ENGINEERING, COLLEGE OF

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Undergraduate Extension Programs

Antelope Valley Engineering Program: Kenneth W. Santarelli, Director (661)723-6429 ext. 104

Introduction

The Mission of the College of Engineering is to serve the State of California, the nation, and society at large, by graduating well-prepared professionals, who are provided with excellent education and training in the fundamentals of their discipline through a combination of theory and laboratory practice, and who are provided with the ability and skills to expand knowledge and transform complex ideas into working systems.

The College of Engineering offers four-year curricula leading to Bachelor of Science degrees in the disciplines of Engineering, Computer Science, and Engineering Technology. The B.S. programs provide broad education and training for entry to the professions and for continuing academic work toward advanced degrees. The graduate programs in the college include Master of Science degrees in Aerospace, Civil, Computer, Electrical and Mechanical Engineering, and in Computer Science. The Master of Science in Engineering is also offered in interdisciplinary areas. The Ph.D. in Engineering and Industrial Applied Mathematics is offered jointly with The Claremont Graduate University. These programs provide opportunities to specialize in the areas of Aerospace, Biomedical, Chemical, Civil, Computer, Electrical and Construction Management.

The College of Engineering also offers undergraduate programs in electrical engineering and mechanical engineering as extension programs at Lancaster University Center, Lancaster, CA as part of the Antelope Valley Engineering Program. These special programs, offered through the College of Continuing and Professional Education (CCPE), have specific admission requirements and accept upper division transfer students only. The extension program employs a cohort-based model, expecting students to proceed as a group through the program in a prescribed sequence and placing greater emphasis on teamwork.

ABET Accreditation

The Bachelor of Science programs in Aerospace, Chemical, Civil, Computer, Electrical and Mechanical Engineering are accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

The Bachelor of Science in Computer Science is accredited by the Computing Accreditation Commission of ABET, http://www.abet.org.

The Electrical Engineering Extension Program and the Mechanical Engineering Extension Program, offered at Lancaster University Center, Lancaster, CA, are undergoing accreditation review in 2014-2015.

ACCE Accreditation

The Bachelor of Science in Construction Engineering Management is accredited by the American Council for Construction Education (ACCE), website: http://www.acce-hq.org/.

Programs at a Glance

The following is a list of degree programs offered by the college. Details about each program is described in the respective sections of the catalog.

Bachelor of Science:
- Aerospace Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Computer Engineering Technology
- Computer Science
- Construction Engineering Management
- Electrical Engineering
- Electrical Engineering - Undergraduate Extension
- Electronics Engineering Technology
- Engineering
  - Option in Biomedical and Clinical Engineering
- Mechanical Engineering
- Mechanical Engineering - Undergraduate Extension

Minors:
- Computer Science
- Computer Science Applications
- Environmental Engineering
- Web Technologies and Applications

Master of Science:
- Aerospace Engineering

Civil Engineering
Computer Science
Option in Computer Engineering
Option in Computer Science
Electrical Engineering
Engineering (Interdisciplinary)
Mechanical Engineering
Ph.D. in Engineering and Industrial Applied Mathematics
(jointly with The Claremont Graduate University)
Certificates:
Web Technologies and Applications (CECS)

Academic Standards

Preparation for Admission

High school students planning to enter engineering, engineering technology, or computer science are advised to pursue a program with courses in biology, physics, chemistry, advanced algebra, and trigonometry. The general requirements for admission to the University must be satisfied. Deficiencies in any of these areas may result in an extension of the time required to complete the program. Full-time students can complete any baccalaureate degree in engineering, engineering technology, or computer science in four years.

The curricula are also designed to accommodate students transferring from other colleges or universities. Transfer students should note and follow, where possible, the appropriate curriculum as outlined on the University Admissions website.

Most required courses are offered in multiple sections every semester. In addition, many required courses are also offered during Summer Sessions.

General Academic Requirements

The College of Engineering values good communication skills which are achieved through the General Education courses and are measured by the Graduation Writing Assessment Requirement (GWAR). A student must fulfill the GWAR before qualifying for any degree. Students are advised that, while specific course requirements vary depending on the nature of the subject, most College of Engineering courses require not only detailed analysis, and competent design, but also clear and concise written and oral reports and presentations. ENGL 100 or equivalent is a prerequisite to upper division laboratory courses.

Letter Grade Policy

A grade of "C" or better must be achieved in prerequisites for courses required of Engineering, Computer Science, and Engineering Technology majors.

Required Foundation courses must be taken for a Letter grade only, not Credit/No Credit.

Concurrent and/or Summer Enrollment in Another College

Students who wish to take coursework in a community college or another college or university to meet curricular requirements while enrolled as an undergraduate in the College of Engineering must petition the appropriate department for prior approval to enroll in specific courses. This policy is for either concurrent enrollment or summer enrollment. University policy must also be complied with; see "Concurrent Enrollment" and "Transfer of Undergraduate Credit" in this *Catalog*. Courses not receiving prior approval may not be accepted for credit by the department.

The Engineering Student Success Center (ESSC)

Coordinator of Academic Advising
Jason Deutschman (562) 985-2729

Director of Professional Development & Internship
Emmitt Clark (562) 985-1719

Director of Outreach and Recruitment
Saba Yohannes-Reda (562) 985-1463

The Engineering Student Success Center provides key services to students in an inclusive environment that fosters collaboration, community building and academic success skills. The center provides outreach and recruitment activities, first-year experience programs for freshmen and incoming transfer students, mandatory academic advising by professional and peer advisors, tutoring resources, professional development and practice services, and career and graduate school guidance. As a one-stop shop, the center encourages students to visit for help from professional advising staff. The center focuses its full efforts on informing, engaging and encouraging students to be self-directed in their educational planning process and overall academic success.

Undergraduate Programs

Minor in Environmental Engineering

This 18-unit interdisciplinary minor is designed for undergraduates from various engineering and science backgrounds who are interested in applying engineering approaches to environmental issues.

Requirements

A minimum of 6 units selected from the following core:

Take one of the following courses:

C E 364 Environmental Engineering I: Fundamentals (3)
Prerequisites: CHEM 111A, BIOL 200/BIOL 201 or MICR 200 with a grade of "C" or better,
Prerequisite/Corequisite: CE 335.

CH E 475 Environmental Pollution (3)
Prerequisite: CHEM 220A or CHEM 227 with a grade of "C" or better, or consent of instructor.

Take the following course:

CH E 455 Environmental Compliance (3)
Prerequisite: CHEM 227 with a grade of "C" or better or consent of instructor.

Take 12 units from the following:

CH E 415, CH E 445, CH E 485; C E 466; E T 409F

Most of the courses in the minor require some background in engineering and/or chemistry. Upper division students majoring in Biology, Chemistry, Chemical Engineering, Civil Engineering, or Mechanical Engineering may have sufficient background to select from the above choices without needing additional prerequisites. Those majoring in other branches of science and engineering may need several additional courses in engineering and/or chemistry to meet prerequisite requirements of courses in this minor.

All prerequisites to the courses in the minor must be completed with a grade of "C" or better.

Graduate Programs

Master of Science in Engineering

Program Director: Antonella Sciortino

Typical tasks and responsibilities undertaken by students in the curriculum for this program would not fall within one of the traditional specialties in engineering, e.g. aerospace, chemical, civil, electrical and mechanical engineering, or computer science and engineering. The student may pursue an interdisciplinary program, approved by a graduate advisor, by selecting courses from the various departments of engineering. For information concerning the programs, special facilities, laboratories and research possibilities, contact the College of Engineering.

Prerequisites

1. A bachelor's degree in an ABET accredited curriculum in engineering with a minimum GPA of 2.7; or
2. A bachelor's degree with a minimum GPA of 2.7 in engineering, mathematics, natural science or other discipline with the requirement that essential undergraduate prerequisites in engineering are satisfied.
3. The general Graduate Record Examination (GRE) is required.
4. Graduate students must consult with a graduate advisor, with whom they will be working, for information concerning procedures and requirements for appropriate approval of their courses of study prior to enrolling in their graduate programs.
5. The Graduation Writing Assessment Requirement (GWAR) must be met during the first semester in residence. Failure to attempt to fulfill the GWAR during the first semester will prevent registration in engineering courses in subsequent semesters.

Requirements

PLAN I

Completion of a minimum of 30 units beyond the bachelor's degree in graduate and 400-level courses approved by the student's Department Graduate Advisor, including:

1. Eighteen units of 500- and/or 600-level courses in engineering;
2. Six units of electives selected from approved graduate or 400-level courses from appropriate areas;
3. Completion of six units of 698-Thesis and submission of a written thesis.

PLAN II

Completion of a minimum of 30 units beyond the bachelor's degree in graduate and 400-level courses approved by the student's Department Graduate Advisor, including:

1. Twenty-four units of 500- and/or 600-level courses in engineering;
2. Six units of electives selected from approved graduate or 400-level courses from approved areas;
3. Completion of a comprehensive written exam. Note: Students are strongly advised to read and be familiar with the campus regulations described under "Graduate Programs" elsewhere in this catalog.

Advancement to Candidacy

Students applying for advancement to candidacy must have:

1. completed all undergraduate deficiencies with grades of "C" or better;
2. attained an overall grade point average (GPA) of 3.0;
3. completed at least 12 units applicable to the degree with a GPA of at least 3.0;
4. fulfilled the Graduation Writing Assessment Requirement (GWAR). This requirement can also be met by presenting evidence that the student met the requirement while an undergraduate at CSULB or at certain CSU campuses;
5. program of studies approved by the program's graduate advisor.

Ph.D. in Engineering and Industrial Applied Mathematics

Program Director: Hamid Rahai

Degree Designation

In accordance with an agreement between CGU and CSULB, the degree is designated the Doctorate of Philosophy in Engineering and Industrial Applied Mathematics and is granted at Claremont Graduate University in the name of the two universities. The diploma indicates the dual nature of the degree and specifies that it is granted only when requirements have been satisfied in both subject areas as specified by the collaborating institutions.

Program Supervision

Overall program supervision is the responsibility of the Program Committee, consisting of the directors of the Joint Doctoral Program (JDP) from each institution, the Dean of Mathematics at CGU, and the Dean of Engineering at CSULB.

Admission Requirements

Students must be admitted to both institutions jointly. Admission will be granted to a limited number of qualified students; therefore, application should be made as early as possible. Applications are encouraged from both men and women, particularly from members of minority groups or individuals with disabilities. Completed applications must be received by April 15 for the fall semester or October 1 for the spring semester, although late applications are allowed at the discretion of the Program Committee. The Program Committee is responsible for making admission decisions consistent with campus regulations (see Application Procedure in this booklet).

