		3
		18

Semester **IV**

EGN 4450	Intro. to Linear Systems	2
EGN 3365	Materials	3
ECH 3702	Instrument Systems I	4
ECH 3023	Intro. to Process Eng	3
*Historical Perspectives Elective		3
		15

Semester **V**

ECH 3264C	Transport Processes I	3
ECH 4123C	Phase & Chemical Equilibria	3
CHM 2210	Organic Chemistry I	4
CHM 2210L	Organic Chemistry I Lab	2
CHM 4412	Physical Chemistry III	3
		15

Semester **VI**

ECH 4265C	Transport Processes II	3
CHM 2211	Organic Chemistry II	4
ECH 4605	Strat Proc Engr	3
ENC 4931	Engineering Communications	3
MW-MI (Non-enginering)		3
		16

Semester **VII**

ECH 4323C	Automatic Controls I	3
ECH 4415C	Reacting Systems	3
ECH 4244L	Chem. Lab II	2
MW-MI (Engineering)		3
**Chemistry Elective		3
		14

Semester **VIII**

ECH 4615C	Plant Design and Opt	3
Technical Electives		9
*Social Science Elective		3
		15

*Approved General Education Requirements
**Not from Chem 2XXX, 3400, 3401, 3402, 4070, 4905, 4932, 4970

- ***Program of Study at a Florida Community/Junior College or SUS School for Students Planning to Transfer to USF (State Mandated Common Prerequisites)***

Complete the A.A. degree at the community college. Some courses required for the major may also meet General Education Requirements thereby transferring maximum hours to the university. A minimum of 60 semester hours must be completed at the university. If a student wishes to transfer without an A.A. degree and have fewer than 60 semester hours of acceptable credit, the student must meet the university's entering freshman requirements including ACT or SAT test scores, GPA, and course requirements.

The following are transferable courses from the Community College that will be accepted in the Math/Science/Engineering areas:

Math

Calculus

USF	C/C
MAC 2281	MAC 2311 (3)
MAC 2282	MAC 2312 (3)
MAC 2283	MAC 2313 (3)

Differential Equations

MAP 2302	MAP 2302 (3)

Chemistry

General

USF	C/C
CHM 2041	CHM 1045 (3)
CHM 2045L	CHM 1045L (1)
CHM 2046	CHM 1046 (3)
CHM 2046L	CHM 1046L (1)

Physics

USF	C/C
PHY 2048	PHY 2048 (3)
PHY 2048L	PHY 2048L (1)
PHY 2049	PHY 2049 (3)
PHY 2049L	PHY 2049L (1)

Fortran

USF	C/C
EGN 2210	COP 2202 (3)

This is a limited access program involving special admissions requirements. Please be aware of the immunization, foreign language, continuous enrollment policies of the university, and qualitative standards required.

Procedures for Applying to the College of Engineering

Students should complete and submit an Engineering Admissions Application to the College of Engineering Advising Office. Freshmen and Sophomores must submit copies of high school transcripts, SAT and ACT test scores to the College of Engineering, Advising Office. This is in addition to records requested by the University's Admissions Office. Transfer applicants must furnish transcripts from previously attended institutions to the College of Engineering, Advising Office. This is in addition to transcripts sent to the University's Admissions Office. Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL scores must be 550. Credentials must be received in the Engineering Advising Office 30 days prior to the date of applicable term. Failure to comply will result in the application being denied by the College of Engineering. Credentials will be held for one year. If application is not updated within that year, credentials must be re-submitted.

Engineering Admissions Requirements

Transfer students must have completed the equivalent USF Engineering Calculus sequence with a 2.0 GPA; must have completed one year of equivalent USF General Physics and Chemistry courses with a minimum of 2.0 GPA; must have an overall GPA of 2.0 or better.

2. Civil and Environmental Engineering

Students pursuing the Bachelor of Science in Civil Engineering program take designated engineering mechanics, civil engineering, and environmental engineering course work. This course work is supplemented by electives and courses m one of the following areas of concentration:

a. Environmental Engineering - courses in water and wastewater treatment, air pollution control, and environmental unit operations and unit processes.
b. Water Resources - courses in water resources engineering, environmental unit operations, and air pollution control.
c. Geotechnical/Transportation engineering - courses in soil mechanics, transportation, matrix structural analysis, cement and concrete design, and air pollution control
d. Materials - courses in materials and corrosion.
e. Structural engineering - courses in matrix structural analysis, timber and masonry design, structural modeling, Cement and concrete design, and corrosion of engineering materials.

As a culminating design experience, all students take a Capstone design course in their respective areas of concentration.

Students completing the program may enter the professor as engineers in the civil, structural, geotechnical, transportation, water resources, environmental, hydraulics, or materials discipline. All of these disciplines share the need for knowledge in the areas of engineering mechanics, civil engineering, material science, and environmental engineering. Through choice of the proper area of concentration, a student has the opportunity to channel academic studies specifically towards his/her career choice.

Graduates of the program may commence their engineering careers in either industry, in engineering consulting firms, or in public service at the federal, state, or local level. Initial assignments may include planning, design and implementation of water resources systems; planning and design of transportation and housing systems; regional planning, design, and management for abatement of air, water, and solid waste pollution problems; design of bridges and single and multistory structures; and supervision of construction projects.

The schedule which follows indicates how a serious, well prepared student who can devote full time to coursework can satisfy degree requirements in four academic years. Students without a solid foundation and those who cannot devote full time to academics should plan on a slower pace.

An additional graduation requirement is that graduating seniors **must take the Fundamentals of Engineering Examination.**

Bachelor's Curricula - Civil Engineering Option

Semester **I**

ENC 1101	Freshman English I	3
MAC 2281	Engr. Calculus I	3
CHM 2041	General Chemistry I	3
EGN 1002	Engr. Orientation	0
EGS 1113	Intro. Design Graphics	3
*Social Science Elective		3
		15

Semester **II**

ENC 1102	Freshman English II	3
MAC 2282	Engr. Calculus II	3
CHM 2046	General Chemistry II	3
CHM 2045L	Gen. Chemistry I Lab	1
PHY 2048	General Physics I	3
PHY 2048L	Gen. Physics I Lab	1
*Social Science Elective		3
		17

Summer **Term**

ENG 2210	Computer Tools for Engineers	3
*Social Science Elective		3
*Historical Perspectives Elective		3
		9

Semester **III**

PHY 2049	General Physics II	3
PHY 2049L	Gen. Physics II Lab	1
MAC 2283	Engr. Calculus III	3
EGN 3311	Statics	3
*Historical Perspectives Elective		3
*Fine Arts Elective		3
		16

Semester **IV**

MAP 2302	Differ. Equations	3
EGN 3321	Dynamics	3
EGN 3343	Thermodynamics I	3
EGN 3443	Eng. Statistics	3
EGN 3365	Materials	3
		15

Semester **V**

EGN 3353	Fluid Mechanics	3
EGN 3331	Mechanics of Materials	3
EGN 3331L	Mechanics of Materials Lab	1
EGN 3373	Intro to Electrical Systems	3
TTE 4004	Transportation	3
*ALAMEA Perspective Elective		3
		16

Semester **VI**

CES 3102	Structures	3
CWR 4202	Hydraulics	3
ENV 3001	Environmental Engr.	3
GLY 3850	Geology for Engineers	3
EGN 3613	Engineering Economy	3
ENC 4931	Engineering Communication	3
		18

Semester **VII**

CES 4605	Concepts of Steel Design	3
CES 4702	Concepts of Concrete Design	3
CEG 4011	Soil Mechanics	3
CEG 4011L	Geotech Lab	1
C.E. Concentration Requirement		3
C.E. Concentration Requirement		3
		16

Semester **VIII**

CGN 3021L	C.E. Lab	2
*CGN 4122C	Engr. Contracts Specs. & Ethics (MW/MI)	3

C.E. Capstone Design Requirement		3
C.E. Concentration Requirement		3
*MW/MI (Non-Engineering)		3
		14

*Approved General Education Requirements

Civil Engineering Concentration Requirements

(A student must complete a minimum of 9 hours, with at least 2 courses from one group.)

Water Resources

ENV 4502	Environmental Unit Operations	3
ENV 4101	Air Pollution Control	3
CWR 4103	Water Resources Engineering	3

Geotechnical/Transportation

CEG 4012	Soil Mechanics II	3
TTE 4005	Transportation Engineering II	3
CGN 4851	Cement and Concrete Design	3
CES 4141	Matrix Structural Analysis	3
ENV 4101	Air Pollution Control	3

Materials

EGN 4366	Materials Engineering II	3
EMA 4324	Corrosion of Engineering Materials	3
CGN 4851	Cement and Concrete Design	3

Structural

CES 4141	Matrix Structural Analysis	3
CES 4820	Timber & Masonry Design	3
CES 4561	Computer Aided Structural Design	3
CGN 4851	Cement and Concrete Design	3
EMA 4324	Corrosion of Engineering Materials	3

Civil Engineering Design Requirements

A student must complete the capstone design course in his/her area of concentration.

Water Resources

CWR 4821	Capstone Water Resources Design	3

Geotechnical/Transportation

CEG 4850	Capstone Geotechnical/Transportation Design	3

Materials

CES 4650	Capstone Materials Design	3

Structural

CES 4604	Capstone Structural Design	3

Environmental Engineering Concentration Within Civil Engineering

Semester **I**

ENC 1101	Freshman English I	3
MAC 2281	Engr. Calculus I	3
CHM 2041	General Chemistry I	3
EGS 1113	Intro. to Des. Graphics	3
EGN 1002	Engr. Orientation	0
*Approved Elective		3
		15

Semester **II**

ENC 1102	Freshman English II	3
MAC 2282	Engr. Calculus II	3
CHM 2046	General Chemistry II	3
PHY 2048	General Physics I	3
PHY 2048L	General Physics I Lab	1
*Historical Perspectives Elective		3
		16

Summer **Term**

ENG 2210	Computer Tools for Engineers	3
*Social Science Elective		3
*Historical Perspectives Elective		3
		9

Semester **III**

MAC 2283	Engr. Calculus III	3
PHY 2049	General Physics II	3
PHY 2049L	General Physics II Lab	1
EGN 3311	Statics	3
ENV 4400	Chem. Aspects of Environmental Engineering	3
*Social Science Elective		3
		16

Semester **IV**

MAP 2302	Differ. Equations	3
EGN 3343	Thermodynamics I	3
EGN 3373	Intro. to Elect. Sys. I	3
EGN 3443	Engr. Statistics I	3
EGN 3365L	Materials Engr. I	3
		15

Semester **V**

EGN 3321	Dynamics	3
EGN 3331	Mechanics of Materials	3
EGN 3331L	Mech. of Materials Lab	1
EGN 3353C	Basic Fluid Mechanics	3
ENV 3001	Environmental Engr.	3
*ALAMEA Perspectives Elective		3
		16

Semester **VI**

CES 3102	Structures	3
CWR 4202	Hydraulics	3
ENV 4502	Environmental Unit Operation	3
EGN 3613	Engineering Economy	3
ECH 3023	Intro. to Process Engr.	3
ENV 4004	Env. Engr. Laboratory	1
		16

Semester **VII**

CEG 4011	Soil Mechanics I	3
CEG 4211	Geotech. Laboratory	1
CES 4606	Concepts of Structural Design	3
ENC 4931	Engineering Communication	3
ENV 4552	Unit Ops. & Processes Lab	1
ENV 4503	Unit Processes	3
TTE 4004	Transportation	3
		17

Semester **VIII**

CGN 4122C	Engr. Contracts Specs. and Ethics	3
ENV 4101	Air Pollution	3
ENV 4450	Capstone Design	4
*Fine Arts Elective		3
*MW/MI (Non-Engineering)		3
		16

*Approved General Education Requirements

- ***Program of Study at a Florida Community/Junior College or SUS School for Students Planning to Transfer to USF (State Mandated Common Prerequisites)***

Complete the A.A. degree at the community college. Some courses required for the major may also meet General Education Requirements thereby transferring maximum hours to the university. A minimum of 60 semester hours must be completed at the university. If a student wishes to transfer without an A.A. degree and have fewer than 60 semester hours of acceptable credit, the student must meet the university's entering freshman requirements including ACT or SAT test scores, GPA, and course requirements.

The following are transferable courses from the Community College that will be accepted in the Math/Science/Engineering areas:

Math
Calculus

USF	C/C
MAC 2281	MAC 2311 (3)
MAC 2282	MAC 2312 (3)
MAC 2283	MAC 2313 (3)

Differential Equations

MAP 2302	MAP 2302 (3)

Chemistry
General

USF	C/C
CHM 2041	CHM 1045 (3)
CHM 2045L	CHM 1045L (1)
CHM 2046	CHM 1046 (3)
CHM 2046L	CHM 1046L (1)

Physics

USF	C/C
PHY 2048	PHY 2048 (3)
PHY 2048L	PHY 2048L (1)
PHY 2049	PHY 2049 (3)
PHY 2049L	PHY 2049L (1)

Graphics

USF	C/C
EGS 1113	EGS 1111 (3)

Fortran

USF	C/C
EGN 2210	COP 2202 (3)

This is a limited access program involving special admissions requirements. Please be aware of the immunization, foreign language, continuous enrollment policies of the university, and qualitative standards required.

Procedures for Applying to the College of Engineering

Students should complete and submit an Engineering Admissions Application to the College of Engineering Advising Office. Freshmen and Sophomores must submit copies of high school transcripts, SAT and ACT test scores to the College of Engineering, Advising Office. This is in addition to records requested by the University's Admissions Office. Transfer applicants must furnish transcripts from previously attended institutions to the College of Engineering, Advising Office. This is in addition to transcripts sent to the University's Admissions Office. Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL scores must be 550. Credentials must be received in the Engineering Advising Office 30 days prior to the date of applicable term. Failure to comply will result in the application being denied by the College of Engineering. Credentials will be held for one year. If application is not updated within that year, credentials must be re-submitted.

Engineering Admissions Requirements

Transfer students must have completed the equivalent USF Engineering Calculus sequence with a 2.0 GPA; must have completed one year of equivalent USF General Physics and Chemistry courses with a minimum of 2.0 GPA; must have an overall GPA of 2.0 or better.

3. Computer Science and Engineering

Three undergraduate degree tracks are offered within Computer Science and Engineering. These tracks are Computer Engineering, Computer Science and Information Systems, which leads to the Bachelor of Science in Computer Engineering, in Computer Science and in Information Systems respectively.

The Computer Engineering program emphasizes the design and utilization of computers and has a core of engineering and basic science courses like those of other engineering programs in the college. The Computer Science program focuses on languages, systems, and computation and application. The Information Systems Track emphasizes the understanding and development of software with an emphasis on business and end-user applications.