To be admitted to the Joint Doctoral Program, an applicant must have received a bachelor’s or master’s degree in science, engineering, or mathematics from an accredited institution. Moreover, he or she must have attained scholastic records and present confidential recommendations which indicate that he or she is well qualified to pursue, with distinction, advanced study and research. Be advised that admission may be refused solely on the basis of limited facilities in the option desired.

GRE Requirement

The analytical, verbal, and quantitative portion of the Graduate Record Examination (GRE) is required before admission. GRE subject examinations (mathematics and engineering) are not required. Applicants whose first or native language is not English are required to have a current minimum score of 550 (80 iBT on the new scale) on the Test of English as a Foreign Language (TOEFL); however, this requirement is waived for students with a bachelor's or master's degree from an accredited U. S. university.

Registration and Enrollment

It is important that students register and enroll in classes each semester at either CGU or CSULB. Failure to enroll at any given semester will be considered leave without permission (discontinued enrollment) and the student will be dropped from the program.

Program Planning and Supervision

At CSULB, an initial engineering advisor is assigned to the student at the time of admission. At CGU, the student needs to arrange with the program director, within the first semester of study, for a mathematics advisor. The student's program of study is arranged individually in collaboration with their advisors; the two advisors confer periodically regarding the student's progress. The Program Committee monitors the student's overall performance.

Course Work and Examinations

A minimum 72 units of course work, independent study, and research (including transfer credit) must be completed. Transfer credit of up to 24 units of related courses at the master's level is permissible on approval of the Program Committee; this course work must have been completed with at least a grade of "B" or above, at an accredited institution, and must be directly related to the joint program and the student's goals. Of the 72 units, a minimum of 24 units must be completed in the graduate engineering program at CSULB and a minimum of 24 units in the graduate mathematics program at CGU. Both sets of 24 units must conform to the area requirements of the relevant institution and must be approved by the Program Committee. All degree requirements must be completed within seven years (or six with the transfer of 24 units according to CGU regulations) from the time a student begins graduate study.

Every doctoral student must maintain a cumulative grade-point average (GPA) of 3.0 and a grade-point average of 3.0 in all courses applicable to the degree. Furthermore, students must earn at least a grade of "B" or above in any course that is counted towards the course work requirement. Students are put on academic probation if they fail to maintain a cumulative or term GPA of at least 3.0 in all units attempted subsequent to admission to the degree program. After two consecutive semesters on probation, students are subject to disqualification if they fail to earn sufficient grade points to be removed from the probationary status.

CSULB Minimum Course Requirement

The following four courses (15 units) are required at CSULB to meet the 24-unit course requirement:

ENGR 790: Advanced Special Topics in Engineering (3)
ENGR 795: Advanced Directed Studies (4)
ENGR 796: Doctoral Seminar (4)
ENGR 798: Doctoral Dissertation (4)

The remaining 9 units of course work for students who have received transfer credit, may include courses needed for the Preliminary Examinations (see the Preliminary Examination section of the handbook.)

Minimum Student Load Per Semester

It is highly recommended that doctoral students enroll in at least 9.0 units per semester in order to demonstrate progress towards the degree. The CSULB director of the program, in consultation with the doctoral advisor, may require that a student take at least 9.0 units per semester if the student is not showing adequate progress.

These courses may include the following:

ENGR 797A: Preparation for Ph.D. Preliminary Examinations
ENGR 797B: Preparation for Ph.D. Qualifying Examination
ENGR 797C: Research for Ph.D. Dissertation

Students may take from 4.0 to 12.0 units of ENGR 797A, ENGR 797B or ENGR 797C each semester, though these courses may not be used to fulfill the 72-unit course work. These courses are offered on Credit/No Credit bases and are designed to formally recognize the students' efforts towards the program.

Residency Requirements

Doctoral students must complete their program within a period of seven years (or six with the transfer of 24 units) according to CGU regulations (see below). During this time, a minimum of 72 units of course work, independent study, and research (including transfer credit) must be completed. Normally no more than 16 units per semester may be credited toward the degree. No more than 12 units per summer session may be credited toward the degree. The transfer of credit form is available on the CGU website. The Program Committee will consider petitions for extensions and/or exemptions.

All degree requirements must be completed within seven years from the time a student begins graduate study. Work for which transfer credit is granted will be counted as part of the seven years, e.g., if transfer credit of 24 units (one year) is granted, the time limit will be six years.

The residency requirements for the Ph.D. may be met either by two semesters of full-time study in a 24-month period or by the completion of 48 units of course work within a 48-month period (including work in the summer session). There are special provisions for students transferring units as described below.

Students who receive transfer credit for 12 units or less may meet the residency requirement either by completing two full-time semesters of course work within a 24-month period or by completing 36 units within a 48-month period. Those receiving transfer credit for 13 to 24 units may meet the residency requirement by completing 24 units within a 36-month period. The seven-year maximum time period for the Ph.D. degree is reduced by six months for 12 units or less of transfer credit and by 12 months for 13 to 24 units of transfer credit.

Plan of Study

After consultation with their advisors, students are required, before the end of the second semester, to prepare and file with the Program Committee a Plan of Study for completing the course requirements for the degree. The purpose of the Plan of Study is to ensure that the student is aware of the requirements for the degree. The Plan of Study should indicate the areas of study that the student will be taking in preparation for the preliminary examinations. In consultation with the student's advisor and Program Committee, the Plan of Study may be altered at a subsequent time by petition.

If a student withdraws from the program after completing a substantial portion of the course work, a master's degree at either or both institutions is still possible by satisfaction of the appropriate requirements. Both CGU and CSULB require 30-36 semester units of course work for master's degrees.

Preliminary Examinations

The student is required to pass written preliminary examinations. These examinations consist of four examination areas: two in engineering and two in mathematics. These examinations are usually taken after completion of the relevant course work at each institution. These examinations are given two or three times a year at the discretion and under the control of the Program Committee. Should a student fail an examination, they may petition the Program Committee for one retake.

Before taking the first preliminary examination, the student is required to complete the Preliminary Examination Permission Form (available at the CSULB website, www.csulb.edu/colleges/coe, or at the CGU site, www.cgu.edu/math). This form requires the student to specify the four areas of the Preliminary Examination; the student's intended dissertation advisor and the directors of the Joint Doctoral Program must sign it. The purpose of this form is to certify that the student and dissertation advisor are in agreement on the set of examinations. If, in the course of time, this set of examinations and/or the advisor is amended, the form must be resubmitted. The preliminary examinations are considered completed when the four examinations specified on the student's form have been successfully passed. You must be enrolled at CSULB (e.g., enrolling in at least 4.0 units of 797A) in order to take the CSULB portion of the Preliminary Examinations. For a list of courses, please review the student handbook at our web site www.csulb.edu/coe/phd

Research Tool

Students in the Joint Doctoral Program must demonstrate proficiency in problem-solving ability using computer programs. This demonstration may take different forms depending on the student's engineering sub-discipline, but must include evidence that the student has used an appropriate computer language and an algorithmic method to solve a problem from an engineering discipline.

Research and Dissertation

Upon completion of at least 48 units of course work (including transfer units), the preliminary examinations, and the research tool requirement, a student embarks on the research phase of the Joint Doctoral Program. In preparation for the research phase, the student is expected to spend at least a semester in advanced graduate courses, seminars, or directed reading courses where exposure to research material is emphasized. From these and other sources, the student gains the ability to understand the motivation for research in engineering and applied mathematics and learns to apply research techniques.

Doctoral Committee

During entry to the program and through the period of the main body of course work at CGU and CSULB, the Program Committee will monitor the student's progress. Upon successful completion of the preliminary examinations, the student petitions the Program Committee to constitute the Doctoral Committee. The student chooses this committee with advice from the faculty advisor and with approval of the Program Committee. The committee must include at least two faculty members each from CGU and CSULB; it must also provide breadth and depth in mathematics and engineering in the chosen faculty members. The Doctoral Committee supervises the student's progress through research preparation and dissertation writing; it also administers the qualifying and oral examinations for the degree. The chair of the Doctoral Committee is the dissertation supervisor.

Research Proposal and Qualifying Examination

With these advanced courses as background, and with the guidance of the Doctoral Committee, the student defines an area of proposed research and prepares a written Dissertation Proposal containing an outline of the research to be undertaken and references to relevant source materials. The Dissertation Proposal is presented to the Doctoral Committee at least two weeks prior to the Qualifying Examination. The appropriate form under "Doctoral Degree Forms" can be obtained from the CGU website www.cgu.edu (under Current Students, Registrar Information). The Qualifying Examination is an oral presentation to the Doctoral Committee describing the planned research. The student is expected to present evidence both as to the mathematical content and to the engineering application of the proposed research, supporting such evidence with references to previous research in both areas. The Doctoral Committee judges the fitness and quality of the Dissertation Proposal from this presentation and from the written proposal. It subsequently communicates its recommendations to the Program Committee. Only upon a positive recommendation may the student embark on a dissertation. In the event of failure, the qualifying examination may be retaken once after petition to the Program Committee.

Advancement to Candidacy

After successful completion of the Qualifying Examination and certification that all other requirements are fulfilled, the student is advanced to candidacy. The appropriate form under "Doctoral Degree Forms" may be obtained from the CGU website. This must occur at least six months before the Final Oral Defense.

Dissertation and Final Oral Examination

Upon completion of the research, the student will prepare the dissertation in accordance with CGU regulations. A final draft of the dissertation will be presented to each member of the Doctoral Committee at least three weeks prior to the final oral examination. The appropriate form under "Doctoral Degree Forms," along with an abstract of the dissertation, must be filed with CGU's Office of Admission and Records three weeks before the exam. This deadline is very strict and no exceptions will be made. Please see the CGU website under "Academic Calendar" for the final defense scheduling dates. The oral defense will normally be held on the campus of the dissertation supervisor.

Policies and Procedures

1. Throughout their entire program of study, unit-taking students must be registered at either CGU or CSULB. Students, who intend not to take course work at either institution, including those who have finished their required units, must take the necessary steps to maintain continuous enrollment. This is achieved by registering for Math 499 (Doctoral Study) at Claremont Graduate University or by registering for Engineering 798 (Doctoral Dissertation) at California State University, Long Beach. At least two semesters of registration for Math 499 at CGU must be maintained during the last year prior to graduation. In order for the degree to be conferred, a student must meet all regulations as stated in the CGU Bulletin under "Degree Regulations."

Requests for leave of absence must be submitted to each registrar's office and approved by both institutions according to the standards of each; upon approval of leave the student should advise the math office at CGU and the office of the Joint Doctoral Program at CSULB. Students should contact each registrar's office for leave of absence policies. If the student fails to advise the registrar at CGU of his/her leave granted by CSULB, he/she will be dropped from the program (CGU has no official arrangement for leaves). Upon return, the student will be required to pay CGU a reinstatement fee in addition to regular semester tuition.

2. International students registered for units at CSULB must provide the CGU International Student Advisor, Marianna Panossi, with proof of registration within two weeks of the beginning of the semester at CGU. Proof of full-time registration (8 units minimum) is required to maintain immigration status. (In the circumstance of completion of units, registration in Doctoral Study, CGU Math 499, is required.)
3. Students should arrange for advisors, one in math at CGU and one in engineering at CSULB, at the earliest opportunity. The program committee will help provide advisors.
4. After consultation with their advisors, students must submit a plan of study, including a petition for transfer of credits, if applicable, during their first year of study. The Plan of Study must be approved and transfer of units recommended to the Registrar by the program committee.

Procedures for Student Admission

1. Students must complete application forms for both CGU and CSULB. The completed application package must include official transcripts, three letters of reference (preferably on the forms supplied in the CGU package), a personal statement and a resume. Current, official GRE scores are required. Scores may not be older than 5 years.
2. The completed application package (including a separate Long Beach fee and application) must be submitted to the CGU Admissions Office, 160 East Tenth Street, Claremont, CA 91711-6163. Do not send application materials to CSULB as this will result in considerable delay. Both application fees are required
3. Online applications are acceptable for the Joint Program; however, consult the Program Advisors at CGU and CSULB for appropriate procedures.
4. The CGU director of the CSULB/CGU Joint Doctoral Program, Marina Chugunova, reviews completed files. In the event of a negative review, a rejection letter is issued by CGU. In the event of a positive review, the application, along with a copy of the completed file, is forwarded to the CSULB director of the CSULB/CGU Joint Doctoral Program, Dr. Antonella Sciortino.
5. Results of the Long Beach review are transmitted back to CGU Math. Upon a positive review by CSULB, the application and fee are sent to the CSULB Admissions Office to be processed. A negative review initiates a rejection letter from CGU.
6. Upon admission to the program, CGU will generate two admission letters; one is mailed to the student and one is sent to CSULB. This letter includes a decision card and specifies a required $200 tuition deposit that should be submitted to CGU if the student chooses to accept the offer of admission.
7. Students admitted to provisional status must provide the materials needed to complete their files before the end of their first semester of enrollment. Official scores for the GRE General Test are required of all students before admission to full graduate standing. The joint faculty program committee will review completed files for change of status.
8. The academic progress of students admitted to conditional status will be reviewed by the program committee prior to a decision about change of status.

Courses (BME)

100. Introduction to Biomedical Engineering (1)

Prerequisite: None

Introduction to major topics and concepts in Biomedical Engineering. Current and future trends and challenges in various subfields of Biomedical Engineering. Social, ethical and economical issues related to biomedical technology. Exploration of career and professional development opportunities.

Letter grade only (A-F). May be repeated to a maximum of 2 units in different semesters. (Lecture 1 hour)

201. Programming for Biomedical Engineering (3)

Prerequisite: MATH 122

Introduction to the constructs in the MATLAB programming language. Array and matrix operations, functions and function handles, control flow, plotting and image manipulation, cell arrays and structures, and various related toolboxes. Programming projects/examples will emphasize Biomedical Engineering applications.

Letter grade only (A-F). May be repeated to a maximum of 6 units in different semesters. (Lecture 2 hours, Laboratory 3 hours)

Courses (ENGR)

LOWER DIVISION

100. Fundamentals of Engineering Analysis (4)

Prerequisites: Appropriate ELM score, ELM exemption, or MAPB11.

Use of an application-oriented, hands-on approach to math topics in a variety of core engineering courses; analysis of experimental data; applications of MATLAB in solving engineering problems.

Letter grading only (A-F). (Lecture 3 hours , Laboratory 3 hours)

101. Introduction to the Engineering Profession (1)

Prerequisite: Freshman standing or consent of instructor.

Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122

Freshman orientation seminar on careers in engineering. Speakers from various fields illustrate opportunities and challenges in the engineering profession.

(Lecture-problems 1 hour) Letter grade only (A-F). Same course as ENGR 101H. Not open for credit to students with credit in ENGR 101H.

101H. Introduction to the Engineering Profession (1)

Prerequisite: Freshman standing or consent of instructor.

Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122

Freshman orientation seminar on careers in engineering. Speakers from various fields illustrate opportunities and challenges in the engineering profession.

Letter grade only (A-F). Same course as ENGR 101. Open to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in ENGR 101. (Lecture-problems 1 hour)

102. Academic Success Skills (1)

Prerequisite: ENGR 101 with a grade of "C" or better.

Development of skills and identification of strengths and weaknesses for success in a COE major.

(Lecture 1 hour). Letter grade only (A-F). Same course as ENGR 102H. Not open for credit to students with credit in ENGR 102H.

102H. Academic Success Skills (1)

Prerequisite: ENGR 101 with a grade of "C" or better.

Development of skills and identification of strengths and weaknesses for success in a COE major.

Letter grade only (A-F). Same course as ENGR 102. Open to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in ENGR 102. (Lecture 1 hour).

123. Inventions and Innovations: Good, Bad, and Weird (3)

Use of language, thought, and logic in science, distinguishing scientific fact from science fiction. Critical review of technological achievements from ancient times to the present, from practical inventions to perpetual motion machines. Science, pseudoscience, and paranormal. Experimentation and witchcraft.

(Lecture-Problems 3 hours)

130. Health, Energy, Environment, Transportation (HEET) (3)

Prerequisites: Completion of high school classes in geometry, algebra, chemistry, and environmental sciences.

Introductory course in healthy environment requirements, renewable energy, elements green design, transport systems and management, economics, environmental impacts of transportation. Hybrid, module-based class, with simulations, interact exercises, design projects and assessments renewable energy, green design, water resources, and air quality.

Letter grade only (A-F). (Lecture 3 hours)

170. Introduction to Solid Modeling and Engineering Graphics (2)

Prerequisites: Knowledge of geometry and intermediate algebra.

Introduction to part modeling, solid models, detail drawings with dimensioning and assembly modeling using SolidWorks software. Focuses on project-based learning, which organizes learning around complete projects.

Letter grade only (A-F). (Lecture-problems 1 hour, Lab 2 hours)

200H. Introduction to Engineering Honors Program (1)

Prerequisites: ENGR101 and ENGR 102.

Engineering honors program organization and procedures. Introduction to professional societies, technical communication, team-building, networking, and other engineering career-advancing skills. Participating in community engagement activities.

Credit/No Credit grading only.

203. Engineering Problems and Analysis (3)

Prerequisite: MATH 122 with a grade of "C" or better; Corequisite: ENGR 203L.

Formulation of engineering problems and methods for their analysis. Application of vectors, matrices, derivatives and intregration into engineering problems. Computer aided analysis using MATLAB, MathCad, etc.

(Lecture - Problems hours) Letter grade only (A-F).

203L. Engineering Problems and Analysis Laboratory (1)

Prerequisite: MATH 122 with a grade of "C" or better; Corequisite: ENGR 203.

Computer-based exercises on fundamental concepts such as vectors, matrices, derivatives, integrals. Practical engineering problems are assigned and solved using MATLAB.

(Laboratory 3 hours) Letter grade only (A-F).

296. Introduction to Biomedical Research Methods (3)

Prerequisites: GE foundation requirements and consent of instructor.

Introduction to principles and ethics of experimentation, hypothesis formulation, and testing. Data measurement, analysis and presentation. Students will learn how to find and read scientific literature, keep a laboratory notebook and basic data graphing and analysis skills.

Not open for credit to students with credit in NSCI 296.

Letter grade only (A-F). Same course as: NSCI 296. (Lecture 3 hours)

UPPER DIVISION

300H. Introduction to Engineering Honors Research (1)

Prerequisites: ENGR200H, Junior standing.

Introduction to engineering research for honors students, including proposal writing, literature reviews, formal research methods and publication of results. Introduction to departmental honors program advisors and exposure to active areas of research in the college.

Credit/No Credit grading only.

302. Energy and Environment: A Global Perspective (3)

Prerequisites: G.E. Foundation requirements, one or more Exploration courses, and upper-division standing.

Renewable/nonrenewable energy sources, including fossil fuels, nuclear, solar, wind, wave, geothermal, hydroelectric and biomass. Available resources, market, trends, and technology. Energy conservation, balance, alternatives, social, cultural, and political impacts. Ecosystem, human-induced climate changes. Environment and power generation, pollution, ozone depletion. Recycling.

(Lecture-Problem 3 hours) Letter grade only (A-F).

310. Business Communications in Engineering Profession (3)

Prerequisites: ENGL 100 or GE Composition (Area A1), COMM 110 all with a grade of "C" or better.

Basic concepts for understanding/practice of communication in world of business for managers and professionals. Language/conversations in business and role in coordinating actions, resolving breakdowns in work and customer satisfaction. Business writing formats, formal report, business conversation. International, technical, and linguistic developments in business communication.

Credit/No Credit grading only. (Lecture-Problem 3 hours) May be used to satisfy the GWAR. Students who have failed the WPE at least once can take the course and submit a portfolio at the end for GWAR credit that will be issued if the student passes the portfolio that is reviewed by a committee.

340. Guitar Electronics: Engineering Sound (3)

Prerequisites: Upper division standing, GE Foundation requirements, one course from G.E. category Blb.

Historical review of electro-magnetic principles and their application to the reproduction, modification, and creation of sound. The electric guitar, its amplifiers, and special effects devices (analog and digital) will be used to gain practical experience. Electrical safety, physiology and physics of the ear.

Not open for credit to students with credit in EE 333. (Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

350. Computers, Ethics and Society (3)

Prerequisites: 3 units from GE Category A.1 (Writing) and 3 units from GE Category D (Social and Behavioral Science).

Examination of the social impact of information technologies. Topics include a survey of the technology (software, hardware and key applications), ethical obligations of specialists, the computer in the workplace, shifts of power, privacy, and legal issues related to computing.

(Lecture-problems 3 hrs)

360. Robotic Technology in Health Care (3)

Explores various robotic innovations developed for biomedical applications and their global impact on the quality of patient care, economy, and policy through new methods and tools for diagnosis and treatment, clinical training, education, and rehabilitation.

Letter grade only (A-F). (Lecture-Problems 3 hours)

361. Scientific Research Communication (3)

Prerequisite: G.E. foundation courses; score of 11 or higher on the GWAR Placement Examination or successfully completed the necessary portfolio course that is a prerequisite for a GWAR Writing Intensive Capstone.

Introduction to technical writing for students pursuing research careers. Accessing and using research literature. Writing technical and research reports for various purposes and audiences. Oral presentation of research and scientific information. Includes intensive writing.

Letter grade only (A-F). Same course as HHS 361, CLA 361, and NSCI 361. Not open for credit to students with credit in HHS 361, CLA 361, or NSCI 361.(Lecture 3 hours)

370. Astronautics and Space (3)

Prerequisites: GE Foundation requirements, one or more Exploration courses, and upper-division standing.