Graduates from these programs follow fruitful careers in either scientific or business application's of computers, as well as in the design of computer systems. They are often involved in the systems level definition of information processing complexes for both manufacturers of computers and for users. A wide and expanding variety of design and applications opportunities characterize this field. The rapid growth and continual change within this field makes it essential for students to acquire a broad foundation in applied mathematics and the physical sciences, and to develop communication skills and to become familiar with the domains of potential computer application in the Humanities and Social Sciences. Research and development opportunities as a computer scientist and engineer, often following graduate education, are present in the areas of computer architecture and VSLI design, artificial intelligence, software engineering, digital data communications, robotics, database, networks, user interface, fault-tolerant computing and testing, computer graphics, image processing and computer vision, and simulation.

The schedules which follow indicate how a serious, well prepared student who can devote full time to coursework can satisfy degree requirements in four academic years. Students without a solid foundation and those who cannot devote full time to academics should plan on a slower pace.

Bachelor of Science in Computer Science Curriculum

Semester I

EGN 1002	Engr. Orientation	0
MAC 2281	Engr. Calculus I	3
*Science Elective		3
ENC 1101	Freshman English I	3
*Social Science Elective		3
*Historical Perspectives Elective		3
		15

Semester II

MAC 2282	Engr. Calculus II	3
PHY 2048	Physics I	3
PHY 2048L	Physics I Lab	1
*Science Elective		3
ENC 1102	Freshman English II	3
*Social Science Elective		3
		16

SummerTerm

PHY 2049	Physics II	3
PHY 2049L	Physics II Lab	1
MAC 2283	Engr. Calculus III	3
*Historical Perspectives Elective		3
		10

Semester III

EGN 3373	Elect. Sys. I	3
COT 3100	Intro. to Discrete Structures	3
ENC 4931	Engineering Communications	3
EGN 3613	Engr. Economy	3
MAP 2302	Diff. Equations	3
		15

Semester IV

Non-technical Elective		3
STA 4442	Intro. to Probability	3
MAS 2103	Linear Algebra	3
COP 2002	Intro to Computer Science	3
COP 2000L	Intro to Computer Science Lab	1
*ALAMEA Perspective Elective		3
		16

Semester V

EEL 4851C	Data Structures	3
EEL 4705	Logic Design	3

EEL 4705L	Logic Design Lab	1
COP 2510	Programming Concepts	3
Quantitative Elective		3
*Fine Arts Elective		3
		16

Semester VI

CDA 4100	Computer Organization and Architecture	3
COT 4210	Intro. to Automata Theory	3
*MW/MI (Non-engineering)		3
Computer Science Elective		6
		15

Semester VII

EEL 4744	Microprocessor Principles & Applications	3
EEL 4743L	Microprocessor Lab	1
COP 4600	Operating Systems	3
COT 4400	Analysis of Algorithms	3
Computer Science Elective		6
		16

Semester VIII

CEN 4020	Software Engr.	3
CIS 4250	Ethical Issues (MW/MI)	3
Quantitative Elective		3
Computer Science Electives		6
		15

*Approved General Education Requirements

- ***Program of Study at a Florida Community/Junior College or SUS School for Students Planning to Transfer to USF (State Mandated Common Prerequisites)***

Complete the A.A. degree at the community college. Some courses required for the major may also meet General Education Requirements thereby transferring maximum hours to the university. A minimum of 60 semester hours must be completed at the university. If a student wishes to transfer without an A.A. degree and have fewer than 60 semester hours of acceptable credit, the student must meet the university's entering freshman requirements including ACT or SAT test scores, GPA, and course requirements.

Students should complete the following *prerequisite courses* listed below at the lower level prior to entering the University. If these courses are not taken at the community college. they must be completed before the degree is granted. Unless stated otherwise, a grade of "C" is the minimum acceptable grade.

The following are transferable courses from the Community College that will be accepted in the Math/Science/Engineering areas:

Math

Calculus

USF	C/C
MAC 2281	MAC 2311 (3)
MAC 2282	MAC 2312 (3)
MAC 2283	MAC 2313 (3)

Differential Equations

MAP 2302	MAP 2302 (3)

Physics

USF	C/C
PHY 2048	PHY 2048 (3)
PHY 2048L	PHY 2048L (1)
PHY 2049	PHY 2049 (3)
PHY 2049L	PHY 2049L (1)

Science Electives (6)

Fortran

USF	C/C
EGN 2210	COP 2202 (3)

This is a limited access program involving special admissions requirements. Please be aware of the immunization, foreign language, continuous enrollment policies of the university, and qualitative standards required.

Procedures for Applying to the College of Engineering

Students should complete and submit an Engineering Admissions Application to the College of Engineering Advising Office. Freshmen and Sophomores must submit copies of high school transcripts, SAT and ACT test scores to the College of Engineering, Advising Office. This is in addition to records requested by the University's Admissions Office. Transfer applicants must furnish transcripts from previously attended institutions to the College of Engineering, Advising Office. This is in addition to transcripts sent to the University's Admissions Office. Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL scores must be 550. Credentials must be received in the Engineering Advising Office 30 days prior to the date of applicable term. Failure to comply will result in the application being denied by the College of Engineering. Credentials will be held for one year. If application is not updated within that year, credentials must be re-submitted.

Engineering Admissions Requirements

Transfer students must have completed the equivalent USF Engineering Calculus sequence with a 2.0 GPA; must have completed one year of equivalent USF General Physics and Chemistry courses with a minimum of 2.0 GPA; must have an overall GPA of 2.0 or better.

Bachelor of Science in Computer Engineering Curriculum

Semester I

EGN 1002	Engr. Orientation	0
MAC 2281	Engr. Calculus I	3
CHM 2041	General Chemistry I	3
CHM 2045L	General Chemistry I Lab	1
ENC 1101	Freshman English I	3
*Social Science Elective		3
*Historical Perspectives Elective		3
		16

Semester II

MAC 2282	Engr. Calculus II	3
PHY 2048	General Physics I	3
PHY 2048L	General Physics I Lab	1
ENC 1102	Freshman English II	3
CHM 2046	General Chemistry II	3
*Historical Perspectives Elective		3
		16

Summer Term

PHY 2049	General Physics II	3
PHY 2049L	General Physics II Lab	1
MAC 2283	Engr Calculus III	3
*Social Science Elective		3
		10

Semester III

EGN 3373	Elect. Sys. I	3
COT 3100	Intro. to Discrete Structures	3
MAP 2302	Diff. Equations	3
EGN 3343	Thermo I	3
EGN 3311	Statics	3
ENC 4931	Engineering Communications	3
		18

Semester IV

EEL 3302	Electronics I	3
EGN 3321	Dynamics	3
COP 2002	Intro to Computer Science	3
COP 2000L	Intro to Computer Science Lab	1
EGN 4450	Intro to Linear Systems	2
EGN 3443	Engr. Statistics I	3
		15

Semester V

EGN 3365L	Materials Engr. I	3
EEL 4851C	Data Structures	3
EGN 3613	Engr. Economy I	3
EEL 4705	Logic Design	3
EEL 4705L	Logic Design Lab	1
EEL 4305	Electronics II	3
		16

Semester VI

CDA 4100	Computer Organization & Architecture	3
COP 2510	Programming Concepts	3
COT 4210	Intro. to Automata Theory	3
*Fine Arts Elective		3
Computer Engineering Elective		3
		15

Semester VII

EEL 4744	Microprocessor Principles and Applications	3
EEL 4743L	Microprocessor Lab	1
COP 4600	Operating Systems	3
Computer Engineering Elective		3
*ALAMEA Perspective Elective		3
*MW/MI (Non-engineering)		3
		16

Semester VIII

EEL 4748	Microprocessor Based System Design and Application	3
CDA 4203	Comp. Sys. Design	3
EEL 4303L	Computer Sys Design Lab	1
CIS 4910	Comp. Engr. Project	2
Computer Engineering Elective		3
CIS 4250	Ethical Issues (MW/MI)	3
		15

*Approved General Education Requirements

- *Program of Study at a Florida Community/Junior College or SUS School for Students Planning to Transfer to USF (State Mandated Common Prerequisites)*

Complete the A.A. degree at the community college. Some courses required for the major may also meet General Education Requirements thereby transferring maximum hours to the university. A minimum of 60 semester hours must be completed at the university. If a student wishes to transfer without an A.A. degree and have fewer than 60 semester hours of acceptable credit, the student must meet the university's entering freshman requirements including ACT or SAT test scores, GPA, and course requirements.

The following are transferable courses from the Community College that will be accepted in the Math/Science/Engineering areas:

Math

Calculus

USF	C/C
MAC 2281	MAC 2311 (3)
MAC 2282	MAC 2312 (3)
MAC 2283	MAC 2313 (3)

Differential Equations

MAP 2302	MAP 2302 (3)

Chemistry

General

USF	C/C
CHM 2041	CHM 1045 (3)
CHM 2045L	CHM 1045L (1)
CHM 2046	CHM 1046 (3)
CHM 2046L	CHM 1046L (1)

Physics

USF	C/C
PHY 2048	PHY 2048 (3)
PHY 2048L	PHY 2048L (1)
PHY 2049	PHY 2049 (3)
PHY 2049L	PHY 2049L (1)

Fortran

USF	C/C
EGN 2210	COP 2202 (3)

This is a limited access program involving special admissions requirements. Please be aware of the immunization, foreign language, continuous enrollment policies of the university, and qualitative standards required.

Procedures for Applying to the College of Engineering

Students should complete and submit an Engineering Admissions Application to the College of Engineering Advising Office. Freshmen and Sophomores must submit copies of high school transcripts, SAT and ACT test scores to the College of Engineering, Advising Office. This is in addition to records requested by the University's Admissions Office. Transfer applicants must furnish transcripts from previously attended institutions to the College of Engineering, Advising Office. This is in addition to transcripts sent to the University's Admissions Office. Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL scores must be 550. Credentials must be received in the Engineering Advising Office 30 days prior to the date of applicable term. Failure to comply will result in the application being denied by the College of Engineering. Credentials will be held for one year. If application is not updated within that year, credentials must be re-submitted.

Engineering Admissions Requirements

Transfer students must have completed the equivalent USF Engineering Calculus sequence with a 2.0 GPA; must have completed one year of equivalent USF General Physics and Chemistry courses with a minimum of 2.0 GPA; must have an overall GPA of 2.0 or better.

Bachelor of Science in Information Systems Curriculum

Semester I

EGN 1002	Engr. Orientation	0
ENC 1101	Freshman English I	3
MAC 2233	Elementary Calculus I	4
ACG 2001	Elem. Accounting I	3
*Historical Perspective Elective		3
		13

Semester II

ENC 1102	Freshman English II	3
MAC 2234	Elementary Calculus II	4
PHY 2053 or 2048	Physics I	3
PHY 2053L or 2048L	Physics I Lab	1
ENG 3613	Engineering Economy I	3
		14

Summer Term

PHY 2054 or 2049	General Physics II	3
PHY 2049L or 2054L	Physics II Lab	1
EGN 2210	Computer Tools for Engineers	3
*Science Elective		3
		10

Semester III

COT 3100	Intro. to Discrete Structures	3
COP 2120	COBOL Programming I	3
ECO 2023	Economic Principles (Microeconomics)	3
STA 2023	Intro. to Statistics	4
*Social Science Elective		3
		16

Semester IV

COP 2002	Intro. to Computer Science	3
COP 2000L	Intro. to Computer Science Lab	1
EGN 4450	Intro. to Linear Systems	2

ECO 2013	Economic Principles (Macroeconomics)	3
*Social Science Elective		3
*Historical Perspectives Elective		3
		15

Semester **V**

EEL 4851C	Data Structures	3
EEL 4705	Logic Design	3
MAN 3025	Principles of Mgmt	3
CEN 4020	Software Engineering	3
COP 2510	Programming Concepts	3
		15

Semester **VI**

EEL 4852C	Data Base Systems	3
ENC 4931	Engineering Communication	3
CIS 4930	Software Design Methodologies	3
Information Systems Elective		7
		16

Semester **VII**

COP 4600	Operating Systems	3
EEL 4781C	Dist. Proc. & Computer Networks	3
CIS 4930	Applications Development	3
*ALAMEA Perspective Elective		3
*Fine Arts Elective		3
		15

Semester **VIII**

CIS 4910	Computer Science Project	2
CIS 4930	Computer Simulation	3
CIS 4250	Ethical Issues	3
*MW/MI (Non-Engineering)		3
Information Systems Elective		3
		14

*Approved General Education Requirements

- *Program of Study at a Florida Community/Junior College or SUS School for Students Planning to Transfer to USF (State Mandated Common Prerequisites)*

Complete the A.A. degree at the community college. Some courses required for the major may also meet General Education Requirements thereby transferring maximum hours to the university. A minimum of 60 semester hours must be completed at the university. If a student wishes to transfer without an A.A. degree and have fewer than 60 semester hours of acceptable credit, the student must meet the university's entering freshman requirements including ACT or SAT test scores, GPA, and course requirements.

The following are transferable courses from the Community College that will be accepted in the Math/Science/Engineering areas:

Math

Calculus

USF	C/C
MAC 2233	MAC 2233 (3)
MAC 2234	MAC 2234 (3)

Statistics

STA 2023	STA 2023 (3)

Physics

General

USF	C/C
PHY 2053	PHY 2053 (3)
PHY 2053L	PHY 2053L (1)
PHY 2054	PHY 2054 (3)
PHY 2054L	PHY 2054L (1)

Science Electives (6)

Business Courses

USF	C/C
ACG 2001	ACG 2001 (3)

Economics

ECO 2013	ECO 2013 (3)
ECO 2023	ECO 2023 (3)

Fortran

USF	C/C
EGN 2210	COP 2202 (3)

Cobol

COP 2120	COP 2120 (3)

This is a limited access program involving special admissions requirements. Please be aware of the immunization, foreign language, continuous enrollment policies of the university, and qualitative standards required.

Procedures for Applying to the College of Engineering

Students should complete and submit an Engineering Admissions Application to the College of Engineering Advising Office. Freshmen and Sophomores must submit copies of high school transcripts, SAT and ACT test scores to the College of Engineering, Advising Office. This is in addition to records requested by the University's Admissions Office. Transfer applicants must furnish transcripts from previously attended institutions to the College of Engineering, Advising Office. This is in addition to transcripts sent to the University's Admissions Office. Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL scores must be 550. Credentials must be received in the Engineering Advising Office 30 days prior to the date of applicable term. Failure to comply will result in the application being denied by the College of Engineering. Credentials will be held for one year. If application is not updated within that year, credentials must be re-submitted.

Engineering Admissions Requirements

Transfer students must have completed the equivalent USF Engineering Calculus sequence with a 2.0 GPA; must have completed one year of equivalent USF General Physics and Chemistry courses with a minimum of 2.0 GPA; must have an overall GPA of 2.0 or better.

4. *Electrical Engineering*

Students pursuing the Bachelor of Science in Electrical Engineering program take designated coursework in network analysis, electronics, communications, electromagnetic theory, control systems, microelectronics and microprocessors. This coursework is supplemented by electives in many specialized areas of electrical engineering.