Combines the disciplines of space engineering with economics, human physiology, satellite meteorology, earth resources and environmental science, astronautics and space exploration. Emphasis on oral and written communications, numeracy and use of computers. Extensive use of computer animation, videographics and the Internet.

(Lecture–problems 3 hours) Letter grade only (A-F).

392. Water: People, Politics, and Processes (3)

Prerequisite: GE Foundation requirements.

Explores the impact of water resources management on society, economy, and governance through socio-political and hydrological overviews as well as both domestic and international case studies.

Letter grade only (A-F). Same course as I/ST 350. Not open for credit to students with credit in I/ST 350. (Lecture-Problems 3 hours.)

432. Logistics Systems Engineering (3)

Prerequisite: Consent of instructor.

Logistics concepts, methods and techniques for engineering. Logistics from a historical perspective, the economic impact of logistics, the engineering tool chest, and logistics as an integrating function. Logistics systems requirements and design; transportation and distribution, inventory analysis and operational support.

(Lecture-problems 3 hours) Letter grade only (A-F).

492B. Internship In Engineering (3)

Prerequisites: Major in the College of Engineering, completion of 9 units of upper division COE coursework, a 2.5 GPA overall or 2.75 GPA in the student's major, and consent of instructor prior to registration.

Qualifying students must provide contact information for the major- or career-related assignment in private industry or in public agencies for which the course is being used. The position may be either a volunteer or paid work assignment. The instructor is required to visit the work site. Learning assignments will be arranged through the Career Development Center and the instructor. Final written report required.

Minimum of 120 hours of field experience required. Credit/No Credit grading only. May be repeated to a maximum of 6 units in different semesters. (Activity 6 hours)

496. Advanced Behavioral Research Methods (3)

Prerequisites: (ENGR 296) or (NSCI 296), and (HHS 361) or (CLA 361) or (ENGR 361) or (NSCI 361), or consent of instructor.

An advanced study of the theoretical and practical aspects of conducting biomedical research including hypothesis formulation, experimental design, assessment of error within empirical data, and the preparation of sound and fundable grant proposals.

Not open for credit to students with credit in NSCI 496.

Letter Grade Only (A-F). Same course as: NSCI 496. (Lecture 3 hours)

496H. Honors Directed Research (1-3)

Prerequisite: Junior Standing

Theoretical, experimental, or industrial problems in an area approved by the Honors Advisor requiring advanced analysis culminating in a substantial report.

Letter grade only (A-F). May be repeated for a maximum of 3 units with same topic in different semesters.

498. Engineering Systems Senior Project (3)

Prerequisite: Senior Standing.

Senior Project in Engineering Systems. Design and development of a senior project. Presentation of oral and written report.

(Seminar 3 hours) Letter grade only (A-F).

498H. Honors Thesis (1-3)

Prerequisite: Senior Standing

Planning, preparation and completion of a thesis or project, in an area approved by the Honors Advisor.

Letter grade only (A-F). May be repeated for a maximum of 3 units with same topic in different semesters.

GRADUATE LEVEL

513. Optimal Engineering Design Decision-Making (3)

Prerequisite: COE Graduate Standing or consent of instructor.

Application based overview of methods for making optimal design decisions, involving both theory and practical usage; importance of modeling; design of experiments; linear and nonlinear optimization; multiple objectives; design under uncertainty; decision-making algorithms; project work required.

Lecture-problems 3 hours. Letter grade only (A-F).

570. Applied Data Analysis for Engineers (3)

Prerequisites: Graduate standing or consent of instructor.

This course covers signal processing, data mining and machine learning techniques and algorithms which are frequently used to analyze engineering data. Practical projects/assignments from various engineering fields will be given to exemplify the concept.

Letter Grade only (A - F). (Lecture-problems 3 hours)

691. Curricular Practical Training (1)

Prerequisite: Graduate Standing, Completion of 18 units of graduate work, Advancement to Candidacy, and good standing.

Curricular Practical Training class provides international graduate students in the College of Engineering with opportunities to gain practical experiences in their field of study.

Credit/no credit only. May be repeated to a maximum of 3 units in different semesters.

790. Selected Topics in Engineering (1-4)

Prerequisites: MS or equivalent and formally admitted to the Ph.D. program.

Each offering is based on an area of engineering in which recent advances have been made.

Letter grade only (A-F). Topics announced in the *Schedule of Classes*.

795. Advanced Directed Studies (4)

Explorations of theoretical and experimental (if applicable) Engineering problems in great depth with emphasis on mathematical modeling and analysis. Students must present the findings in a formal report and a seminar.

Letter grade only (A-F).

796. Doctoral Seminar (2)

Prerequisite: Graduate Standing.

Research seminar on advanced technical fields.

May be repeated to a maximum of 4 units in different semesters. (Seminar 2 hours). Letter grade only (A-F).

797A. Preparation for Ph.D. Preliminary Examinations (4-12)

Prerequisite: Graduate Standing.

Tutorial. Limited to doctoral students who are preparing for the preliminary examinations.

ENGR 797A does not count towards the 48 units of course requirement. Credit/No Credit grading only.

797B. Preparation for Ph.D. Qualifying Examination (4-12)

Prerequisite: Graduate Standing.

Tutorial. Limited to doctoral students who are preparing for the qualifying examination.

ENGR 797B does not count towards the 48 units of course requirement. Credit/No Credit grading only.

797C. Research for Ph.D. Dissertation (4-12)

Prerequisite: Graduate Standing. Tutorial. Limited to doctoral students who are preparing or working on the dissertation research. ENGR 797C does not count towards the 48 units of course requirement. Credit/No Credit grading only.

798. Doctoral Dissertation (4-12)

Prerequisites: Successful completion of the Ph.D. preliminary examinations, research tool test, and at least 48 units of course work. A written dissertation proposal containing an outline of the research to be undertaken and references to relevant source material must be submitted. Only upon a positive recommendation a student may embark on a dissertation.

Letter grade only (A-F).

Courses (MSEM)

UPPER DIVISION

406B. Engineering Economy and Administration (3)

Prerequisite/Corequisite: ECON 300 or consent of instructor.

Engineering management principles and economic analysis: with time value of money, after-tax analysis for rate of return. Graduate students will be required to do an additional assignment.

Letter grade only (A-F).

GRADUATE LEVEL

506B. Management of Engineering Technology and Innovation (3)

Prerequisite: Graduate engineering standing.

Analysis of the principles and theory of engineering administrative organizations, information systems, management functions, decision making tools, strategies and administrative policy formulations.

Letter grade only (A-F).

507B. Engineering Project Management (3)

Prerequisite: Graduate engineering standing.

Theory and philosophies of project management, principles of internal and industrial organization planning and control systems, motion in time study, industrial statistics, industrial research as aid to decision making.

Letter grade only (A-F).

508B. Systems Engineering and Integration (3)

Prerequisite: Senior standing or consent of instructor.

Introduction to the tools and methods employed by systems engineers in the aerospace industry. Development of system functions, requirements, verification and validation, and interfaces in the context of integrated product teams and the product life cycle.

Letter grade only (A-F).

511B. Advanced Manufacturing Management Systems (3)

Prerequisite: Consent to instructor.

Management systems for Integrated Product Development and Concurrent Engineering; Quality, Productivity and Costs, emphasis Just-in-Time Manufacturing; Quality-Based Manufacturing Systems: TQM and ISO 9000; Customer Requirement and Quality Function Deployment; Design Manufacturing and Assembly, Poka-Yoke; Demand-Driven, “Pull” manufacturing. “Lean Enterprise”.

Letter grade only (A-F).

570B. Engineering Management Principles and Applications (3)

Prerequisite: Graduate standing, or consent of instructor.

Engineering management principles/applications. Relationships of management functions -modern products or service based companies. Technical organization in global market place. Reengineering, empowerment, concurrent engineering, and systemic thinking. Evolutionary theories of management. Strategic planning, goal setting, communication, resource distribution, etc. Team projects.

Letter grade only (A-F).

596B. Special Projects in Engineering Management (3)

Prerequisites: Eligible for advancement to candidacy and consent of instructor.

Under faculty supervision students will pursue synthesis work, as a culminating experience, on the topics learned for the interdisciplinary MSEM degree. In consultation with the Program Advisor, an Independent Study form must be completed. An acceptable project report must be submitted.

May be repeated to a maximum of 6 units. Letter grade only (A-F).

CHEMICAL ENGINEERING
College of Engineering

Department Chair: Larry K. Jang

Department Office: EN2 101
Telephone: (562) 985-4909
Website: http://www.csulb.edu/coe/che

Faculty: Larry K. Jang, Chih-Cheng Lo, Sergio Mendez, Sepideh Faraji, Ted Yu

Undergraduate Advisor: Sergio Mendez

Graduate Advisor: Chih-Cheng Lo

Environmental Technology Advisor: Sergio Mendez

General Education Advising: Academic Advising - Horn Center

Career Possibilities

Chemical Engineer • Process Engineer • Automation Control Engineer • Chemical Research Engineer • Chemical Test Engineer • Biochemical Engineer • Biomedical Engineer • Technical Sales • Management • Technical Writer • Quality Control Specialist • Consultant • Safety Engineer • Environmental Engineer • (Some of these careers require additional education or experience. For more information, see www.careers.csulb.edu.)

Introduction

Chemical engineering is a major that opens the way for many career opportunities. As the name implies, chemical engineers must build a foundation on engineering, science, and math while specializing in the application of chemistry to engineering systems. This is a versatile major that also encourages students to take courses from the other engineering disciplines as well as the biological sciences. In general, chemical engineers integrate their broad knowledge and analytical skills to design, implement and optimize chemical processes that convert raw materials into valuable products in a sustainable manner. Chemical engineers ensure that processes are operated safely and economically with minimum energy consumption and waste emission. Many of our graduates find career opportunities in traditional industries such as petroleum refining, energy production, chemical manufacturing and pharmaceuticals. Because of their diverse technical skill set, our graduates are increasingly finding employment in emerging industries such as alternative energy, biomedical engineering, environmental engineering, semiconductors, materials, and nanotechnology.

Program Educational Objectives

The Chemical Engineering bachelor degree program's educational objective statement is directed towards the career accomplishments and expectations of the alumni. The objectives of the program are that recent alumni become successful in their professional careers, and that they continue on a path of professional development.

The Bachelor of Science in Chemical Engineering program objectives are to produce well-rounded graduates who, after entering the chemical engineering practice, will progress to leadership roles by:

- Applying the knowledge, principles, and skills of chemical engineering to the solution of complex engineering problems;
- Practicing safety, sustainability, and ethics throughout their professional careers;
- Communicating effectively and working collaboratively in multidisciplinary teams;
- Pursuing life-long learning through continued education, professional registration, and participation in professional organizations.

The faculty members of the Department of Chemical Engineering strive to continuously improve the program and the curriculum as well as laboratory facilities to ensure the professional career success of our recent graduates. The goal is to prepare students for a wide range of career routes that use chemical engineering principles with a solid foundation in engineering, math, science, and societal awareness. The scope of this program is broadened by courses from general education as well as specialized technical elective courses in chemical engineering and other engineering disciplines. Students develop teamwork skills and gain interdisciplinary experience particularly in laboratory courses, lecture courses with laboratory components, and the capstone design class that require team projects. This program provides ample opportunities for students to develop communication skills such as oral and poster presentations as well as written technical reports. Students are encouraged to participate in life-long learning activities such as professional meetings on or off campus and field trips. The goal is to have a comprehensive, student-centered program that can allow us to meet the educational objectives.

Chemical Engineering Advisory and Development Council

The Department of Chemical Engineering Advisory and Development Council, consisting of outstanding engineers and executives from industry and government in Southern California, provides guidance to our program. Its mission is to advise and assist in developing the Department and to support its efforts to serve students, the community, and industry. This liaison between the University and industry ensures that industry concerns are addressed in our curricula and provides career guidance for our graduates.

ABET Accreditation

The Bachelor of Science in Chemical Engineering is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

Other Related Programs

Students interested in obtaining a Minor in Environmental Engineering should refer to the College of Engineering section of this catalog. Students who take required Chemistry courses are most likely eligible for Minor in Chemistry degree. See the College of Natural Science and Mathematics section of this catalog.

Students wishing to pursue advanced study may be interested in the College of Engineering's Master of Science in Engineering (MSE) degree. Thesis work may be supervised

by chemical engineering faculty. For detailed MSE requirements, see the College of Engineering section of this catalog.

Grade Requirements

In addition to other University requirements, all students must obtain a grade of "C" or better in each prerequisite for any chemical engineering course. Also, required Written English (GE A1), Speech (GE A2), and Interdisciplinary (IC) courses must be taken for a letter grade, not Credit/No Credit.

Undergraduate Programs

Bachelor of Science In Chemical Engineering (120 units)

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Chemical Engineering). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Chemical Engineering must also meet similar major specific requirements. To become fully admitted into the Chemical Engineering major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower-Division Major Requirements:
MATH 122 (Calculus I), MATH 123 (Calculus II), PHYS 151 (Mechanics and Heat), CHEM 111A (General Chemistry)

General Education Foundations Courses:
Written and Oral Communication

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-time Freshmen: A grade of "C" or better must be achieved in MATH 122 within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 123 and PHYS 151 within one calendar year.

Requirements

A grade of "C" or better must be achieved in all required courses listed below.

Lower Division:

Take all the following courses:

CH E 200 Chemical Engineering Fundamentals (3)
Prerequisites: CHEM 111A, MATH 122, PHYS 151 all with a grade of "C" or better.

CH E 210 Computer Methods in Chem Engineering (3)
Prerequisite/Corequisite: MATH 123

CH E 220 Chemical Engineering Thermodynamics I (3)
Prerequisite: CH E 200 with a grade of "C" or better.

CHEM 111A General Chemistry (5)
Prerequisites: A passing score on the Chemistry Placement Examination and a "C" or better in MATH 113 or MATH 117 or MATH 119A or MATH 122. One year of high school chemistry is strongly recommended.

CHEM 111B General Chemistry (5)
Prerequisite: CHEM 111A and MATH 113 or MATH 115 or MATH 117 or MATH 119A or MATH 122 all with a grade of "C" or better.

C E 205 Analytical Mechanics I (Statics) (3)
Prerequisite: PHYS 151 with a grade of "C" or better.
Prerequisite/Corequisite: MATH 123.

ENGR 101 Introduction to Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

CH E 100 Introduction to Chemical Engineering (1)
Prerequisite: None.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113, or a grade of "C" or better in MATH 117.

MATH 123 Calculus II (4)
Prerequisite: A grade of "C" or better in MATH 122.

MATH 224 Calculus III (4)
Prerequisite: A grade of "C" or better in MATH 123 or MATH 222.

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

Take one of the following choices:

PHYS 152 Electricity and Magnetism (4)
Prerequisite: PHYS 151; Prerequisite/Corequisite: MATH 123.

or both of the following:

EE 210 Electro-Magnetic Foundations in EE (3)
Prerequisite: PHYS 151 with a grade of "C" or better.
Corequisites: MATH 123, EE 210L.

EE 210L Electro-Magnetic Foundations in EE Lab (1)
Corequisite: EE 210

Take one of the following choices:

CHEM 220A, CHEM 223A, CHEM 220B, and CHEM 223B

or

CHEM 227 and one of the following: BIOL 200, BIOL 205, or BIOL 211

Upper Division:

Take all the following courses:

CH E 310 Chemical Engineering Thermodynamics II (3)
Prerequisites: CHE 210, CHE 220 all with a grade of "C" or better.

CH E 320 Fluids (3)
Prerequisites: CH E 200, C E 205 all with a grade of "C" or better.

CH E 330 Separation Processes (3)
Prerequisite/Corequisite: CHE 310

CH E 420 Heat and Mass Transport (3)
Prerequisites: CHE 310, CHE 320 all with a grade of "C" or better.

CH E 430 Chemical Reactor Kinetics (3)
Prerequisite: CHE 310

CH E 440 Chemical Engineering Laboratory I (2)
Prerequisites: CHE 320, CHE 330 all with a grade of "C" or better.

CH E 450 Chemical Engineering Laboratory II (2)
Prerequisites: CHE 440 with a grade of "C" or better.
Prerequisite(s)/Corequisite(s): CHE 420, CHE 430, and CHE 460

CH E 460 Chemical Process Control (3)
Prerequisites: CHE 420, CHE 430, and (MATH 370A or CHE 480) all with a grade of "C" or better

CH E 470 Chemical Engineering Design (4)
Prerequisites: CHE 330, CHE 420, CHE 430 all with a grade of "C" or better.

CHEM 375 Physical Chemistry for Engineers(3)
Prerequisites: MATH 123; PHYS 151 and either PHYS 152 or EE 210/EE 210L; CH E 220; CHEM 111A/B; and CHEM 220A or CHEM 227, all with grades of "C" or better. CH E 310 is strongly recommended.

MATH 370A Applied Mathematics I (3)
Prerequisites: A grade of "C" or better in MATH 123. Exclude freshmen.

Take six units from the following courses:
CHE 300, CHE 415, CHE 431, CHE 432, CHE 433, CHE 437, CHE 445, CHE 455, CHE 475, CHE 480, CHE 485, CHE 490;

All students are encouraged to attempt FE Exam. Those who pass the FE Exam before graduation can waive 3 units of elective course.

Minor in Environmental Engineering

For requirements, see the description in the College of Engineering section of this catalog.

Chemical Engineering Courses (CH E)

LOWER DIVISION

100. Introduction to Chemical Engineering (1)

Chemical engineering as a profession. Nature of profession and career opportunities. Emerging frontiers of chemical engineering.

(Lecture 1 hour) Letter grade only (A-F).

200. Chemical Engineering Fundamentals (3)

Prerequisites: CHEM 111A, MATH 122, PHYS 151 all with a grade of "C" or better.

Dimensional analysis of units, steady and transient balances of mass, momentum and energy, the mathematical solution of chemical engineering problems.

(Lecture-problems 3 hrs) Letter grade only (A-F). Same course as CHE 200H. Not open for credit to students with credit in CHE 200H.

200H. Chemical Engineering Fundamentals (3)

Prerequisites: CHEM 111A, MATH 122, PHYS 151 all with a grade of "C" or better.

Dimensional analysis of units, steady and transient balances of mass, momentum and energy, the mathematical solution of chemical engineering problems

Letter grade only (A-F). CHE 200H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CHE 200. (Lecture-problems 3 hours)

210. Computer Methods in Chemical Engineering (3)

Prerequisite/corequisite: MATH 123

Beginning programming and techniques of numerical analysis applied to typical problems in chemical engineering.

(Lecture-problems 2 hours, lab 3 hours) Letter grade only (A-F).

220. Chemical Engineering Thermodynamics I (3)

Prerequisite: CH E 200 with a grade of "C" or better.

Applications of the first and second laws of thermodynamics to chemical processes. Concepts of heat, work, and energy. Energy balances in batch and flow processes, with and without chemical reaction. Gas behavior, phase change, vapor pressure, humidity.

(Lecture-problems 3 hours) Letter grade only (A-F).

UPPER DIVISION

300. The Chemical Industry (3)

Prerequisite: CH E 200 with a grade of "C" or better.

Survey of industrial chemical processing techniques and the activities of engineers in this area, illustrated by field trips, speakers, professional society meetings, films, readings, etc.

(Lecture 3 hours) Letter grade only (A-F).

310. Chemical Engineering Thermodynamics II (3)

Prerequisites: CH E 210, CH E 220 all with a grade of "C" or better.

Analysis and design of process equipment and systems using thermodynamics. Turbines, compressors, power plants, refrigeration cycles. Phase equilibria and nonideal solution behavior. Chemical reaction equilibria and heat effects.

(Lecture-problems 3 hours) Letter grade only (A-F). Not open for credit to students with credit in CHE 410.

320. Fluids (3)

Prerequisites: CH E 200, C E 205 all with a grade of "C" or better.

Study of the deformation and flow of fluids, both liquids and gases, with applications to chemical engineering.

(Lecture-problems 3 hours) Letter grade only (A-F).

330. Separation Processes (3)

Prerequisite/Corequisite: CHE 310

Material and energy balances around multi-stage mass transfer unit operations. Calculation and graphical estimation of ideal number of stages. Binary and multicomponent liquid-liquid extraction, distillation and gas absorption. Model equilibrium staged separation processes with chemical process simulation software.

(Lecture-problems 2 hours, lab 3 hrs) Letter grade only (A-F). Same course as CHE 330H. Not open for credit to students with credit in CHE 330H.

330H. Separation Processes (3)

Prerequisite/Corequisite: CHE 310

Material and energy balances around multi-stage mass transfer unit operations. Calculation and graphical estimation of ideal number of stages. Binary and multicomponent liquid-liquid extraction, distillation and gas absorption. Model equilibrium staged separation processes with chemical process simulation software.

Letter grade only (A-F). CHE 330H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CHE 330. (Lecture-problems 2 hours, laboratory 3 hours)

415./515. Occupational and Environmental Safety Engineering and Management (3)

Prerequisite: CHEM 227 all with a grade of "C" or better or consent of instructor.

Safety analysis and management, legislation, regulations

and standards; toxicology and personal protective equipment; fire hazards; noise control; electrical safety; container and spill management; statistical analysis. Extra requirements for graduate students.