Students completing this program normally pursue industrial careers in the power, electrical, electronic, or information industries or in related governmental laboratories and public service agencies. The electrical graduate may apply his/her knowledge to such diverse areas as television, communications, remote guidance, sensing (of people, vehicles, weather, crops, etc.), automation, computer and information systems, electric power generation and transmission, electrically propelled transportation, etc. The graduate may do this by performing needed engineering functions related to research and development (often requires an advanced degree), design, production, operation, sales, or management of these products/services.

The schedule which follows indicates how a serious, well prepared student who can devote full time to coursework can satisfy degree requirements in four academic years. Students without a solid foundation and those who cannot devote full time to academics should plan on a slower pace. A minimum departmental GPA of 2.0 is required for graduation.

Bachelor's Curriculum - *Electrical Engineering*

Semester **I**

ENC 1101	Freshman English I	3
CHM 2041	Gen. Chem. I	3
CHM 2045L	Gen. Chem. Lab	1
MAC 2281	Engr. Calculus I	3
*EGN 1002	Engr. Orientation	0
**Social Science Elective		3
**Historical Pespective Elective		3
		16

Semester **II**

ENC 1102	Freshman English II	3
CHM 2046	Gen. Chem. II	3
PHY 2048	Gen. Phy. I	3
PHY 2048L	Gen. Phy. I Lab	1
MAC 2282	Engr. Cal. II	3
*EGN 2210	Computer Tools for Engineers	3
		16

Semester **III**

PHY 2049	Gen. Phys. II	3
PHY 2049L	Gen. Phys. II Lab	1
MAC 2283	Eng. Calculus III	3
EGN 3613	Egr. Economy I	3
*EGN 3311	Statics	3
**Historical Perspective Elective		3
		16

Semester **IV**

MAP 2302	Differ. Equations	3
PHY 3101	Modern Physics	3
*EGN 3373	Intro. to Elec. Sys. I	3
*EGN 3443	Engr. Statistics I	3
*EGN 3343	Thermodynamics I	3
**Social Science Elective		3
		18

Summer **Term**

EGN 3375	Intro. to Elec. Systems III	3
ENC 4931	Engineering Communications	3
EGN 3365L	Materials Engineering	3
		9

Semester **V**

EGN 4450	Intro. to Linear Systems	2
EEL 4935	Intro to Electromagnetics	3
EEL 3100	Network Analysis & Design	3
EEL 3302	Electronics I	3
*ALAMEA Perspective Elective		3
ELR 4937	Wireless Cir Sys Des Lab	2
		16

Semester **VI**

EEL 4102	Linear Systems Analysis	3
EEL 4351	Semiconductor Devices	3
EEL 4705	Logic Design	3
EEL 4705L	Logic Design Lab	1
EEL 4163	Computer Aided Design	2
ELR 3301L	Lab I (Curcuits)	1
*MW/MI (Non-engineering)		3
		16

Semester **VII**

EEL 4744	Microprocesors	3
EEL 4743L	Microprocessors Lab	1
ELR 3302L	Lab II (Electronics)	1
EEL 4906	Intro. to Engr. Design	2
*Fine Arts Elective		3
Approved Technical Elective		4
		14

Semester **VIII**

EEL 4936	Design Project	3
EGN 4831	Technology in Society (MWMI Engr.)	3
Approved Technical Elective		3
Approved Technical Elective		3
Approved Technical Elective		3
		15

*Required for admissions to the Electrical Engineering Department
**Approved General Education Requirements

- *Program of Study at a Florida Community/Junior College or SUS School for Students Planning to Transfer to USF (State Mandated Common Prerequisites)*

Complete the A.A. degree at the community college. Some courses required for the major may also meet General Education Requirements thereby transferring maximum hours to the university. A minimum of 60 semester hours must be completed at the university. If a student wishes to transfer without an A.A. degree and have fewer than 60 semester hours of acceptable credit, the student must meet the university's entering freshman requirements including ACT or SAT test scores, GPA, and course requirements.

The following are transferable courses from the Community College that will be accepted in the Math/Science/Engineering areas:

Math

Calculus

USF	C/C
MAC 2281	MAC 2311 (3)
MAC 2282	MAC 2312 (3)
MAC 2283	MAC 2313 (3)

Differential Equations

MAP 2302	MAP 2302 (3)

Chemistry

General

USF	C/C
CHM 2041	CHM 1045 (3)
CHM 2045L	CHM 1045L (1)
CHM 2046	CHM 1046 (3)

Physics

USF	C/C
PHY 2048	PHY 2048 (3)
PHY 2048L	PHY 2048L (1)
PHY 2049	PHY 2049 (3)
PHY 2049L	PHY 2049L (1)

Fortran

USF	C/C
EGN 2210	COP 2202 (3)

This is a limited access program involving special admissions requirements. Please be aware of the immunization, foreign language, continuous enrollment policies of the university, and qualitative standards required.

Procedures for Applying to the College of Engineering

Students should complete and submit an Engineering Admissions Application to the College of Engineering Advising Office. Freshmen and Sophomores must submit copies of high school transcripts, SAT and ACT test scores to the College of Engineering, Advising Office. This is in addition to records requested by the University's Admissions Office. Transfer applicants must furnish transcripts from previously attended institutions to the College of Engineering, Advising Office. This is in addition to transcripts sent to the University's Admissions Office. Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL scores must be 550. Credentials must be received in the Engineering Advising Office 30 days prior to the date of applicable term. Failure to comply will result in the application being denied by the College of Engineering. Credentials will be held for one year. If application is not updated within that year, credentials must be re-submitted.

Engineering Admissions Requirements

Transfer students must have completed the equivalent USF Engineering Calculus sequence with a 2.0 GPA; must have completed one year of equivalent USF General Physics and Chemistry courses with a minimum of 2.0 GPA; must have an overall GPA of 2.0 or better.

5. Industrial and Management Systems Engineering

Students pursuing the Bachelor of Science in Industrial Engineering degree program take designated, specialized

coursework in industrial processes, work analysis, production control, facilities design, operations research, human factors, computer simulation, quality control, and robotics and automation. This coursework is supplemented by engineering electives and comprehensive industrial engineering design projects.

Students completing this program are prepared for graduate study or for careers in a broad range of industries, business, and public service areas. The strength of industrial engineering lies, in part, in its breadth and the applicability of its common body of knowledge in a wide variety of enterprises. Students may be involved in traditional areas of manufacturing and production, or state-of-the-art functions in automation and robotics. The same engineering principles are also applied to business organizations, service delivery systems, and governmental administration.

The schedule which follows indicates how a serious, well prepared student who can devote full time to coursework can satisfy degree requirements in four academic years. Students without a solid foundation and those who cannot devote full time to academics should plan on a slower pace.

Bachelor's Curriculum
Industrial and Management Systems Engineering

Semester **I**

ENC 1101	Freshman English I	3
MAC 2281	Engr. Calculus I	3
CHM 2041	General Chemistry I	3
EGN 1002	Engr. Orientation	0
EGS 1113	Intro. to Design Graphics	3
*Fine Arts Elective		3
*Social Science Elective		3
		18

Semester **II**

ENC 1102	Freshman English II	3
MAC 2282	Engr. Calculus II	3
CHM 2046	General Chemistry II	3
CHM 2045L	Gen. Chemistry I Lab	1
PHY 2048	General Physics I	3
PHY 2048L	Gen. Physics I Lab	1
EGN 2210	Computer Tools for Engineers	3
		17

Semester **III**

PHY 2049	General Physics II	3
PHY 2049L	Physics II Lab	1
MAC 2283	Engr. Calculus III	3
EGN 3365L	Materials Engineering I	3
EGN 3311	Statics	3
EGN 3443	Eng. Statistics I	3
		16

Semester **IV**

MAP 2302	Differ. Equations	3
EGN 3373	Intro. to Electrical Systems I	3
EGN 3321	Dynamics	3
EGN 3343	Thermodynamics I	3
*Social Science Elective		3
		15

Summer Term

ENC 4931	Engineering Communications	3
ENG 3613	Engineering Economy	3
EGN 4450	Intro. to Linear Systems	2
*Science Elective		3
		11

Semester **V**

EIN 4312L	Work Analysis	3
EGN 3375	Intro. to Electrical Systems III	3
EIN 4411L	Manufacturing Processes	3
EIN 4933	Managerial Cost Accounting	3
ESI 4312	Deterministic O.R.	3
		15

Semester **VI**

ESI 4313	Probabilistic O.R.	3
EIN 4313L	Human Factors	3
EIN 4601	Automation and Robotics	3
EIN 4333	Production Control	3
*HIstorical Perspectives Elective		3
		15

Semester **VII**

ESI 4224	Design of Experiments	3
ESI 5423	Industrial Systems Simulation	3
EIN 4364L	Facilities Design I	3
*HIstorical Perspectives Elective		3
*ALAMEA Perspective Elective		3
		15

Semester **VIII**

ESI 4911	Senior Project	2
EIN 4365L	Facility Design II (MW/MI)	3
ESI 4221	Industrial Statistics & Quality Control	3
Technical Elective		3
*MW/MI (Non-Engineering)		3
		14

*Approved General Education Requirements

- ***Program of Study at a Florida Community/Junior College or SUS School for Students Planning to Transfer to USF (State Mandated Common Prerequisites)***

Complete the A.A. degree at the community college. Some courses required for the major may also meet General Education Requirements thereby transferring maximum hours to the university. A minimum of 60 semester hours must be completed at the university. If a student wishes to transfer without an A.A. degree and have fewer than 60 semester hours of acceptable credit, the student must meet the university's entering freshman requirements including ACT or SAT test scores, GPA, and course requirements.

The following are transferable courses from the Community College that will be accepted in the Math/Science/Engineering areas:

Math

Calculus

USF	C/C
MAC 2281	MAC 2311 (3)
MAC 2282	MAC 2312 (3)
MAC 2283	MAC 2313 (3)

Differential Equations

MAP 2302	MAP 2302 (3)

Chemistry

General

USF	C/C
CHM 2041	CHM 1045 (3)
CHM 2045L	CHM 1045L (1)
CHM 2046	CHM 1046 (3)

Physics

USF	C/C
PHY 2048	PHY 2048 (3)
PHY 2048L	PHY 2048L (1)
PHY 2049	PHY 2049 (3)
PHY 2049L	PHY 2049L (1)

Graphics

USF	C/C
EGS 1113	EGS 1111 (3)

Fortran

USF	C/C
EGN 2210	COP 2202 (3)

This is a limited access program involving special admissions requirements. Please be aware of the immunization, foreign language, continuous enrollment policies of the university, and qualitative standards required.

Procedures for Applying to the College of Engineering

Students should complete and submit an Engineering Admissions Application to the College of Engineering Advising Office. Freshmen and Sophomores must submit copies of high school transcripts, SAT and ACT test scores to the College of Engineering, Advising Office. This is in addition to records requested by the University's Admissions Office. Transfer applicants must furnish transcripts from previously attended institutions to the College of Engineering, Advising Office. This is in addition to transcripts sent to the University's Admissions Office. Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL scores must be 550. Credentials must be received in the Engineering Advising Office 30 days prior to the date of applicable term. Failure to comply will result in the application being denied by the College of Engineering. Credentials will be held for one year. If application is not updated within that year, credentials must be re-submitted.

Engineering Admissions Requirements

Transfer students must have completed the equivalent USF Engineering Calculus sequence with a 2.0 GPA; must have completed one year of equivalent USF General Physics and Chemistry courses with a minimum of 2.0 GPA; must have an overall GPA of 2.0 or better.

6. Mechanical Engineering

Students pursuing the Bachelor of Science in Mechanical Engineering program take coursework in thermodynamics and heat transfer; instrumentation and measurements, energy conversion systems, solid and fluid mechanics, dynamics, machine analysis and design, mechanical design, controls, and fluid machinery. This is supplemented by elective coursework in such areas as power plant analysis, refrigeration and air conditioning, mechanical design, advanced mechanics, heat transfer, robotics, propulsion, vibrations, computer-aided design, manufacturing, composite materials, and aerodynamics.

Students completing this program normally enter careers in a wide range of industries which either produce mechanical products or rely on machines, mechanical devices and systems to produce electricity, petroleum products, foods, textiles, building materials, etc. Mechanical Engineering graduates may follow careers in such fields as transportation, power generation, manufacturing, instrumentation, automatic control, machine design, construction, refrigeration, heating and air conditioning, aerospace, defense and all the process industries (foods, textiles, petrochemicals, pharmaceuticals, etc.). There are abundant career opportunities in this wide range of industries because mechanical equipment is required in every aspect of industrial production.

Bachelor's Curriculum
Mechanical Engineering

Semester I

ENC 1101	Freshman English I	3
MAC 2281	Engineering Calculus I	3
CHM 2041	General Chemistry I	3
CHM 2045L	Chemistry Lab I	1
EGS 1113	Intro. to Design Graphics	3
ENG 1002	Engineering Orientation	0
*Social Science Elective		3
		16

Semester II

ENC 1102	Freshman English II	3
MAC 2282	Engineering Calculus II	3
CHM 2046	General Chemistry II	3
CHM 2046L	General Chemistry II Lab	1
PHY 2048	General Physics I	3
PHY 2048L	General Physics I Lab	1
*Historical Perspectives Elective		3
		17

Summer Term

MAC 2283	Engineering Calculus III	3
PHY 2049	General Physics II	3
PHY 2049L	General Physics II Lab	1
EGN 2210	Computer Tools for Engineers	3
		10

Semester III

EGN 3311	Statics	3
EGN 3443	Engineering Statistics	3
MAP 2302	Differential Equations	3
EGN 3343	Thermodynamics I	3
EGN 3373	Intro. to Electrical Systems I	3
		15

Semester IV

EGN 4450	Intro. to Linear Systems	2
EGN 3321	Dynamics	3
EML 4106	Thermal Systems and Economics	3
EGN 3365L	Materials Engineering I	3
EGN 3375	Intro. Electrical Systems III	3
*Social Science Elective		3
		17

Semester V

EGN 3433	System Dynamics	3
EML 4041	Computer Methods	3
EML 3262	Kinematics and Dynamics of Machinery	3
EML 3500	Mach. Anal. and Des. I	3
*Historical Perspectives Elective		3
*ALAMEA Perspectives Elective		3
		18

Semester VI

EML 4501	Machine Design	3
EML 3701	Fluid Systems	3
ENC 4931	Engineering Communications	3
*Fine Arts Elective		3
MW/MI (Non-engineering)		3
		15

Semester VII

EML 4142	Heat Transfer I	3
EML 3303	Mechanical Engineering Lab I	3
EML 4551	Capstone Deisgn (MW/MI)	3
Approved Technical Elective		3
Approved Technical Elective		3
		15

Semester VIII

EML 4302	Mechanical Engineering Lab II	3
Controls Elective		3
Approved Design Elective		3
Approved Technical Elective		3
Approved Technical Elective		1
		13

*Approved General Education Requirements

- ***Program of Study at a Florida Community/Junior College or SUS School for Students Planning to Transfer to USF (State Mandated Common Prerequisites)***

Complete the A.A. degree at the community college. Some courses required for the major may also meet General Education Requirements thereby transferring maximum hours to the university. A minimum of 60 semester hours must be completed at the university. If a student wishes to transfer without an A.A. degree and have fewer than 60 semester hours of acceptable credit, the student must meet the university's entering freshman requirements including ACT or SAT test scores, GPA, and course requirements.