(Lecture-problems 3 hours) Letter grade only (A-F).

420. Heat and Mass Transport (3)

Prerequisites: CHE 310, CHE 320 all with a grade of "C" or better.

Heat exchange by conduction, convection and radiation. Diffusion in fluids and solids. Simultaneous heat and mass transport.

(Lecture-problems 2 hours, lab 3 hours) Letter grade only (A-F).

426. Engineering Properties of Polymers (3)

Prerequisites: CHE 320, or CE 335, or MAE 333 all with a grade of "C" or better.

Analysis of mechanical tests of polymers in the glassy, rubbery, and fluid states. Glass transition, amorphous and crystalline materials. Mechanical behavior of thermoplastics, vulcanized rubber, and thermosets. Viscoelastic properties, failure mechanics, yielding of polymers. Fatigue and fracture mechanics for polymers.

Letter grade only (A-F). (Lecture-Problems 3 hours).

430. Chemical Reactor Kinetics (3)

Prerequisite: CHE 310

Mechanism and rate law of chemical reaction, temperature and pressure effects, homogeneous and heterogeneous reactions and application to reactor design, catalysts.

(Lecture-problems 2 hours, lab 3 hours) Letter grade only (A-F).

431./531. Heterogeneous Catalysts (3)

Prerequisite: CHE 430 with a grade of "C" or better or consent of instructor.

Basic principles of solid catalysts and solid catalyzed reactions. Proper choice of catalysts and how to solve catalyst-related problems in chemical engineering. Development of chemical processes that utilize innovative catalysts. Graduate students will need to do more assignments.

Letter grade only (A-F). (Lecture-problems 3 hours).

432./532. Microfabrication and Microfluidics Technology (3)

Prerequisites: CHE 320, CHEM 227, (MATH 370A or CHE 480) all with a grade of "C" or better or consent of instructor.

Fundamentals of major microfabrication techniques for device construction and microfluidics technology. Topics: photolithography, wet/dry etching, metal/dielectric deposition, soft lithography, diffusion/mixing/separation in microfluidic devices, and chip-to-world interfaces. Graduate students need to do more assignments.

Letter grade only (A-F). (Lecture-problems 3 hours).

433./533. Green Engineering I: Alternative Energy (3)

Prerequisites: CHE 220. CHE 330, CHE 310 all with a grade of "C" or better or consent of instructor.

Aspects of green engineering. Sustainable liquid fuels: ethanol and biodiesel from renewable sources. Photovolaic solar devices: semiconductor- and polymer-based solar cells. Solar array collectors: power cycles to convert heat to electrical power. Hydrogen fuel cells: electrochemical cells, and proton exchange membranes. Graduate students will submit final written reports.

Letter grade only (A-F). (Lecture-Problems 3 hours).

437./537. Materials Purification Processes (3)

Prerequisite: CH E 330, CHE 420 all with a grade of "C" or better or consent of instructor.

Rate-controlled separation processes such as membrane separations, pressure swing adsorption, molecular sieve separation, supercritical fluid extraction, reverse osmosis, and spray drying.

Additional projects required for CH E 537. (Lecture-problems 3 hours) Letter grade only (A-F).

439. Fuel Cell Fundamentals and Theory (3)

Prerequisites: MAE 322 and 330; or CHEM 371A all with a grade of "C" or better

Theory of electrochemistry. Survey of electrochemical fuel cell systems. Fundamentals of electrochemical thermodynamics, electrochemical kinetics, charge transport, and mass transport. Review of fuel cell modeling and characterization techniques. Atomic level density functional theory (DFT) calculations of a fuel cell catalyst reaction. .

Letter grade only (A-F). (Lecture-problem 3 hours).

440. Chemical Engineering Laboratory I (2)

Prerequisites: CHE 320, CHE 330 all with a grade of "C" or better.

Laboratory study of fluid mechanics, separation processes and thermodynamics. Experimental design and analysis and preparation of engineering reports.

(Laboratory 6 hours) Letter grade only (A-F).

445./545. Pollution Prevention (3)

Prerequisite: CH E 330 with a grade of "C" or better.

Pollution prevention strategies in chemical industry. Hierarchical approach of waste minimization. Life cycle analyses of wastes. Identification of pollution source. Environmentally compatible materials. Unit operations for minimizing waste. Economics of pollution prevention. Extra requirement for graduate students.

(Lecture-problems 3 hours) Letter grade only (A-F).

450. Chemical Engineering Laboratory II (2)

Prerequisites: CHE 440 with a grade of "C" or better. Prerequisite(s)/Corequisite(s): CHE 420, CHE 430, and CHE 460

Apply fundamental knowledge of heat transfer, chemical separations, process control and chemical kinetics to practical experiments. Remote data acquisition and control of process equipment. Design experiments to collect data, and perform data analysis. Written reports and oral/poster presentations.

(Laboratory 6 hours) Letter grade only (A-F).

455./555. Environmental Compliance (3)

Prerequisite: CHEM 227 with a grade of "C" or better or consent of instructor.

Physical and chemical properties of hazardous materials and wastes. Environmental hazards. An examination of environmental laws, regulations and standards dealing with storage, transportation, treatment and disposal of hazardous wastes. Emergency planning and preparedness. Extra requirement for graduate students: term papers or projects.

(Lecture-problems 3 hours) Letter grade only (A-F).

460. Chemical Process Control (3)

Prerequisites: CHE 420, CHE 430, and (MATH 370A or CHE 480) all with a grade of "C" or better.

Control theory and practice, instrumentation, system responses, transfer functions, feed-back control, and stability as applied to chemical engineering processes.

(Lecture-problems 2 hours, lab 3 hours) Letter grade only (A-F).

470. Chemical Engineering Design (4)

Prerequisites: CHE 330, CHE 420, CHE 430 all with a grade of "C" or better.

One-semester capstone design course fulfilling integrative learning. Design and optimization of chemical processing plants using analytical methods and modern computer simulation tools. Chemical process equipment sizing. Economic, ethical and safety issues considered. Teamwork, oral presentations and written reports are required.

(Lecture-problems 3 hours, problem-design session 3 hrs) Letter grade only (A-F). Same course as CHE 470H. Not open for credit to students with credit in CHE 470H.

470H. Chemical Engineering Design (4)

Prerequisites: CHE 330, CHE 420, CHE 430 all with a grade of "C" or better.

One-semester capstone design course fulfilling integrative learning. Design and optimization of chemical processing plants using analytical methods and modern computer simulation tools. Chemical process equipment sizing. Economic, ethical and safety issues considered. Teamwork, oral presentations and written reports are required.

Letter grade only (A-F). CHE 470H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CHE 470. (Lecture-problems 3 hours, problem-design session 3 hours)

475./575. Environmental Pollution (3)

Prerequisite: CHEM 220A or CHEM 227 all with a grade of "C" or better or consent of instructor.

Application of chemistry to the problems of pollution. Graduate students have additional assignments.

(Lecture-problem 3 hours) Letter grade only (A-F).

480./580. Theoretical Methods in Chemical Engineering (3)

Prerequisites: CH E 420, CHE 430 all with a grade of "C" or better.

Simulation and optimization of chemical engineering processes by mathematical formulation and computer modeling.

Extra requirements for graduate students: term papers or projects. (Lecture-problems 3 hours) Letter grade only (A-F).

485./585. Air Pollution (3)

Prerequisite: CH E 475 or CE 364 all with a grade of "C" or better or consent of instructor.

Air pollution chemistry; control strategies; origin of pollutants; meteorology; vapor dispersion models; control principles for particulates, sulfur dioxide, and nitrogen oxides.

Extra requirements for graduate students: term papers or projects. (Lecture-problems 3 hrs) Letter grade only (A-F).

490. Special Problems (1-3)

Prerequisite: Consent of instructor.

Assigned topics in technical literature or laboratory projects and reports on same.

Letter grade only (A-F).

GRADUATE LEVEL

505. Advanced Chemical Engineering Thermodynamics (3)

Prerequisite: CHE 310 or equivalent course

Modern equations of state. Theoretical treatment of non-ideal multiphase equilibria. Statistical mechanics and ensembles to describe thermodynamic properties and fundamental property relations. Non-equilibrium thermodynamics with applications to chemical reaction kinetics. Optimization of power and refrigeration cycles.

Letter grade only (A-F). (Lecture-problem 3 hours).

515./415. Occupational and Environmental Safety Engineering and Management (3)

Prerequisite: CHEM 227 all with a grade of "C" or better or consent of instructor.

Safety engineering and management, legislation, regulations and standards; toxicology and personal protective equipment; fire hazards; noise control; electrical safety; system safety analysis; container and spill management; use of computer systems and statistical methods.

Extra requirements for graduate students: term papers or projects. (Lecture-problems 3 hours) Letter grade only (A-F).

520. Advanced Transport Phenomena (3)

Prerequisites: CH E 320, CHE 420, CHE 430 all with a grade of "C" or better.

Application of differential and integral mass, momentum and energy balances to chemical engineering processes. Analysis of fluid flow, heat transfer, diffusion and chemical reaction in various unit operations.

(Lecture-Problems 3 hours) Letter grade only (A-F).

530. Advanced Reactor Kinetics (3)

Prerequisite: CH E all with a grade of "C" or better.

Modeling of chemical reactors; effects of multiple phases, mixing, adsorption, diffusion and catalysts on reactor performance.

(Lecture-Problems 3 hrs) Letter grade only (A-F).

531./431. Heterogeneous Catalysts (3)

Prerequisite: CHE 430 with a grade of "C" or better or consent of instructor.

Basic principles of solid catalysts and solid catalyzed reactions. Proper choice of catalysts and how to solve catalyst-related problems in chemical engineering. Development of chemical processes that utilize innovative catalysts. Graduate students will need to do more assignments.

Letter grade only (A-F). (Lecture-Problems 3 hours)

532./432. Microfabrication and Microfluidics Technology (3)

Prerequisites: CHE 320, CHEM 227, MATH 370A or CHE 480 all with a grade of "C" or better or consent of instructor.

Fundamentals of major microfabrication techniques for device construction and microfluidics technology. Topics: photolithography, wet/dry etching, metal/dielectric deposition, soft lithography, diffusion/mixing/separation in microfluidic devices, and chip-to-world interfaces. Graduate students need to do more assignments.

Letter grade only (A-F). (Lecture-Problems 3 hours).

533./433. Green Engineering I: Alternative Energy (3)

Prerequisites: CHE 220. CHE 330, CHE 310 all with a grade of "C" or better or consent of instructor.

Aspects of green engineering. Sustainable liquid fuels: ethanol and biodiesel from renewable sources. Photovolaic solar devices: semiconductor- and polymer-based solar cells. Solar array collectors: power cycles to convert heat to electrical power. Hydrogen fuel cells: electrochemical cells, and proton exchange membranes. Graduate students will submit final written reports.

Letter grade only (A-F). (Lecture-Problems 3 hours).

537./437. Materials Purification Processes (3)

Prerequisites: CH E 330, CH E 420 all with a grade of "C" or better. or consent of instructor.

Rate-controlled separation processes such as membrane separations, pressure swing adsorption, molecular sieve separation, supercritical fluid extraction, reverse osmosis, and spray drying.

Additional projects required for CH E 537. (Lecture-problems 3 hours) Letter grade only (A-F).

545./445. Pollution Prevention (3)

Prerequisite: CH E 330 with a grade of "C" or better.

Pollution prevention strategies in chemical industry; hierarchical approach waste minimization; life cycle analyses of wastes; identification of pollution source; environmentally compatible materials; unit operations for minimizing waste; economics of pollution prevention.

Extra requirement for graduate students. (Lecture-problems 3 hours) Letter grade only (A-F).

555./455. Environmental Compliance (3)

Prerequisite: CHEM 227 with a grade of "C" or better or consent of instructor.

Physical and chemical properties of hazardous materials and wastes. Environmental hazards. An examination of environmental laws, regulations and standards dealing with storage, transportation, treatment and disposal of hazardous wastes. Emergency planning and preparedness.

Extra requirement for graduate students: term papers or projects. (Lecture-problems 3 hours) Letter grade only (A-F).

560. Advanced Chemical Process Control (3)

Prerequisite: One of the following: CH E 460, E E 370/L, E E 411, EE 470, EE 471, EE 511, MAE 376, E T 492 all with a grade of "C" or better or consent of instructor.

Principles and practices of controller selection and tuning, advanced control loops, model predictive control, decoupling, hands-on experience of control loop design and implementation using Labview.

(Lecture-Problems 3 hours) Letter grade only (A-F).

575./475. Environmental Pollution (3)

Prerequisite: CHEM 220A or CHEM 227 all with a grade of "C" or better or consent of instructor.

Application of chemistry to the problems of pollution. Graduate students have additional assignments.

(Lecture-problem 3 hours). Letter grade only (A-F).

580./480. Theoretical Methods in Chemical Engineering (3)

Prerequisites: CH E 420, CHE 430 all with a grade of "C" or better.

Simulation and optimization of chemical engineering processes by mathematical formulation and computer modeling.

Extra requirements for graduate students: term papers or projects. (Lecture-problems 3 hours) Letter grade only (A-F).

585./485. Air Pollution (3)

Prerequisite: CH E 475 or CE 364 all with a grade of "C" or better or consent of instructor.

Air pollution chemistry; control strategies; origin of pollutants; meteorology; vapor dispersion models; control principles for particulates, sulfur dioxide, and nitrogen oxides.

Extra requirement for graduate students: term papers or projects. (Lecture-problems 3 hrs) Letter grade only (A-F).

697. Directed Research (1-3)

Prerequisite: Graduate standing.

Individual research or intensive study under the guidance of a faculty member on theoretical or experimental problems in chemical engineering.

(Independent Study) Letter grade only (A-F).

698. Thesis or Industrial Project (2-6)

Prerequisite: Advancement to Candidacy.

Preparation and completion of a thesis or industrial project in chemical engineering.

May be repeated to a maximum of 6 units.

CIVIL ENGINEERING AND CONSTRUCTION ENGINEERING MANAGEMENT

College of Engineering

Department Chair: Richard P. Nguyen

Department Office: Vivian Engineering Center (VEC) – 104
Telephone: (562) 985-5118
Website: www.csulb.edu/colleges/coe/cecem/

Faculty: Pitiporn Asvapathanagul, Tesfai Goitom, Jin-Lee Kim, Yu-Fu (Paul) Ko, Elhami Nasr, Tang-Hung Nguyen, Richard P. Nguyen, Emelinda M. Parentela, Shadi Saadeh, Antonella Sciortino, Lisa Star, Tariq Shehab-Eldeen, Rebeka Sultana, Luis Arboleda, Vesna Terzic

Undergraduate Advisors:
Paul Ko (CE), Tang-Hung Nguyen (CEM)

Emelinda M. Parentela (CE)

Graduate Advisor: Tesfai Goitom

General Education Advising: Academic Advising - Horn Center

Administrative Support Coordinator: Ameeta Perera

Students desiring detailed information about Civil Engineering or Construction Management programs should contact the department office for referral to one of the faculty advisors.

Career Possibilities

Civil Engineer • Traffic Engineer • Sanitary Engineer • Structural Engineer • Hydraulic Engineer • Highway Administration Engineer • Harbor Engineer • Airport Engineer • Environmental Engineer • Transportation Engineer • Drainage Design Coordinator • Technical Sales and Consulting • Field Engineer • Facilities Engineer • Plant Engineer • Project Engineer • Safety Engineer • Sales Representative • Estimator • Construction Coordinator • Procurement Construction Coordinator • Construction Inspector • Cost Analysis Coordinator • Contract Coordinator • Consultant (Some of these, and other careers, require additional education or experience. For more information, see www.careers.csulb.edu.)

Advisory and Development Councils

The Civil Engineering Advisory and Development Council

This council consists of outstanding engineers and executives from industry and government in Southern California. Its function is to form a liaison between the University and industry and to keep the administration and faculty informed of modern engineering practices. This ensures that the curricula are kept up-to-date. It also advises on placement opportunities before and after graduation.

Construction Management Advisory and Development Council

This council provides current information and guidance about industrial developments in methods, materials and techniques. Members make recommendations in course content, methods and/or facilities. Present membership in the council is made up of representatives from the different sectors of the construction industry.

ABET Accreditation

The Bachelor of Science in Civil Engineering is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

ACCE Accreditation

The Bachelor of Science in Construction Management is accredited by the American Council for Construction Education (ACCE), website: http://www.acce-hq.org/.

Undergraduate Programs

Bachelor of Science in Civil Engineering (120 units)

Mission

The mission of the Civil Engineering Program is to prepare students to succeed in the civil engineering profession by providing them with essential technical tools and skills and to promote the need for lifelong learning.

Educational Objectives

The Civil Engineering Program Educational Objectives are to produce graduates, who after entering the civil engineering practice will:

1. Apply knowledge of fundamental science and engineering principles and design to the solution of complex engineering projects.
2. Pursue lifelong learning through continuing education and/or advanced degrees in civil engineering or other related fields.
3. Progress to professional registration and continue to develop professionally.
4. Progress to leadership or management in engineering.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Civil Engineering). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Civil Engineering must also meet similar major specific requirements. To become fully admitted into the Civil Engineering major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower Division Major Requirements:
MATH 122 (Calculus I), MATH 123 (Calculus II), PHYS 151 (Mechanics and Heat)

General Education Foundations Courses:
Written and Oral Communication

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 122 within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 123 and PHYS 151 within one calendar year.

Requirements

Lower Division:

Take all of the following:

CHEM 111A General Chemistry (5)
Prerequisites: A passing score on the Chemistry Placement Examination.
Corequisite: MATH 109 or higher.

CE 101 Introduction to Civil Engineering and Construction Engineering Management (1)
Prerequisites: None.

CE 130 Surveying and Mapping (1)
Corequisites: CE 130L and MAE 172 or CEM 121.

CE 130L Surveying and Mapping Laboratory (1)
Corequisite: CE 130.

CE 200 Materials for Civil Engineering (1)
Prerequisites: CHEM 111A and PHYS 151 all with a grade of "C" or better; consent of department undergraduate advisor.
Corequisite: CE 200L

CE 200L Materials for Civil Engineering Lab (1)
Prerequisites: CHEM 111A and PHYS 151 all with a grade of "C" or better and consent of department undergraduate advisor.
Co-requisite: CE 200.

CE 205 Analytical Mechanics I (Statics) (3)
Prerequisite: PHYS 151 with a grade of "C" or better.
Prerequisite/Corequisite: MATH 123.

CE 206 Computer Programming and CE Applications I (1)
Prerequisites: MATH 122, PHYS 151 all with a grade of "C" or better.
Corequisite: CE 206L

CE 206L Computer Programming and CE Applications I Lab (1)
Prerequisites: MATH 122, PHYS 151
Corequisite: CE 206

ENGR 101 Intro to the Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122.

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113.

MATH 123 Calculus II (4)
Prerequisite: A grade of "C" or better in MATH 122.

MATH 224 Calculus III (4)
Prerequisite: A grade of "C" or better in MATH 123 or MATH 222.

MAE 172 Engineering Design Graphics (2)
Prerequisites: None.

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

Take one of the following:

BIOL 200 General Biology (4)
Prerequisite: GE Foundation requirements.

BIOL 201 Microbiology for Health Professionals (4)
Prerequisites: CHEM 111A or CHEM 140 with a grade of "C" or better and GE Foundation requirements.

Take 4 units of the following:

EE 210 Electro-Magnetic Foundations in EE (3)
Prerequisite: PHYS 151 with a grade of "C" or better.
Corequisites: MATH 123, EE 210L.

EE 210L Electro-Magnetic Foundations in EE Lab (1)
Corequisite: EE 210.

PHYS 152 Electricity and Magnetism (4)
Prerequisite: PHYS 151; Prerequisite/Corequisite: MATH 123.

Upper Division:

Take all of the following:

CE 307 Probability & Statistics in Civil Engineering (2)
Prerequisites: CE 206

CE 325 Transportation Safety and Sustainability (3)
Prerequisites: GE Foundation requirements.

CE 335 Fluid Mechanics (3)
Prerequisites: MATH 224 and C E 205 all with a grade of "C" or better.

CE 345 Geotechnical Engineering I (3)
Prerequisite: Consent of Department Undergraduate Advisor.
Corequisites: MAE 373; GEOL 370.

CE 346 Geotechnical Engineering Laboratory (1)
Prerequisite: ENGL 100 or GE Composition (Area A1) with a grade of "C" or better.
Corequisite: CE 345.

CE 359 Structural Analysis I (3)
Prerequisite: MAE 373 with a grade of "C" or better.

CE 364 Environmental Engineering (3)
Prerequisites: CHEM 111A, BIOL 200/BIOL 201 or MICR 200 with a grade of "C" or better.
Prerequisite/Corequisite: CE 335.

CE 406 Project Cost-Benefit Analysis (3)
Prerequisite: GE Foundation requirements.

CE 426 Transportation Engineering (3)
Prerequisite: CE 345 with a grade of "C" or better.
Corequisite: CE 406.

CE 437 Engineering Hydraulics (3)
Prerequisites: C E 335, MATH 370A all with a grade of "C" or better.

CE 459 Reinforced Concrete Design I (3)
Prerequisites: C E 200 and 359 all with a grade of "C" or better.

CE 481 Professional Practice in Civil Engineering (1)
Prerequisite: Senior standing.