The following are transferable courses from the Community College that will be accepted in the Math/Science/Engineering areas:

Math
Calculus

USF	C/C
MAC 2281	MAC 2311 (3)
MAC 2282	MAC 2312 (3)
MAC 2283	MAC 2313 (3)

Differential Equations

MAP 2302	MAP 2302 (3)

Chemistry
General

USF	C/C
CHM 2041	CHM 1045 (3)
CHM 2045L	CHM 1045L (1)
CHM 2046	CHM 1046 (3)
CHM 2046L	CHM 1046L (1)

Physics

USF	C/C
PHY 2048	PHY 2048 (3)
PHY 2048L	PHY 2048L (1)
PHY 2049	PHY 2049 (3)
PHY 2049L	PHY 2049L (1)

Graphics

USF	C/C
EGS 1113	EGS 1111 (3)

Fortran

USF	C/C
EGN 2210	COP 2202 (3)

This is a limited access program involving special admissions requirements. Please be aware of the immunization, foreign language, continuous enrollment policies of the university, and qualitative standards required.

Procedures for Applying to the College of Engineering

Students should complete and submit an Engineering Admissions Application to the College of Engineering Advising Office. Freshmen and Sophomores must submit copies of high school transcripts, SAT and ACT test scores to the College of Engineering, Advising Office. This is in addition to records requested by the University's Admissions Office. Transfer applicants must furnish transcripts from previously attended institutions to the College of Engineering, Advising Office. This is in addition to transcripts sent to the University's Admissions Office. Applicants whose native language is other than English must submit TOEFL scores to the College of Engineering. The minimum TOEFL scores must be 550. Credentials must be received in the Engineering Advising Office 30 days prior to the date of applicable term. Failure to comply will result in the application being denied by the College of Engineering. Credentials will be held for one year. If application is not updated within that year, credentials must be re-submitted.

Engineering Admissions Requirements

Transfer students must have completed the equivalent USF Engineering Calculus sequence with a 2.0 GPA; must have completed one year of equivalent USF General Physics and Chemistry courses with a minimum of 2.0 GPA; must have an overall GPA of 2.0 or better.

College Regulations

1. Humanities and Social Science Requirements

While the Engineering undergraduate student is expected to complete certain requirements during the first two years of study which are directed toward the humanities and social sciences, and which are fulfilled by the completion of the General Education requirements of the University, the College of Engineering expects more of its prospective engineering graduates than this minimum. The engineer must not only be a technically competent individual, but must also be a person who can understand, adjust and contribute to the social environment.

Students who transfer from a State of Florida community college with an Associate of Arts degree and who have met that college's General Education Requirement will normally find that their General Education coursework satisfies the major portion - but not all - of the Social Science and Humanities Core Requirements.

All Engineering students must complete the USF Exit Requirments. The Literature and Writing portion can be met by completing ENC 3210 Technical Writing.

2. English Requirement

Students who have been admitted to the College of Engineering may be required to take an examination in order to evaluate their preparedness in the use and understanding of the English language. The examination will be administered by the faculty of the University's English program.

Students evidencing an English deficiency will be required to initiate the necessary corrective programs, with the assistance of their advisers. It is recognized that such deficiencies can exist even though a student has met the University's minimum English requirements. Correction of any deficiency must commence the term after a student has been notified and must be completed prior to recommendation of the student for graduation by the faculty of the College.

See Continuation and Graduation Requirements below for minimum grade requirements.

3. Mathematics Requirement

Students who are pursuing an engineering program are expected to acquire a facility for the rapid and accurate solution of problems requiring the use of mathematics. This requirement includes the ability to translate physical situations into mathematical models. Students evidencing a lack of manipulative ability or of the ability to apply mathematics will be required to take remedial coursework in engineering analysis and problem solving that is over and above their regular degree requirements. Faculty of the College who encounter students who are deficient in their mathematical ability will refer such cases to the Advising Office.

4. Continuation and Graduation Requirements

The curricula for the programs offered by various departments of the College of Engineering may be divided into four categories: a) General Education (Non-Technical Requirements); b) Basic Science Requirements (i.e., Math, Chemistry and Physics); c) Engineering Core Requirements; d) Program Specialization Requirements. All undergraduate students in the College of Engineering must maintain the minimum grade-point average (GPA) of 2.0 for each category and a 2.0 GPA for all engineering courses attempted. In no case will the minimum GPA for a category be less than 2.0. It is the student's responsibility to make sure she/he meets all departmental requirements. In addition to the completion of the coursework and/or project requirements of the respective program of the College, students must be recommended for their degrees by the faculty of the College.

Students who do not maintain the required minimums of the program pursued in each category are ineligible for further registration in the College unless individually designed continuation programs are recommended by the student's academic adviser and approved by the department chairperson and the Engineering Associate Dean for Academic Affairs. All students who are academically dismissed from the University will be denied readmission to the College of Engineering unless they meet admission requirements in effect at the time readmission is sought and are recommended for readmission by the department and the Associate Dean for Academic Affairs.

Students who register for a course three times without receiving a grade "D" or better (i.e., receive grades of W or F) will be denied further enrollment in the College of Engineering unless written permission is obtained from the department chairperson and the College Associate Dean for Academic Affairs.

Students pursuing College of Engineering degree programs are expected to take their courses on a graded basis (ABCDF).

Exceptions require written approval of the department adviser prior to registration.

The College of Engineering requires that a student complete the Basic Science, Engineering Science and Specialization Requirements for the baccalaureate degree within seven years prior to the date of graduation. Any exceptions require approval of the department and Dean's Office.

Each engineering student is required to complete the *Application for* **G***radu***a***tion* **- Ch***eck* **L***i***st** and submit it to the College of Engineering Advising Office by the drop date of the term prior to the semester in which graduation is sought. Completion of this form is a requirement for graduation.

Effective fall of 1987 all students pursuing Bachelor of Science degree programs in Civil or Mechanical Engineering will be required to take the Fundamentals of Engineering Exam of the State Board of Professional Regulation at least one term prior to the term of anticipated graduation. Engineering students in other disciplines are strongly encouraged to do the same. (See the College Advising Office for applications and information.)

5. **T***ransfer* **C***redi***t**

Transfer credit will be allowed by the USF College of Engineering when appropriate if the transferred course has been passed. In some cases credit for a course **may** be granted, but the hours accepted may be less than the hours earned at another school.

While credit for work at other institutions may be granted subject to the conditions of the previous paragraph, a **m***ini***mum** of thirty semester hours of engineering coursework specified by the degree granting department is required for a baccalaureate degree.

■ FIV*E*-Y*EA*R *P*ROGR*A*M - L*EA*DING TO B*A*CH*E*LOR*S A*ND M*AS*TE*R*S D*E*GR*EES*

Students who, at the beginning of their senior year, are clearly interested in graduate study are invited to pursue a Five-Year Program of study leading simultaneously to the Bachelor of Science in Engineering or Engineering Science and Master of Science in Engineering or Engineering Science degrees. The keys to this program are:

1. A two-year research program extending through the fourth and fifth year.
2. The opportunity of taking graduate courses during the fourth year and deferring the taking of senior courses to the fifth year. The requirements of the combined degrees do not differ from those for the two degrees pursued separately.

Students apply for admission to this program through their adviser, who should be consulted when additional information is needed. General requirements include:

1. Senior standing (90 credits) with at least 16 upper level engineering credits completed at the University of South Florida with a 3.0 GPA.
2. A minimum score of 1000 on the verbal and quantitative portions of the Graduate Records Examination is expected.
3. Above-average performance in the chosen Engineering program is expected.

C*ert*ifica*t*e *Progra*ms

C*ert*ifica*t*e *in* B*io*m*edical Engineering*

The Certificate in Biomedical Engineering provides students an opportunity to get an introduction to a rapidly developing field of study and to receive recognition for their endeavors. Students in the program must fulfill all the requirements for an Engineering undergraduate degree, such as Bachelor of Science in Chemical Engineering, and also meet the additional requirements of the Certificate program.

Ch*em***i***st***ry/B***iology*** (10 hours min.)
- BSC 2010 Biology II - Cellular Processes*
- BCH 3023 Biochemistry**

One of the following Organic Chemistry sequences:
- CHM 2210 Organic Chemistry I*
- CHM 2211 Organic Chemistry II*
- CHM 2200 Organic Chemistry***

Other "human sciences" (6 hrs. min.)
- PSY 3044 Experimental Psychology**

One of the following:
- PET 3310 Kinesiology
- PET 3351 Exercise Physiology I
- EXP 4104 Sensory Processes
- PSB 4013C Neuropsychology
- (or approved substitute)

Engineering (9 hrs. min.****)
- EEL 4935 Special Electrical Topics
- ECH 5746 Intro to Biomedical Engineering

One or more of the following (to achieve 9 hrs. min. in area):
- EIN 4313L Human Factors
- EIN 5245 Work Physiology & Biomechanics
- ECH 5747 Selected Topics in Chemical Engineering Biotechnology
- ECH 5748 Selected Topics in Biomedical Engineering
- (or other approved Engineering courses)

*These courses are typically required for Medical School admission. Note that there may be other required courses, such as a course in Human Genetics and the Organic Chemistry laboratories.

**These courses are not normally required for Medical School admission, but are often "highly recommended".

***This is a single semester course in Organic Chemistry. This course does not normally satisfy the admission requirements of most medical schools. It also does not count towards the Chemical Engineering degree (students must take the full year sequence).

****It is important to note that these engineering courses are above and beyond the courses necessary to satisfy the 136 hour requirement. That is, these courses will not also be countable as engineering electives towards the B. S. requirements for any of the departmental degree programs.

C*ert*ifica*t*e *of En***h***ance***m***en***t**

The Certificate of Enhancement in (designated discipline) provides students an opportunity to gain an enhanced experience in their chosen field while pursuing an engineering degree and to permit them to receive recognition for the same requirements.

R*equ***i***re***m***en***t***s:***

1. Enrolled in a Bachelor of Science degree program in a specified engineering discipline.
2. A minimum of 15 hours of additional elective courses, not included as a part of the B. S. degree, from an approved list. Courses must be taken on a letter-grade basis and a minimum of 9 hours must be in engineering courses.
3. A G.P.A. of 2.0 or greater for the additional hours.
4. The student must receive the engineering degree to receive the Certificate of Enhancement.

Please contact the appropriate department chairperson to be accepted in the program.

C*om***p***ut***e***r Ser***v***ice* C*ou***r***ses***

These courses marked SC are specifically designed for the non-engineering student.

Recognizing that the general purpose digital computer has made significant contributions to the advancement of all elements of the academic community and that it will have an ever greater impact in the future, the College of Engineering offers several levels of credit coursework, both undergraduate and graduate, to serve students of all colleges in order that they may be prepared to meet the computer challenge.

Computer-oriented courses are offered in two broad categories: (1) those courses which are concerned with the operation, organization and programming of computers and computer systems from the viewpoint of examining the fundamental principles involved in computer usage; and (2) those courses which are concerned with computer applications to a variety of different disciplines, by means of user-oriented-languages such as FORTRAN, PL/I, COBOL, PASCAL, BASIC, "C" and ADA.

Students in engineering, the physical sciences, and mathematics must consult their adviser for suitable computer courses, since these courses are not acceptable to a number of degree programs.

College Facilities

Each of the departments has several modern well-equipped laboratories that are used for undergraduate teaching. Some examples of specialized equipment available are a scanning electron microscope, a gas chromatograph mass spectrometer, a 250,000 lb. material testing machine, several microprocessor base control systems, industrial robots, a low turbulence subsonic wind tunnel, computer numerical controlled machinery, metal organic chemical vapor deposition systems, and integrated circuits design workstations.

College Computing Facilities

The College of Engineering Computing Facilities are used to provide support for specialized engineering calculations above and beyond those which are available at the IBM based Central Florida Regional Data Center (CFRDC).

The College of Engineering operates a cluster of file and computer servers for students and faculty within the College. These consist of SUN servers and four Ardent multiprocessors mini-supercomputers. The networks provide access from offices and laboratories, computer rooms and dial-in facilities. All machines are configured for E-mail, and access to Internet. Conventional ascynchronous links to the campus central facility will shortly be supplemented with an Ethernet link.

In addition to the network facilities, the College operates open access P.C. labs. Two are available for undergraduate engineering students; a third smaller lab is reserved for graduate students and faculty. Another open access P.C. lab is operated in conjunction with the Technology program.

The network facilities provide access either via Ethernet or the ISDN. Connections to offices, laboratories and classrooms are available on request, subject to budget priorities. The FEEDS studies are also networked to provide demonstrations for remote classes.

The College facilities run most of the standard engineering software. Languages include Fortran, Basic, Pascal, C. Ada, several varieties of LISP and Prolog. Applications software includes mathematical libraries, suites of programs for VLSI design, chemical process design, civil and mechanical engineering design, robotics simulation, and circuit simulation and analysis. There are high resolution color terminals for use in conjunction with these activities, and for mechanical design there are four multiple display workstations with joysticks and digitizing pads. Similar arrangements are used for VLSI design.

Additionally, the Computer Science and Engineering Department within the College runs other facilities consisting of an Ethernet with SUN and DEC machines, an Intel Hypercube parrallel computer, and extensive microcomputer laboratories.

Cooperative Education Program

A wide variety of industries and government agencies have established cooperative programs for engineering students to provide them the opportunity to become familiar with the practical aspects of industrial operations and engineering careers. Students in the Career Resource Center's Cooperative Education (Co-op) program alternate periods of paid employment in their major field with like periods of study. Students following the Co-op program usually encounter no problems in scheduling their program, since required Social Science and Humanities, Mathematics and Science, and Engineering Core courses are offered every semester. Students normally apply for participation in this program during their sophomore year and pursue actual Co-op employment during their sophomore and junior years. The senior year is generally pursued on a full-time study basis, since many specialization courses are not offered every semester. The students receive a Cooperative Education Certificate upon successful completion of a minimum of two work assignments.

STAC
(Southern Technology Applications Center)

The Space Act of 1958 directed NASA "to provide the widest practical and appropriate dissemination of information concerning its activities and results thereof." In order to pursue this mandate NASA established a network of Industrial Applications Centers (IACS) to disseminate and transfer NASA technology, products and processes to the private sector.

In 1977 NASA and the State University System of Florida combined resources to form the Southern Technology Applications Center which operated a regional IAC in the State of Florida. STAC is a not-for-profit 501.C3 Corporation partially supported by NASA and SUS grants and its effective network of experts and resources are located at the colleges of Engineering at six of the SUS universities.

In December 1991 the NASA IAC Network was reorganized to provide comprehensive technology transfer and economic development services. The new program resulted in a network of six Regional Technology Transfer Centers that link NASA Field Centers, Federal laboratories, universities and other Technology Transfer networks for more efficient technology transfer.

In January 1992 STAC was appointed the Southeast Regional Technology Transfer Center (RTTC) with responsibility for nine Southeastern states.

Since the early days of its existence STAC has built a reputation for successfully identifying, matching, developing and deploying the critical information and technology needed by business, industry, academic institutions and government. In this way, American companies, especially small firms are able to capitalize rapidly on the results of scientific research and technological innovation and realize the increased productivity necessary to compete in the dynamic marketplace.

The cornerstone of STAC's technology transfer success is a professional staff trained and experienced in engineering, physical and biological sciences, medicine, social and behavioral sciences, business planning, marketing, training, library science and government. STAC's Information Research Center accesses an international array of over 2000 databases and 35 document retrieval sources. STAC's hands-on approach enables each client to receive the attention and alternative solutions needed to make the best strategic decisions.

STAC is the connection to access the information technology, inventions, equipment, facilities and expertise that resides within NASA, the other 700+ Federal laboratories and the SUS universities.

Army & Air Force R.O.T.C.
For Engineering Students

The Engineering curriculum, coupled with involvement in the Army or Air Force R.O.T.C. program, requires a minimum of five (5) years to complete the degree requirements. Army and Air Force R.O.T.C. cadets must take 16 additional hours in either military science or aerospace studies. Additionally, Air Force-sponsored summer training camp is scheduled between the sophomore and junior year for Air Force cadets, and Army cadets attend an Army-sponsored summer training program between the junior and senior years.

ENGINEERING FACULTY

Chemical Engineering

Chair*person:* R. Gilbert; *Professors:* J.C. Busot, L. Garcia-Rubio, J.A. Llewellyn, C. A. Smith, A. K. Sunol; *Associate Professors:* V.R. Bhethanabotla, S.W. Campbell, R.A. Gilbert, W.F. Lee, III; **I**nstruct*or:* C. Biver; **Courtesy Faculty***:* R. Heller.

Civil and Environmental Engineering

Chair*person:* W. C. Carpenter; *Professors Emeriti*: J. E. Griffith, B.E. Ross; *Professors:* M.W. Anderson, R.P. Carnahan, W.C.Carpenter, W. F. Echelberger, Jr., S.C. Kranc, R. J. Murphy, L.W. Oline, M. A. Ross, A. A. Sagues, R. Sen; *Associate Professors:* M. Gunaratne, R. I. Stessel, A. Zayed; *Assistant Professors:* D. Bonnin, J.F. Devine, J.T. Franques, Jr.,S. Hassiotis, J. J. Lu, R. O. Mines, Jr. R. Pendyala; **I**nstruct*or:* K. Nohra; **Courtesy Faculty***:* F.R. Jones, A. G. Mullins, G.L. Brosch, S.E. Polzin, J. B. Rose, R. C. Sheck, F. L. Young.

Computer Science and Engineering

Chair*person:* A. Kandel; *Professors:* K. Bowyer, L. Hall, A. Kandel, L. Piegl, R. Perez, M. Varanasi; *Associate Professors:* S. Al-Arian, D. Goldgof, P. Maurer, N. Ranganathan, D. Rundus; *Assistant Professors:*K. Christensen, S. Mahadevan, S. Sakar, M. Soo.

Electrical Engineering

Chair*person:* E.K. Stefanakos; **D***ean Emeritus:* G.A. Burdick; *Professors:* C.T.M. Chen, Y. Chiou, S.J. Garrett, R.E. Henning, V.K. Jain, L.L. Jastrzebski, M.G. Kovac, G. Lachs, J.J. Lagowski, D.L. Morel, A.D. Snider, T.E. Wade; *Associate Professors:* K.A. Buckle, H.A. Nienhaus, P.H. Wiley; *Assistant Professors:* J.G. Cottle, L. P. Dunleavy, C. Ferekides, P. Flikkema, F.D. King, J.T. Leffew, W. Moreno, R. Sankar, T. Weller; **L***ecturers:* H.C. Gordon.

Industrial and Management Systems

Chair*person:* P.E. Givens; *Professor Emeritus:* R. J. Wimmert; *Professors:*J.L. Brown, P. E. Givens, S. K. Khator, L.A. Weaver; *Associate Professors:*A. L. Callahan, T. K. Das, O. G. Okogbaa, W. A. Miller; *Assistant Professor:* P. R. McCright, M X. Weng; **L***ecturer:* S. N. Busansky, D. K. Gooding.

Mechanical Engineering

Chair*person:*R.H. Howell; *Professors*:R.A. Crane, R. H. Howell, A. K. Kaw, S.J. Ying; *Associate Professors:* G. H. Besterfield, D. P. Hess, J.L.F. Porteiro, S. Wilkinson, *Assistant Professors:* M. M. Rahman; **Courtesy** *Appointment*: L. A. Scott; **V***isiting Professor:* J. S. Przemieniecki.

ENGINEERING COURSES

Basic and Interdisciplinary Engineering

EGN 1002 ENGINEERING ORIENTATION (0)
The role of engineering in society, characteristics of different fields of engineering, required preparation for engineering careers, techniques and approaches used by engineers in their profession. (S/U only.)

EGN 2031 HISTORY OF TECHNOLOGY -HP (3)
Covers the evolution of technology and its influence on society from prehistoric man to the modern day. Topics include: seven technological ages of man, methods of producing power, materials, transportation, communication and calculation, and technology and society.

EGN 2200 ENGINEERING WITH COMPUTERS (2)
PR: EGN 2210. Fundamental concepts in engineering and computer applications. Examples chosen from various areas of engineering to illustrate design modelling and analysis with computer assistance. Some topics involve laboratory.

EGN 2210 COMPUTER TOOLS FOR ENGINEERS (3)
PR: MAC 2281. Students will be introduced to computer based engineering tools and their application to the solution of engineering problems. The programming language, FORTRAN, will be the most emphasized tool, but coverage will also be given to other engineering/mathematical tools such as equation solving tools and spreadsheets.

EGN 3311 STATICS (3)
PR: PHY 2048. Principles of statics, mechanical equilibrium, forces, moments, plane trusses. Lec.-pro.

EGN 3321 DYNAMICS (3)
PR: EGN 3311. Dynamics of discrete particles; kinematics and kinetics for rigid bodies. Lec.

EGN 3331 MECHANICS OF MATERIALS (3)
PR: EGN 3311. Stress, strain, Hooke's Law; torsion, beam, column analysis; combined stresses; inelastic effects, limit design. Lec.

EGN 3331L MECHANICS OF MATERIALS LABORATORY (1)
PR: EGN 3311. CR: EGN 3331. Experiments in mechanics of deformable bodies. Lab.

EGN 3343 THERMODYNAMICS I (3)
PR: PHY 2049. Axiomatic introduction to thermodynamic concepts of energy, entropy, work and heat. Properties of ideal and real substances. Applications: power production and refrigeration, phase equilibria.

EGN 3353 BASIC FLUID MECHANICS (3)
PR: EGN 3311, CR: EGN 3321. Fundamental and experimental concepts in ideal and viscous fluid theory; momentum and energy consideration, introduction to hydraulics, pipe flow. Lecture.

EGN 3365 MATERIALS ENGINEERING I (3)
PR: CHM 2046, EGN 3311. Structure and property relationships in engineering materials, i.e., metal, ceramic and polymer systems. Environmental effects are also treated.

EGN 3373 INTRODUCTION TO ELECTRICAL SYSTEMS I (3)
PR: PHY 2049, PHY 2049L, CR: MAP 2302. A course in linear passive circuits. Physical principles and modes. Transient and steady-state analysis.

EGN 3374 INTRODUCTION TO ELECTRICAL SYSTEMS II (3)
PR: EGN 3373. Continuation of EGN 3373.

EGN 3375 INTRODUCTION TO ELECTRICAL SYSTEMS III (3)
PR: EGN 3373. Continuation of EGN 3373 or EGN 3374.

EGN 3433 SYSTEM DYNAMICS (3)
CR: EML 4041; PR: EGN 3321, EGN 4450, PHY 2049. Dynamic analysis of electrical, mechanical, hydraulic and thermal systems; LaPlace transforms; numerical method; use of computers in dynamic systems.

EGN 3443 ENGINEERING STATISTICS I (3)
PR: MAC 2283. An introduction to the basic concepts of statistical analysis with special emphasis on engineering applications.

EGN 3613C ENGINEERING ECONOMY I (3)
A study in analyzing the economic limitations imposed on engineering activities using basic models which consider the time value of money.

EGN 4366 MATERIALS ENGINEERING II (3)
PR: EGN 3365. Applications and structure property relationships of commonly used engineering materials. Steel, nonferrous alloys and their welding, heat treatment and processing. Introduction to ceramic and polymeric materials.

EGN 4420 NUMERICAL METHODS OF ANALYSIS (2)
PR: MAP 2302, EGN 2210. Computation methods of analysis for engineering problem solving by use of digital computers, matrix methods, differential equations, curve fitting, integral equations.

EGN 4450 INTRODUCTION TO LINEAR SYSTEMS (2)
PR: MAC 2282. Study and application of matrix algebra, differential equations and calculus of finite differences.

EGN 4831 TECHNOLOGY AND SOCIETY -XMW (3)
Non-technical survey of engineering activities: utilities, nuclear power, genetics weaponry, space,etc. Students conduct individual in-depth study of environmental/ethical problem.

EGN 4905 INDEPENDENT STUDY (1-5)
PR: CI. Specialized independent study determined by the students' needs and interests. May be repeated up to 15 credit hours. (S/U only.)

EGN 4930 SPECIAL TOPICS IN ENGINEERING (1-3)
PR: CI. New technical topics of interest to engineering students. May be repeated for different topics up to 9 hours.

EGN 5421 ENGINEERING ANALYSIS I (3)
PR: MAP 2302. Vector methods of electromagnetism and fluid mechanics. Vector operators, line and flux integrals, potential and transport theorems, applications.

EGN 5422 ENGINEERING ANALYSIS II (3)
PR: MAC 2302 or CC. Power series solutions for ordinary differential equations, Sturm-Liouville theory, special functions. Vector methods with generalized coordinates. Separation of variables for partial differential equations. Green's functions. Calculus of variations. Numerical methods.

EGN 5423 ENGINEERING ANALYSIS III (3)
PR: CC or EGN 4450. Finite fields and coding applications. Probabilities of error detection and correction. Introduction to neural networks. Advanced matrix algorithms: LU and QR factorizations, least-squares, pseudoinverses.

EGN 5424 ENGINEERING ANALYSIS IV (3)
PR: MAC 2302 or CC. Analytic functions, conformal mapping, residue theory, Laurent series, transforms. Applications to various problems in engineering and physics.

EGN 5425 ENGINEERING ANALYSIS V (3)
PR: EGN 4450 and MAP 2302, or CC. Survey of theory and software for matrix computations: factorization methods, least squares and pseudoinverses, eigenvector algorithms. Special matrices and representations for control system and finite element applications.

EGS 1113 INTRODUCTION TO DESIGN GRAPHICS (3)
An introduction to the basic principles of engineering design. The course will include the graphic projective systems used in engineering drawing and design. Methods of graphic communication and graphic analysis of engineering design problems will be investigated.

Chemical Engineering

ECH 3023 INTRODUCTION TO PROCESS ENGINEERING (3)
PR: EGN 3343. Mass and energy balances on steady state systems with and without chemical reactions. Combustion processes. Psychrometrics.

ECH 3264C TRANSPORT PROCESSES I (3)
PR: ECH 3023. Design, sizing, and selection of fluid flow and heat transfer equipment to satisfy process demands. Lecture/laboratory.

ECH 3702 INSTRUMENT SYSTEMS I (4)
PR: EGN 3373. Applications of analog and digital devices to instrumentation problems in chemical and mechanical engineering. Basic electrical measurements. Computer assisted measurements and process monitoring.

ECH 4123C PHASE AND CHEMICAL EQUILIBRIA (3)
PR: For majors, ECH 3023; for non-majors ECH 3023 or CHM 4410. Correlation of thermodynamic properties of real systems and solutions. Description of multicomponent, multiphase systems in equilibrium. Applications to separation processes and reactor design. Lecture/laboratory.

ECH 4244L CHEMICAL ENGINEERING LABORATORY II (2)
CR: ECH 4415C. PR: ECH 3264C, ECH 3702, EML 3303, or CI. Engineering laboratory experiments in Chemical Engineering Processes: fluid flow, heat transfer, phase and chemical equilibria, and reacting systems.

ECH 4265C TRANSPORT PROCESSES II (3)
PR: ECH 3264C. Design, sizing. and selection of mass transfer equipment. Absorption, distillation, extraction, humidification. Lecture/laboratory.

ECH 4323C AUTOMATIC CONTROL I (3)
PR: ECH 4265C. Analysis of factors affecting process dynamics. Instrumentation required for control system design. Modes of control. Discrete logic operations. Stability. Design case studies. Lec./Lab.

ECH 4415C REACTING SYSTEMS (3)
CR: ECH 4244L PR: CHM 4412, ECH 4123C. Equilibrium and rate phenomena in reacting systems. Description of homogeneous chemical reactors for design and control. Lecture/laboratory.

ECH 4605 STRATEGIES OF PROCESS ENGINEERING (3)
PR: ECH 3023, EGN 4450, or CI. Methods of process cost estimation, profitability analysis, selection among alternatives, and optimization. Uncertainty and risk analysis. Reliability and safety. Project management.

ECH 4615 PLANT DESIGN AND OPTIMIZATION (3)
PR: ECH 4415C, ECH 4323C. Synthesis processing of and analysis of optimal chemical processing routes. Design and selection of process equipment. Process flowsheet simulation troubleshooting case studies.

ECH 4905 INDEPENDENT STUDY (1-4)
PR: CI. Specialized independent study determined by the student's needs and interests. May be repeated up to 3 credit hours.

ECH 4930 SPECIAL TOPICS IN CHEMICAL ENGINEERING I (1-4)
PR: CC. May be repeated up to 9 credit hours.

ECH 4931 SPECIAL TOPICS IN CHEMICAL ENGINEERING II (1-4)
PR: CI. May be repeated up to 9 credit hours.

ECH 5285 TRANSPORT PHENOMENA (3)
PR: Senior or graduate standing in engineering. Basic descriptive equations of fluid, heat, and mass transport. Description and solution to intermediate problems, including unsteady state and multidimensional systems. Estimation of transport and convective coefficients.

ECH 5324 AUTOMATIC PROCESS CONTROL II (3)
PR: ECH 4323C or CI. The course covers the root locus and frequency response methods. The techniques of ration, cascade feed forward, selective, override, and multivariable control techniques are discussed in detail. The course also shows how to utilize these techniques to design control systems. Z-transforms and discrete control including PID, Dahlin, and deadtime compensations.

ECH 5740 THEORY AND DESIGN OF BIOPROCESSES (4)
PR: Senior standing in engineering or CI. Introduction to biotechnology, including applied microbiology, enzyme technology, biomass production, bioreactor design, and transport processes in biosystems. Open to majors and non-majors with CI.

ECH 5742 PHARMACEUTICAL ENGINEERING (2)
PR: Senior or graduate standing in engineering or CI. Introduction to pharmaceutical engineering, including dosage forms (tablets, capsules, powders, liquids, topical forms, and aerosols), excipients, regulatory issues, clinical studies, and good manufacturing practices.

ECH 5746 INTRODUCTION TO BIOMEDICAL ENGINEERING (3)
PR: Senior standing in engineering or CI. Introduction to biomedical engineering, including transport phenomena in biomedical systems, biometerials, biomedical instrumentation, prosthetic devices, and clinical engineering. Open to non-engineering students with CI.

ECH 5747C SELECTED TOPICS IN CHEMICAL ENGINEERING BIOTECHNOLOGY (1-3)
PR: Senior standing in engineering or CI. Selected topics in chemical engineering biotechnology, including pharmaceutical engineering, immobilized enzyme technology, food engineering, and fermentation. Open to majors and non-majors with CI. May be repeated for credit as subjects vary.

ECH 5748 SELECTED TOPICS IN BIOMEDICAL ENGINEERING (1-3)
PR: CI. Selected topics in biomedical engineering, including biomedical materials, biodynamics of circulation, separation processes in biomedical systems, and artificial organ systems. May be taken by non-engineering students with CI. May be repeated for credit as subjects vary.

ECH 5780 ENVIRONMENTAL REACTING SYSTEMS (3)
Application of chemical reaction engineering principles to problems in environmental enginering. Basic chemical kinetics and the modeling of batch and continuous systems. Applications will include containment fate and transport and remediation.

ECH 5820 PRODUCT DEVELOPMENT (2)
Senior or graduate standing in engineering or CI. An introduction to the development of consumer products, including the history of innovation, creativity development, the product development environment, and a detailed examination of several product areas.

ECH 5910 DIRECTED RESEARCH IN BIOENGINEERING (1-3)
PR: CI. Directed research in an area of biomedical engineering or engineering biotechnology. May be repeated up to 4 credit hours.

ECH 5930 SPECIAL TOPICS III (1-4)
PR: CI. May be repeated up to 9 credit hours.

ECH 5931 SPECIAL TOPICS IV (1-4)
PR: CI. May be repeated up to 9 credit hours.

Civil and Environmental Engineering

CEG 4011 SOIL MECHANICS I (3)
PR: EGN 3353C. Fundamental and experimental concepts in soil mechanics with emphasis on soil properties, soil moisture, soil structure, and shearing strength.

CEG 4011L GEOTECHNICAL LABORATORY (1)
CR: CEG 4011. Demonstrates and experiments verifying theoretical bases of Geotechnical Engineering. One hour lecture and two laboratory hours per week.

CEG 4012 SOIL MECHANICS II (3)
PR: CEG 4011. Design of retaining walls, earth slopes, foundations to control settlement, soil stabilization and foundations subjected to dynamic loads. Computer applications to soil mechanics will be covered.

CEG 4801 GEOTECHNICAL DESIGN (2)
PR: CEG 4011. Design of geotechnical systems including bases, foundations, embankments, and dams.

CEG 4850 CAPSTONE GEOTECHNICAL/TRANSPORTATION DESIGN (3)
PR: CEG 4011, TTE 4004. A capstone geotechnical/transportation design experience for seniors in Civil and Environmental Engineering. Design of embankments and pavement bases. Comprehensive surface streets. Open highway intersection and site design involving functional design, facility sizing, complete alignments and coordination, plan preparation, site layout and design, quantity summarization, bid tab planning and specification preparation.

CEG 5115 FOUNDATION ENGINEERING (3)
PR: CEG 4011 or CI. Design of shallow foundations, cantilevered and anchored retaining walls, piling, drilled piers and special foundations. Computer applications to geotechnical engineering are covered.

CEG 5205 LABORATORY TESTING FOR GEOTECHNICAL ENGINEERS (3)
PR: CEG 4011 or CI. Both routine and advanced forms of soil testing are covered. Emphasis is placed on procedures and application of results to design.

CES 3102 STRUCTURES I (3)
PR: EGN 3331. Analysis of simple structural systems, both determinate and indeterminate. Introduction to the use of energy methods in indeterminate structures.

CES 4000 STRUCTURES AND THE URBAN ENVIRONMENT FOR NON-ENGINEERS - 6A -XMW (3)
This course reviews the best works of structural engineering to indicate how current technology and social context affects structural form, to familiarize students with relevant structural principes, and to introduce the concept of structural art.

CES 4141 MATRIX STRUCTURAL ANALYSIS (3)
PR: CES 3102. Analysis of structures by use of matrix techniques and the digital computer. An introduction to finite analysis techniques.

CES 4561 COMPUTER AIDED STRUCTURAL DESIGN (3)
PR: CES 4141. Computer aided structural analysis and design using existing finite element program, static dynamic loading.

CES 4604 CAPSTONE STRUCTURAL DESIGN (3)
PR: CES 4605, CES 4702. A capstone structural design experience for seniors in Civil and Environmental Engineering. Design of structures made of steel and reinforced concrete.

CES 4605 CONCEPTS OF STEEL DESIGN (3)
PR: CES 3102. Introduction to steel design and AISC Manual of Steel Construction: Design of tension members; compression members; beams; beam columns; and bolted, welded, and riveted connections.

CES 4606 CONCEPTS OF STRUCTURAL DESIGN (3)
PR: CES 3102, EGN 3311. Introduction to concrete design and the ACI Building Code Requirements for reinforced concrete; design of flexural reinforcement in beams and slabs, design of sheer reinforcement, design of concrete columns, and design of steel beams.

CES 4618 STRUCTURAL DESIGN STEEL (2)
PR: CES 4605. Design of structures made of steel.

CES 4650 CAPSTONE MATERIALS DESIGN (3)
PR: EGN 3365 plus ONE of the following courses EGN 4851, EMA 4324 or EGN 4366. A Capstone Materials design experience for seniors in Civil and Environmental Engineering. This course will provide students with a focused design experience aimed to design for durability and reliability.

CES 4702 CONCEPTS OF CONCRETE DESIGN (3)
PR: CES 3102. Introduction to concrete design and the ACI Building Code Requirements for reinforced concrete: Design of flexural reinforcement in beams and slabs, design of shear reinforcement, design of concrete columns.

CES 4704 STRUCTURAL DESIGN-CONCRETE (2)
PR: CES 4702. Design of concrete structures.

CES 4820C TIMBER AND MASONRY DESIGN (3)
PR: CES 3102, CES 4702. Fundamentals of timber design including beams, columns, connections and formwork. Introduction to masonry design including design of beams, walls, columns, and pilasters.

CES 5105C ADVANCED MECHANICS OF MATERIALS I (3)
PR: EGN 3331, MAP 2302. Analytical study of the mechanical behavior of deformable solids. Basic concepts, stress and strain transformations, special topics in beams, introduction to theories of elasticity, and bending of thin plates.

CES 5209 STRUCTURAL DYNAMICS (3)
PR: CES 3102. Behavior of structural components and systems when subjected to periodic dynamic loads.

CES 5715C PRESTRESSED CONCRETE (3)
PR: CI. Fundamental principles of prestressing; calculation of losses; stress analysis and design of simple beams for flexure and shear. Examples of prestress applications.

CGN 3021L CIVIL ENGINEERING LABORATORY (2)
PR: CES 3102, EGN 3353, EGN 3365. A laboratory experience in departmental facilities including the subject areas of structures, materials, fluids, transportation, soils, engineering mechanics, environmental engineering, and computer assisted data acquisition.

CGN 4122 ENGINEERING CONTRACTS, SPECIFICATIONS AND ETHICS -XMW (3)
Focus on engineering responsibilities in the technical aspects of preparing contracts and specifications. Objectives are to teach the student their legal and ethical responsibilities in the preparation of contracts and specifications. Make the student aware of technical problems in the preparation of specification; bid documents and contracts. Emphasis of ethics of engineer-client agreements.

CGN 4851 CEMENT AND CONCRETE DESIGN (3)
PR: EGN 3365L. Classifications and production of cements. Design and testing of concrete mixes to produce desired properties.

CGN 4905 INDEPENDENT STUDY (1-5)
PR: CC. Specialized independent study determined by the students' needs and interests. May be repeated up to 15 credit hours. (S/U only.)

CGN 4911 RESEARCH IN CIVIL ENGINEERING AND MECHANICS (1-4)
PR: CC.

CGN 4914 SENIOR PROJECT (2-5)
PR: CI. Problem-solving experience and training for seniors in research and/or design projects. Written final reports are required.

CGN 4933 SPECIAL TOPICS IN CIVIL ENGINEERING AND MECHANICS (1-5)
PR: CI. New technical topics of interest to civil engineering students.

CGN 5933 SPECIAL TOPICS IN CIVIL ENGINEERING AND MECHANICS (1-5)
PR: CI. New technical topics of interest to civil engineering students. May be repeated up to 6 credit hours.

CWR 4103 WATER RESOURCES ENGINEERING (3)
PR: CWR 4202. A study of the engineering principles involved in sustaining and managing the quantity and quality of water available for human activities with particular emphasis on surface water and ground water hydrology.

CWR 4202 HYDRAULICS (3)
PR: EGN 3353. Fundamental and applied aspects of pipe flow, free surface flow, and unsteady flow for hydraulic systems.

CWR 4810 HYDRAULIC DESIGN (2)
PR: CWR 4103, 4202. Design of hydraulic systems, including drainage, water supply, and flood control.

CWR 4821 CAPSTONE WATER RESOURCES DESIGN (3)
PR: CWR 4202, CWR 4103. A capstone water resources design experience for seniors in Civil and Environmental Engineering. A design oriented course to design both industrial and domestic water treatment, and water transport systems and hydraulic systems, including drainage, water supply, and flood control.

EMA 4324 CORROSION OF ENGINEERING MATERIALS I (3)
PR: EGN 3365L. Principles of electrochemical corrosion and the representation of corrosion processes by polarization diagrams. Origin and prevention of the localized forms of corrosion and approaches to corrosion control.

EMA 4703 FAILURE ANALYSIS AND PREVENTION (3)
PR: EGN 3365L, EGN 3331. Failure criteria and the analysis of failures produced by combined states of stress. Principles of fracture mechanics and fatigue. Damage to materials produced by various environments including elevated temperatures and radiation.

ENV 3001 ENVIRONMENTAL ENGINEERING (3)
CR: ENG 3353. An introduction to various aspects of environmental problems faced by today's society. Topics covered are: air pollution, water pollution, noise pollution, solid waste management, ionizing radiation, disease transmission, and food protection.

ENV 4004L ENVIRONMENTAL ENGINEERING LABORATORY (1)
PR: ENV 3001, CR: ENV 4502. Laboratory experience in the measuring of environmental parameters.

ENV 4101 AIR POLLUTION CONTROL (3)
PR: EGN 3353. Behavior and effects of atmospheric contaminants and the principles of making measurements in the air environment. Basic concepts of meteorology and control technology are discussed. Regulatory aspects and air pollution standards are covered.

ENV 4400 CHEMICAL ASPECTS OF ENVIRONMENTAL ENGINEERING (3)
PR: One year general chemistry. Environmental quality and treatment parameters; sampling and sample preservation techniques; selected measurement techniques; interpretation and analysis of data; emphasis on water chemistry principles. Course is restricted to students pursuing the environmental engineering option in Civil Engineering and Chemical Engineering.

ENV 4417 WATER QUALITY AND TREATMENT (3)
PR: EGN 3353. An introduction to municipal water supply and waste water treatment. Topics include water requirements and waste volumes, water quality, physical and chemical treatment processes, and advanced wastewater treatment processes.

ENV 4432 WATER SYSTEMS DESIGN (2)
PR: EGN 3353. Corequisite ENV 4503. A design oriented course which utilizes the theory obtained in the Unit Operations course to design both industrial and domestic water treatment and water transport systems. It emphasizes the design procedures normally used in engineering practice.

ENV 4450 CAPSTONE WATER AND WASTEWATER DESIGN (4)
PR: EGN 3353 and ENV 4503. A capstone environmental design experience for seniors in Civil and Environmental Engineering. A design oriented course to design both industrial and domestic water treatment and water transport systems and wastewater and collection systems. The course emphasizes the design procedure normally used in engineering practice.

ENV 4502 ENVIRONMENTAL UNIT OPERATIONS (3)
PR: EGN 3343, EGN 3353. CR: ENV 3001 The theory and the design of unit operations normally used in the practice of environmental engineering, such as agitation and mixing of liquids, filtration, leaching, gas absorption, sedimentation and clarification, drying, and evaporation.

ENV 4503 ENVIRONMENTAL UNIT PROCESSES (3)
PR: ECH 3023, ENV 4502. The theory and design of unit processes normally used in environmental engineering such as coagulation of colloidal materials, water stabilization, water softening and neutralization, ion exchange, adsorption and oxidation processes for removal of iron and magnesium.

ENV 4531 WASTEWATER SYSTEMS DESIGN (2)
PR: ENV 4503. Emphasis is placed upon design practice and economics for a comprehensive design of a wastewater system and a collection system.

ENV 4552L ENVIRONMENTAL UNIT OPERATIONS AND PROCESSES LABORATORY (1)
PR: EGN 3353, ENV 4004L. CR: ENV 4503. Experimental work of the theory and design practices learned in Unit Operations and Unit Processes lecture courses. It provides the student familiarity with the development of bench and pilot plant processes and operations used in environmental engineering.

ENV 5105 AIR RESOURCE MANAGEMENT (3)
PR: CI. Air pollution source impacts on ambient air quality, modeling, regulatory approaches, source strategic controls and surveillance.

ENV 5345 SOLID AND HAZARDOUS WASTE CONTROL (3)
PR: CI. Treatment practices and design of waste handling systems to include: land treatment, pre-treatment, incineration, resource recovery, recycle, waste elimination.

ENV 5614 ENVIRONMENTAL RISK ANALYSIS (3)
PR: CI. Study of comprehensive application of risk analysis techniques for environmental control and protection purposes.

SUR 3140C ENGINEERING LAND SURVEYING (3)
Principles of land surveying for engineering practice. Traverses, levels, boundary surveys, route surveys, coordinate geometry, and mapping.

TTE 4004 TRANSPORTATION ENGINEERING I (3)
PR: EGN 3321. Principles of surface transportation system development, design, and operations; administration, modal characteristics, capacities, and functional classifications; vehicle kinematics, human factors and minimum design standards; traffic flow theory and queing, capacity and signalization; transportation planning and economics.

TTE 4005 TRANSPORTATION ENGINEERING II (3)
PR: TTE 4004, CR: SUR 3140. Techniques for the geometric route design of surface transportation systems; horizontal and vertical alignments. Spiral curves, superelevations and earthwork analysis; drainage, soils, and a rigid and flexible pavement design; right-of-way acquisition and Environmental Impacts; site layout & design, and operation of alternate models including bus, air, rail, water, and pipeline facilities and terminals.

TTE 4821 TRANSPORTATION SYSTEMS DESIGN (2)
PR: TTE 4005. Comprehensive surface transportation design laboratory experience involving function design, traffic and facility sizing, complete alignments, site surveying & layout plan and quantity preparation with computerized designed applications.

TTE 5501 TRANSPORTATION PLANNING AND ECONOMICS (3)
PR: College Algebra & CI. Fundamentals of urban transportation planning: trip generation, trip distribution, modal split, traffic assignment. Introduction to environmental impact analysis, evaluation and choice of transportation alernatives.

Computer Science and Engineering

CAP 5400 DIGITAL IMAGE PROCESSING (3)
PR: EEL 4851C or Graduate Standing. Image formation, sources of image degradation, image enhancement techniques, edge detection operators, and threshold selection, low-level processing algorithms for vision, image data compression.

CAP 5625 INTRODUCTION TO ARTIFICIAL INTELLIGENCE (3)
PR: EEL 4851C. Basic concepts, tools and techniques used to produce and study intelligent behavior. Organizing knowledge, exploiting constraints, searching spaces, understanding natural languages, problem solving strategies, etc.

CAP 5682 EXPERT AND INTELLIGENT SYSTEMS (3)
Basic concepts, techniques and tools for the design and implementation of expert and intelligent systems. Knowledge representation, inference methods, knowledge acquisition methods, and some advanced concepts. Tools to facilitate construction of expert and intelligent systems.

CDA 4100 COMPUTER ORGANIZATION AND ARCHITECTURE (3)
PR: EEL 4705. Elements of computer systems; processors, memories and switches. Register transfer representation of a computer. ALUs and their implementation. The control unit. Memory and I/O. Hardware support of operation system functions.

CDA 4203 COMPUTER SYSTEM DESIGN (3)
PR: EEL 4705, EEL 4705L. CR: CDA 4203L. Design Methods, Top-Down design, Building Blocks, Instruction and addressing models, minicomputer design, interfacing.

CDA 4203L COMPUTER SYSTEM DESIGN LAB (1)
PR: EEL 4705 and EEL 4705L. CR: CDA 4203. This lab introduces the student to the concept of system design. Several projects are given including building timing circuits, memory-based and communication circuits, and microcumputer-based designs.

CEN 4020 SOFTWARE ENGINEERING (3)
PR: EEL 4851C. An overview of software engineering techniques for producing high quality software. Student will participate in a software development team.

CEN 4721 USER INTERFACE DESIGN (3)
An examination of factors influencing the usability of a computer system. Topics include input and output devices, graphic and multi-media interfaces, formats for interaction/communication between computer and user, and the evaluation of usability.

CIS 4250 ETHICAL ISSUES AND PROFESSIONAL CONDUCT -6A -XMW (3)
PR: Senior standing in the Department of Computer Science and Engineering. An introduction to ethical issues arising in the computer sciences, through written analysis and oral presentations of technical situations which involve ethical conflicts.

CIS 4900 INDEPENDENT STUDY IN COMPUTER SCIENCE (1-5)
PR: CI. Specialized independent study determined by the needs and interests of the student. May be repeated up to 10 credit hours. (S/U only.)

CIS 4910 COMPUTER SCIENCE PROJECT (2)
Projects intended to develop individual interests and abilities in computer science involving either computer hardware or software aspects of a well defined proposal.

CIS 4930 SPECIAL TOPICS IN COMPUTER SCIENCE I (1-4)
PR: CI. May be repeated up to 15 credit hours.

COP 2000L COMPUTER SCIENCE LABORATORY (1)
CR: COP 2002. Laboratory for implementation of algorithms in a general purpose computer language.

COP 2002 INTRODUCTION TO COMPUTER SCIENCE (3)
CR: COP 2000L. Introduction to the concepts of algorithmic formulation of problems for computer solution and the general abstract operations used in these formulations.

COP 2400 COMPUTER SYSTEMS (3)
PR: COP 2000L. Principles of computer organization, machine and assembly language programming.

COP 2510 PROGRAMMING CONCEPTS (3)
PR: COP 2000L. An examination of a modern programming language emphasizing programming concepts and design methodology.

COP 4020 PROGRAMMING LANGUAGES (3)
PR: EEL 4851C. An introduction to programming languages, survey of language types and design of translators and interpreters.

COP 4023 COMPARISON OF PROGRAMMING LANGUAGES (3)
PR: EEL 4851C. A comparative study of procedural and nonprocedural computer languages, emphasizing the fundamental differences in information binding, string and data structures manipulation, control and I/O structures in different languages.

COP 4312 SYMBOLIC COMPUTER FOR ARTIFICIAL INTELLIGENCE (3)
PR: COP 2000L. An examination of the fundamental symbolic computing and its role in artificially intelligent computers. Includes program writing in LISP with emphasis on procedural and data abstraction.

COP 4600 OPERATING SYSTEMS (3)
PR: EEL 4851C. Introduction to systems programming. Design of operating systems. Concurrent processing, synchronization, and storage management policies.

COT 3100 INTRODUCTION TO DISCRETE STRUCTURES (3)
PR: MAC 2281 or equivalent. Introduction to set algebra, propositional calculus and finite algebraic structures as they apply to computer systems.

COT 4210 INTRODUCTION TO AUTOMATA THEORY AND FORMAL LANGUAGES (3)
PR: EEL 4851C. Introduction to the theory and application of various types of computing devices and the languages they recognize.

COT 4400 ANALYSIS OF ALGORITHMS (3)
PR: EEL 4851C. Design principles and analysis techniques applicable to various classes of computer algorithms frequently used in practice.

EEL 4705 LOGIC DESIGN (3)
PR: EGN 3373, CR: EEL 4705L; for CS & E students CR or PR: COP 2002. Binary number systems; truth functions; Boolean algebra; canonical forms; minimization of combinational logic circuits; synchronous logic circuits in computers.

EEL 4705L LOGIC LABORATORY (1)
CR: EEL 4705.

EEL 4743L MICROPROCESSOR LABORATORY (1)
CR: EEL 4744. Laboratory for Microprocessor use and evaluation.

EEL 4744 MICROPROCESSOR PRINCIPLES AND APPLICATIONS (3)
PR: EEL 4705 and EEL 4705L. CR: EEL 4743L. Functional Description. Arithmetic and Logic capabilities. Control and Timing. Interrupts and priority systems. Software design and documentation. Distributed function processing.

EEL 4748 MICROPROCESSOR-BASED SYSTEM DESIGN AND APPLICATION (3)
PR: EEL 4757, EEL 4743L. Study of techniques for design of microprocessor-based systems used in various applications. Includes a project on development of an experimental application system.

EEL 4781C DISTRIBUTED PROCESSING AND COMPUTER NETWORKS (3)
PR: COP 4600, CDA 4100. Design and analysis of distributed processing systems. Covers communication hardware and software, network operating systems, and reliability enhancement techniques.

EEL 4851C DATA STRUCTURES (3)
PR: COP 2002, COP 2000L. Fundamentals of data organization for purposes of program efficiency, clarity and simplicity will be addressed.

EEL 4852C DATA BASE SYSTEMS (3)
PR: EEL 4851C. Fundamentals of data base management systems. CODASYL, network, hierarchical, and relational data base systems are analyzed, and typical applications are presented.

EEL 5771 INTRODUCTION TO COMPUTER GRAPHICS I (3)
PR: CI. An introduction to the evolution of computer graphics including point-plotting, line drawing, two-dimensional transformations and graphics software packages.

Computer Service

(No credit for Engineering Majors)

CGS 2060 SC INTRODUCTION TO COMPUTERS AND PROGRAMMING IN BASIC -6A (3)
An overview of computer systems and their role in society. Survey of the evolution of computer software and hardware technology with emphasis on current applications. Introduction to programming using the BASIC language.

CGS 3062 COMPUTERS AND SOCIETY (3)
This computer literacy course covers the fundamentals of hardware, software, and programming languages, presents

a broad overview of data processing concepts, problems and applications for students with little or no computing background. (For non-engineering majors only.)

CGS 3462 SC PASCAL PROGRAMMING (3)
PR: CGS 2060. Structured programming implemented with the PASCAL language. Emphasis on program structure and data manipulation.

CGS 3463 SC GPSS SIMULATION (3)
PR: COP 2200. The development and execution of discrete event simulation models of real world systems using the GPSS language.

CGS 3464 SC SIMSCRIPT SIMULATION (3)
PR: COP 3463. The use of the Simscript language in discrete event simulation. Development of simulation models of real world systems.

CGS 4260 SC MINI-COMPUTER APPLICATIONS (3)
PR: CGS 4465. Study of mini-computer system components, I-O devices, theory of computer operation.

COP 2120 SC COBOL PROGRAMMING I (3)
PR: CGS 2060. Analysis of ANSI Standard COBOL language elements. Development of file structures and commercially oriented applications.

COP 2121 SC COBOL PROGRAMMING II (3)
PR: COP 2120. Advanced applications of ANSI Standard COBOL. Development of subroutines, relative I-O and data base applications as used in a comprehensive data processing environment.

COP 2200 SC FORTRAN PROGRAMMING (3)
PR: CGS 2060. Solution of scientifically oriented problems using the FORTRAN language. Particular emphasis is placed on file manipulation and system libraries.

ETG 4931 SPECIAL TOPICS IN TECHNOLOGY I (1-5)
PR: CC.

ETG 4932 SPECIAL TOPICS IN TECHNOLOGY II (1-5)
PR: CC.

ETI 4666 PRINCIPLES OF INDUSTRIAL OPERATIONS II (3)
PR: CC. Application of technqiues developed to the operation of an industrial firm through special projects.

Electrical Engineering

EEL 3100 NETWORK ANALYSIS AND DESIGN (3)
PR: EGN 3373. A second course in linear circuit analysis and design. Transient and steady-state responses of passive R-L-C networks to various functions.

EEL 3302 ELECTRONICS I (3)
PR: EGN 3373. A course in the physical principles of electronic devices with emphasis on semi-conductor electronics. Includes the analysis and design of amplifiers and switching circuits.

EEL 4102 LINEAR SYSTEMS ANALYSIS (3)
PR: EEL 3100. Provides further study in the analysis of linear networks and systems. Includes time and frequency domain points of view. Laplace, Fourier and superposition integrals.

EEL 4108 DISTRIBUTED NETWORKS (3)
PR: EEL 4411, EEL 3100. Transmission lines, standing waves, impedance, waveguides.

EEL 4163 COMPUTER AIDED DESIGN AND ANALYSIS (2)
PR: EEL 3302, EEL 4705. The emphasis is upon applications and how to use the major CADA programs as effective tools to solve a wide variety of engineering problems. The coverage includes solid state design, systems analysis, digital logic, and transfer function solutions.

EEL 4305 ELECTRONICS II (3)
PR: EEL 3302. Provides further study in electronic circuits. Includes feedback and frequency response techniques in amplifier design.

EEL 4351C SEMICONDUCTOR DEVICES (3)
PR: EEL 3302. An introduction to the fundamentals of semiconductor materials and semiconductor device operation.

EEL 4511 COMMUNICATION ENGINEERING (2)
PR: EEL 4512. Analog telephone network; digitalization. Digital transmission and multiplexing. Digital switching; space division switching, time-division switching, space-time switching; analog environment. Broadcasting and recording (audio and video); television systems, cable and satellite TV.

EEL 4511L COMMUNICATIONS LABORATORY (1)
CR: EEL 4511. Experiments in amplitude modulation, frequency modulation.

EEL 4512C INTRODUCTION TO COMMUNICATION SYSTEMS (3)
PR: EEL 3100. Signals and Fourier transforms in communication systems; measure of information in signals. AM, FM, and PM modulation and demodulation systems. Sampling, quantization and PCM. Data communication; terminals, and modems; repeaters, timing circuits, and interfaces. Local networks.

EEL 4567 ELECTRO-OPTICS (3)
PR: EEL 3301L, EEL 3302L, EEL 3410. An introduction to the field of electro-optics, including visible and infra-red sources and detectors, radiometry, optical and electronic components, and fiber optics.

EEL 4657 LINEAR CONTROL SYSTEMS (3)
PR: EEL 3100. Introduction to analysis and design of linear feedback control systems. Covers block diagram, flow charts. Bode, Nyquist, and root locus techniques.

EEL 4705 LOGIC DESIGN (3)
PR: EGN 3373. Non-majors may enroll with CI. Binary number system; truth functions; Boolean algebra; canonical forms; minimization of combinational logic circuits; logic circuits in computers.

EEL 4705L LOGIC LABORATORY (1)
CR: EEL 4705.

EEL 4743L MICROPROCESSOR LABORATORY (1)
CR: EEL 4744. Laboratory for microprocessor use and evaluation.

EEL 4744 MICROPROCESSOR PRINCIPLES AND APPLICATIONS (3)
PR: EEL 4705 and EEI 4705L. CR: EEL 4743L. Functional Description. Arithmetic and Logic capabilities. Control and Timing. Interrupts and priority systems. Software design and documentation. Distributed function processing.

EEL 4756 SIGNAL AND IMAGE PROCESSING
Sampling and quantization of signals and images; frequency-domain representations, transforms; filtering, convolution, and correlation; raster scanning and interlacing; color images; mast fethods and parallelism; multi-rate processing; information signals.

EEL 4905 INDEPENDENT STUDY (1 - 5)
PR: CI. Specialized independent study determined by the students' needs and interests. May be repeated up to 15 credit hours. (S/U only.)

EEL 4906 INTRO TO ENGINEERING DESIGN (2)
PR: Senior standing. An introduction to engineering design with applications specific to practical engineering problems. Included are discussions of such "real world" considerationa as economics, safety, ethics, and the environment.

EEL 4935, 4936, 4937 SPECIAL ELECTRICAL TOPICS I, II, III (1 - 4 each)

EEL 5250 POWER SYSTEM ANALYSIS (3)
Analysis technique for AC power systems.

EEL 5344C DIGITAL CMOS/VLSI DESIGN (3)
PR: EEL 4705 or CC. Design, layout, simulation, and test of custom digital CMOS/VLSI chips, a CMOS cell library and state-of-the-art CAD tools. Digital CMOS static and dynamic gates, flip flops CMOS array structures commonly used in digital systems. Top down design example of a bit slice processor.

EEL 5356 INTEGRATED CIRCUIT TECHNOLOGY (3)
PR: EEL 4351 or CI. Physics and Chemistry of integrated circuit and discrete device fabrication, materials limitations, processing schemes, failure and yield analysis. A laboratory is integral to the course.

EEL 5357 ANALOG CMOS/VLSI DESIGN (3)
PR: EEL 4305. Design of analog circuits for CMOS/VLSI design. Op Amps, comparators, D to A and A to D converters. Switched capacitor filters. Analog simulation.

EEL 5382 MICROELECTRONICS (3)
PR: EEL 3410. Quantum mechanics with emphasis on electronic properties in atoms, molecules, and crystals; quantum statistics; energy band theory; crystal structures; defect chemistry; semiconductor properties.

EEL 5437 MICROWAVE ENGINEERING (3)
PR: EEL 4411, 4102, or CC. Introduction to passive and active components, devices, and circuits, including transmission lines and waveguides, employed in microwave integrated circuits and systems.

EEL 5462 ANTENNA THEORY (3)
PR: EEL 4411 or CC. Antenna theory beginning with fundamental parameter definitions and continuing with mathematical concepts, elemental antennas and arrays.

EEL 5572 C LOCAL AREA NETWORKS AND INTERFACING (3)
PR: EEL 4512. Network components: Communication terminals. PC's telephone, etc. Basics of LAN's, Tx media topologies, access methods, and LAN characteristics. Interfacing of terminals and PC's to LAN's; NAU's and other interfacing devices; interface selection. LAN design issues, repeaters, timing circuits, gateways.

EEL 5631 DIGITAL CONTROL SYSTEMS (3)
PR: EEL 4657. Sample data and digital control processes

EEL 5754C MICROPROCESSOR BASED DIGITAL SIGNAL PROCESSING (3)
PR: EEL 4705 or CC. Arithmetic systems, processing struc tures, efficient algorithms. DSP hardware, TI, NEC and other DSP microprocessors; multiprocessing hardware and software. System development. Application to telecommunications and voice processing.

EEL 5935, 5936, 5937 SPECIAL ELECTRICAL TOPICS I, II, III (1-3 each)
PR: CC..

ELR 3301L LABORATORY 1 (1)
PR: EGN 3373.

ELR 3302L LABORATORY 2 (1)
PR: ELR 3301L and EEL 3302, CR: EEL 4305.

ELR 4306L LABORATORY 4 (1)
PR: ELR 3301L CR: EEL 4411.

Industrial and Management Systems

EIN 4304C INTRODUCTION TO INDUSTRIAL ENGINEERING (3)
History of industrial engineering. Introduction to basic industrial processes and controls. Students research specific industries and visit local industrial plants.

EIN 4312C WORK ANALYSIS (3)
PR: EGN 3613, EGN 3443; CR: AGC 3074. Operation analysis and workspace design, work measurement, standard data, ergonomics, and labor costing.

EIN 4313C HUMAN FACTORS (3)
Design of man-machine systems, by taking into consideration both human and machine capabilities and limitations.

EIN 4333 PRODUCTION CONTROL (3)
PR: ESI 4312. Planning and control of production systems. Includes: forecasting and inventory control models, scheduling and sequencing, MRP, CPM/PERT, and resource requirements.

EIN 4364C FACILITIES DESIGN I (3)
PR: EIN 4312 EIN 4411. Design and modification of industrial production and material handling facilities. Basic analysis techniques, use of computer programs, automated warehousing.

EIN 4365 FACILITIES DESIGN II -XMW (3)
PR: EIN 4364. CAD/CIEM, complete design of a plant facility. Course to use computers and software geared toward plant design and operation. A team of students is to be responsible for the complete project.

EIN 4411 MANUFACTURING PROCESSES (3)
PR: EGN 3365. The study of basic manufacturing processes and precision assembly. CAD/CAM including NC programming.

EIN 4601L AUTOMATION AND ROBOTICS (3)
PR: EIN 4411. Introduction to the practices and concepts of automation as applied to material handling, inventory storage, material transfer, industrial processes and quality control.

EIN 4933 SPECIAL TOPICS IN INDUSTRIAL ENGINEERING (1-5)
Special topics related to economic analysis, optimization, human factors, manufacturing and automation aspect of industrial systems. Repeatable up to 5 credit hours.

EIN 5245 WORK PHYSIOLOGY AND BIOMECHANICS (3)
PR: CC. Human physiological limitations encountered in the design, analysis and evaluation of man-machine systems.

EIN 5253 HUMAN PROBLEMS IN AUTOMATION (3)
The study and analysis of combined human operations, automated processes, and robotics in industrial environments.

EIN 5301C INDUSTRIAL ENGINEERING CONCEPTS (3)
PR: CC. Survey of industrial and management engineering methodology. Work measurement, methods, production and inventory control, and facility design.

EIN 5322 PRINCIPLES OF ENGINEERING MANAGEMENT (3)
Introduction to the fundamentals of accounting, finance, management, and marketing as needed by engineers, scientists, and other professionals in managerial positions.

EIN 5357 ENGINEERING VALUE ANALYSIS (3)
Statistical models for analyzing engineering alternatives from an economic viewpoint. The use of advanced engineering economy concepts in solving industrial problems.

EIN 5388 TECHNOLOGICAL FORECASTING (3)
Introduction to forecasting techniques used to plan and schedule production and inventory control functions. Smoothing and decomposition time-series methods, regression methods, and autoregressign/moving average methods. Integrating forecasting and planning into the engineering organization.

EIN 5914 SPECIAL INDUSTRIAL PROJECTS (1-3)
PR: CC.

ESI 4221 INDUSTRIAL STATISTICS AND QUALITY CONTROL (3)
PR: EGN 3443. Application of statistical techniques to the control of industrial processes. Control charts, acceptance sampling, design of experiments, analysis of variance and regression.

ESI 4244 DESIGN OF EXPERIMENTS (3)
PR: EGN 3443. Activity forecasting models and control. Design and use of inventory control models, both designs applicable to engineering analyses. Analysis of variance and regression.

ESI 4312 DETERMINISTIC O. R. (3)
PR: EGN 4450. An introduction to operations research techniques with particular emphasis on deterministic models. Linear programming, dynamic programming, goal programming, integer programming, and PERT/CPM networks are considered.

ESI 4313 PROBABILISTIC O. R. (3)
PR: EGN 3443. Probabilistic models in Operations Research. Discrete and continuous time processes, queueing models, inventory models, simulation models, Markovian decision process and decision analysis.

ESI 4161C COMPUTERS IN INDUSTRIAL ENGINEERING (3)
PR: EGN 2210. Use of micro and mini computer systems for industrial engineering applications. Review of available software packages. Use of computers for CAS/CAM system.

ESI 4523 INDUSTRIAL SYSTEMS SIMULATION (3)
PR: ESI 4313. A study of the development and analysis of computer simulation models: Monte Carlo, time-slice, and next-event. Introduction to special purpose simulation languages.

ESI 4905 INDEPENDENT STUDY (1-5)
PR: CI. Specialized independent study determined by the student's needs and interests. May be repeated up to 15 credit hours. (S/U only.)

ESI 4911 SENIOR PROJECT (2)
PR: EIN 4364, CR: EIN 4333, ESI 4523. Analysis and design of systems in a directed project format. Individual or group work consisting of project proposal, project activities, and final report. Student projects are directed by faculty, with chairman's approval.

ESI 5219 STATISTICAL METHODS FOR ENGINEERING MANAGERS (3)
Study of statistical methods applied to engineering management problems involving estimation and prediction under conditions of uncertainty. Not open to students who have had EGN 3443.

ESI 5236 RELIABILITY ENGINEERING (3)
PR: EGN 3443 or equivalent. Fundamental concepts of reliability, estimation of reliability of systems and components. Measures of availability, maintainability and reliability.

ESI 5306 OPERATIONS RESEARCH FOR ENGINEERING MANAGEMENT (3)
Linear programming, non-linear programming, queueing, inventory, network analysis. Not open to students who have had ESI 4315.

ESI 5470 MANUFACTURING SYSTEMS ANALYSIS (3)
PR: CC. The study of systems of manufacturing entities such as machine tools, robots, and materials handlers. Emphasis is on mathematical description of integrated systems and system optimization.

ESI 5522 COMPUTER SIMULATION II (3)
PR: ESI 4523 or equivalent. Design of discrete and continuous simulation models. Model validation and verification. Statistical analysis of simulation model output.

Mechanical Engineering

EAS 4121 HYDRO AND AERODYNAMICS (3)
PR: EML 3701, MAP 2302. Advanced fluid dynamics, ideal and viscous flows, applications to flow around immersed bodies.

EML 3262 KINEMATICS AND DYNAMICS OF MACHINERY (3)
PR: MAC 2282, PHY 2048, EGN 3321. Kinematics of machines and mechanisms; position, velocity, and acceleration analysis of mechanisms; cams; gear trains; inertia forces in mechanisms; flywheels; balancing of rotating masses.

EML 3303 MECHANICAL ENGINEERING LAB I (3)
PR: EML 3500, EML 3701, EML 4041. Engineering laboratory measurements. Use of the library and the writing of technical reports. Experiments in the measurement of temperature, pressure, fluid flow, psychrometrics, concentration, viscosity. Mass-energy balances of simple systems.

EML 3500 MACHINE ANALYSIS AND DESIGN I (3)
PR: EGN 3311, EGN 3365. Stress and deflection analysis of machine parts, variable loads, endurance limits, fasteners, bearings, power transmission, code consideration of pressure and vacuum vessels, elements of design.

EML 3701 FLUID SYSTEMS (3)
PR: EGN 3343; Principles of fluid flow; piping and duct systems; fluid machinery; metering of compressible and incompressible flow; boundary layer theory; dimensional analysis; introduction to aerodynamics.

EML 4041 COMPUTATIONAL METHODS (3)
PR: EGN 2210, EGN 4450. Techniques to solve engineering problems using numerical methods and digital computers. Topics include roots of equations, simultaneous linear equations, numerical integration and differentiation, and curve fitting.

EML 4106C THERMAL SYSTEMS AND ECONOMICS (3)
PR: EGN 3343. Power and refrigeration cycles; fuels and combustion; internal combustion engine cycles; co-generation; nuclear energy; methods of economic analysis.

EML 4142C HEAT TRANSFER I (3)
PR: EML 3701, EML 4041. Conduction, convection and radiant heat transfer; thermal properties of materials; role of fluid flow in convective heat transfer; design and selection of heat exchangers.

EML 4174 VISUAL BASIC FOR ENGINEERS AND SCIENTISTS (3)
PR: EGN 2210. Introduces students to the powerful graphical interface language of Visual Basic. Illustrates the use of the language in engineering and science applications.

EML 4220C VIBRATIONS (3)
PR: EML 3433 and EML 3262. Natural frequency, damping and resonance in single-degree-of-freedom systems. Vibration isolation and absorbtion. Lagrange's equations. Multi-degree of freedom systems. Introduction to vibration of continuous systems and predictive maintenance.

EML 4302 MECHANICAL ENGINEERING LABORATORY II (3)
PR: EML 3303, EML 4142. Continuation of EML 3303 with emphasis on material and energy balances, stress analysis and vibrations. Lec.-lab. The Team-Project-Time Approach.

EML 4312 MECHANICAL CONTROLS (3)
PR: EGN 3433, EML 4041. Introduces the concept of dynamic systems. Modeling of dynamic systems. Laplace Transforms. Transfer Functions. Block Diagrams. Characteristic equation. Time response of first and second order systems. Stability of dynamic systems. Routh stability criterion. Frequency response of dynamic systems. Polar plots and Bode plots. Introduction to state space model.

EML 4419C PROPULSION I (3)
PR: EML 3701, EML 3500 or CI. Introduction to the design of propulsion systems. Basic analysis of internal combustion, jet and rocket engines. Application to ground and air transportation. Advanced propulsion concepts. Special topics for class discussion.

EML 4501 MACHINE DESIGN (3)
PR: EML 3500, EML 3262. Continuation of EML 3500. Antifriction bearings, journal bearings, power transmission, shafting.

EML 4551 CAPSTONE DESIGN -XMW (3)
PR: EML 4501. Comprehensive design or feasibility project requiring application of previously acquired engineering knowledge; use of ANSYS and CAD.

EML 4552 SENIOR MECHANICAL DESIGN (3)
PR: EML 4551 or CC. Comprehensive design or feasibility study project. In some cases may be a continuation of EML 4551.

EML 4562 INTRODUCTION TO COMPOSITE MATERIALS (3)
introduces manufacturing types and applications of advanced composites. Students study micromechanical and macromechanical behavior of a lamina and analyze and design a laminated structure made of advanced composite materials.

EML 4601 AIR CONDITIONING DESIGN (3)
PR: EML 4106, EML 3701. Application of thermodynamics, heat transfer, and fluid flow to sizing of HVAC systems. Heating and cooling calculations, air requirements, equipment sizing. Energy Code requirements. Design project.

EML 4905 INDEPENDENT STUDY (1-4)
PR: CI. Specialized independent study determined by the student's needs and interests. May be repeated up to 15 credit hours.

EML 4930 SPECIAL TOPICS IN MECHANICAL ENGR. (1-4)
PR: CC. May be repeated up to 9 credit hours.

EML 5105 INTERNAL COMBUSTION ENGINES (3)
PR: EML 4106C or CI. Application of thermodynamics, chemistry, dynamics of machinery, electronics, and fluid mechanics. Topics covered are: introduction of engines, fuels and combustion, numerical modeling, ignition, fuel systems, balance of reciprocating mechanisms, and emission control of exhaust pollutants.

EML 5225 ACOUSTICS AND NOISE CONTROL (2)
Fundamentals of Sound Propagation; Sound Power and Intensity. Psychoacoustics; Industrial Noise sources and Methods of Attenuation; Instrumentation for Noise Measurements.

EML 5245 TRIBOLOGY (3)
PR: EML 4501. An introduction to friction, lubrication, and wear. Contact of real surfaces, mechancis of friction, surface failures, boundary lubrication fluid properties, thin film lubrication, thick film lubrication, bearing and lubricant selection.

EML 5325 MECHANICAL MANUFACTURING PROCESSES (3)
PR: CI. Description of mechanical material cutting, forming and fabrication methods, as used in modern industrial manufacturing processes.

EML 5395 MOTOR SELECTION AND CONTROL (3)
PR: EGN 3373, EGN 3433. Standard electrical voltages; power wiring in industrial plants; NEMA motor designs, techniques for estimating motor starting times and temperature rise; motor selection; starting and operating safety interlocks; conventional motor starting and control systems; direct digital (programmable) controls; electrical code requirements for conductors and protective devices.

EML 5930 SPECIAL TOPICS III (1-4)
PR: CC. May be repeated up to 9 credit hours.

EML 5931 SPECIAL TOPICS IV (1-4)
PR: CC. May be repeated up to 9 credit hours.