CE 490 Senior Design Project (3)
Prerequisite(s): CE 459; completion of all 300-level engineering courses for the civil engineering major all with a grade of "C" or better and consent of department undergraduate advisor.
Prerequisite(s)/Corequisite(s): CE 426, CE 437.

GEOL 370 Geology for Engineers (2)
Prerequisites: CE 200.

MATH 370A Applied Mathematics I (3)
Prerequisites: A grade of "C" or better in MATH 123. Not open to Freshmen.

MAE 330 Engineering Thermodynamics I (3)
Prerequisites: MATH 224, PHYS 151 or equivalent, and CHEM 111A all with a grade of "C" or better or consent of instructor.

MAE 371 Analytical Mechanics II (Dynamics) (3)
Prerequisites: CE 205, MAE 205, or CE 206 and 206L all with a grade of “C” or better.

MAE 373 Mechanics of Deformable Bodies (3)
Prerequisite: CE 205 with a grade of "C" or better.

Take six units of electives courses from:
CE 427/427L, CE 428/428L, CE 429/429L, CE 435, CE 438/438L, CE 439, CE 445, CE 446, CE 455, CE 456, CE 458, CE 464, CE 466, CE 495

Take two laboratories from:
CE 326, CE 336, CE 365, CE 454, MAE 374

A grade of "C" or better must be achieved in the required courses below:
CHEM 111A, MATH 122, MATH 123, MATH 224, MATH 370A, BIOL 200, BIOL 201, PHYS 151, MAE 172, MAE 373, CE 130, CE 130L, CE 200, CE 205, CE 206, CE 325, CE 335, CE 345, CE 359, CE 406, CE 459 and CE 490.

Bachelor of Science in Construction Management (120 units)

Mission

The Mission of the Construction Management program is to educate and prepare students to succeed in the construction management profession by providing them with essential technical, managerial and communication skills and tools which will enable them to perform current and future construction management tasks and to promote the need for life-long learning.

Educational Objectives

The Construction Management program educational objectives are to produce graduates, who after entering the construction management practice with a knowledge of fundamental construction management principles and current technologies, communication skills and practical construction experience, will:

1. Provide substantial contributions to the construction industry.
2. Pursue life-long learning through continuing education and/or advanced degrees in construction management or other related fields.
3. Continue to develop professionally through participation in professional organizations and/or participation in professional development activities in the industry.
4. Progress towards professional certifications.

Major Declaration

Freshmen admission to engineering majors is to a ‘pre-major’ status (i.e., Pre-Construction Management). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student’s ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Construction Management must also meet similar major specific requirements. To become fully admitted into the Construction Management major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower-Division Major Requirements:
MATH 122 (Calculus I), PHYS 100A (General Physics)

General Education Foundations Courses:
Written and Oral Communication

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 111 and MATH 113, and PHYS 100A within one calendar year.

Transfer Students: A grade "C" or better must be achieved in MATH 122 and PHYS 100A & B within one calendar year.

Requirements

Lower Division:

Take all of the following:

CE 101 Introduction to Civil Engineering and Construction Engineering Management (1)
Prerequisites: None.

CE 130 Surveying and Mapping (1)
Corequisites: CE 130L and MAE 172 or CEM 121.

CE 130L Surveying and Mapping Laboratory (1)
Corequisite: CE 130.

ENGR 101 Intro to the Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122.

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113.

PHYS 100A General Physics (4)
Prerequisite: MATH 109 or MATH 113 or MATH 119A or MATH 120 or MATH 122.

PHYS 100B General Physics (4)
Prerequisite: PHYS 100A.

CEM 121 Construction Drawing I (2)
Prerequisites: None.

CEM 125 Fundamentals of Construction (3)
Prerequisites: None.

CEM 200 Concrete Construction (1)
Prerequisite: CEM 125 with a grade of "C" or better.
Corequisite: CEM 200L.

CEM 200L Concrete Construction Laboratory (1)
Corequisite: CEM 200.

CEM 202 Probability and Statistics for CEM (2)
Prerequisite: High School Algebra.

CEM 204 Applied Mechanics-Statics (3)
Prerequisites: MATH 122 and PHYS 100A all with a grade of "C" or better.

CEM 225 Residential and Light Commercial Construction Practices and Estimating (3)

Prerequisites: CEM 121, CEM 125 all with a grade of "C" or better. Corequisites: CEM 200, CEM 200L.

Take one of the following:

BLAW 220 Introduction of Law and Business Transactions (3)
Prerequisites: None

BLAW 320 Legal and Regulatory Environment of Business (3)
Prerequisites: None

Take one of the following:

CEM 201 Cost Accounting for Construction Engineering (3)
Prerequisites: None.

ACCT 201 Elementary Financial Accounting (3)
Prerequisites: None.

Upper Division:

Take all of the following:

CE 406 Project Cost-Benefit Analysis (3)
Prerequisite: GE Foundation requirements.

CEM 304 Applied Mechanics Strength of Materials (2)
Prerequisite: CEM 204 with a grade of "C" or better.

CEM 315 Construction Safety (2)
Prerequisite: CEM 225 or CE 200 with a grade of "C" or better.

CEM 324 Commercial, Institutional, and Industrial Construction Practices and Estimating (3)
Prerequisites: CEM 315 with a grade of "C" or better.

CEM 335 Soil Mechanics Technology (2)
Prerequisite: CEM 304 with a grade of "C" or better. Corequisite: CEM 335L.

CEM 335L Soil Mechanics Technology Laboratory (1)
Prerequisite: CEM 304 with a grade of "C" or better. Corequisite: CEM 335.

CEM 365 Mechanical Equipment for Buildings (2)
Prerequisite: PHYS 100B with a grade of "C" or better. Corequisite: CEM 324.

CEM 375 Electrical Equipment Buildings (2)
Prerequisites: CEM 324, PHYS 100B all with a grade of "C" or better.

CEM 404 Structural Design I (2)
Prerequisite: CEM 304 with a grade of "C" or better.

CEM 421 Construction Planning and Scheduling (3)
Prerequisite: CEM 324 with a grade of "C" or better.

CEM 425 Earthwork and Civil Works Construction Practices (2)
Prerequisite: CEM 324, CE 406 with a grade of "C" or better.

CEM 426 Business and Construction Law (3)
Prerequisites: CEM 324; BLAW 220 with a grade of "C" or better.

CEM 429 Advanced Estimating and Bidding (3)
Prerequisite: CEM 315 with a grade of "C" or better. Corequisite: CEM 425.

CEM 431 Construction Cost Control (3)
Prerequisites: CE 406 and CEM 421 with a grade of "C" or better.

CEM 438 Structural Design II (2)
Prerequisite: CEM 304 with a grade of "C" or better.

CEM 490 Construction Project Management (3)
Prerequisites: CEM 426, CEM 429 and CEM 431 with a grade of "C" or better.

ECON 300 Fundamentals of Economics (3)
Prerequisites: GE Foundation requirements.

MGMT 300 Principles of Management & Operations (3)
Recommended: IS 310.

CBA 300 International Business (3)
Prerequisites: None

Take one of the following:

MGMT 413 Managing Quality for Productivity (3)
Prerequisites: MGMT 300, IS 301.
Recommended: IS 310.

HRM 361 The Human Resource Function (3)
Prerequisites: None.

Upper Division Electives:

Take six units of electives in consultation with an advisor:

1. Design-build Emphasis: CEM 373, CEM 409, CEM 443, CEM 485
2. Facility Management Emphasis: CEM 409, CEM 432, CEM 433, CEM 434, CEM 436, CEM 485
3. Heavy Construction Emphasis: CEM 409, CEM 476, CEM 485, CEM 486.

A grade of "C" or better must be achieved in all required courses listed below:

PHYS 100A and B, MATH 122, CEM 121, CEM 125, CEM 200, CEM 200L, CEM 204, CEM 225, CEM 304, CEM 315, CEM 324, CEM 421, CEM 429, CEM 431, CEM 490; CE 130, CE 130L, CE 406, MGMT 300; ACCT 201; BLAW 220 or BLAW 320.

Fieldwork Requirements

Fieldwork experience is required for the BS in Construction Management, consisting of no less than three months full-time (or equivalent part-time) of employment in an approved industry or governmental agency. The student must hold a position equivalent to a technician or higher which affords the opportunity to exercise responsibility usually given to those who have completed two years of college. The fieldwork must be completed prior to graduation, be certified and approved by the faculty of the department.

GRADUATE PROGRAMS

Master of Science in Civil Engineering

Mission

The mission of the civil engineering graduate program at CSULB is to provide a high-quality educational experience and the technical specialization required to become successful leaders in industry and the society, to engage students in innovative practical research and encourage them to pursue advanced degrees and lifelong learning.

Program Objectives

Graduates of the MSCE program will:

1. have technical competency in an area of specialization.
2. have technical knowledge and skills needed to conduct independent and/or innovative research.
3. keep current with state of the art technologies and advancements in a specialized technical area.

Prerequisites

1. A bachelor's degree in an ABET accredited curriculum in civil engineering or a closely related engineering degree with a minimum GPA of 2.8, with the requirement that essential undergraduate prerequisites in civil engineering are satisfied;
2. The general Graduate Record Examination (GRE) is required and appropriate level of competency will be determined by the Department.
3. Graduate students must consult with the graduate advisor for information concerning procedures and requirements for appropriate approval of their courses of study prior to enrolling in their graduate programs.

. The Graduation Writing Assessment Requirement (GWAR) must be met during the first semester in residence. Failure to attempt to fulfill the GWAR during the first semester will prevent registration in engineering courses in subsequent semesters.

Advancement to Candidacy

1. Removal of all undergraduate deficiencies as determined by the Department Graduate Studies Committee;
2. Completion of at least 12 graduate units at CSULB; minimum GPA of 3.0; currently enrolled;
3. Fulfillment of the Graduation Writing Assessment Requirement (GWAR).

Requirements

1. Completion of 30 units of graduate coursework as follows:
   a. Twelve units of courses in one of the following areas of specialization: construction management, structural engineering, environmental/water resources engineering and geotechnical/ transportation engineering.
   b. Six units of department approved courses with mathematical content;
   c. Twelve units of elective courses from the following options:

      Thesis Option: Complete CE 698 and two elective courses from the approved graduate courses in Civil Engineering.

      Comprehensive Exam Option: Complete CE 697 and three elective courses from the approved graudate courses in Civil Engineering, and successfully complete the Comprehensive Exam on coursework in the student's program.

Civil Engineering Courses (C E)

LOWER DIVISION

101. Introduction to Civil Engineering and Construction Engineering Management (1)

Civil engineering and construction management as a profession. Current trends and challenges, ethical, social and environmental issues in professional practice. Professional organizations and licensure. Communication and lifelong learning skills for professional practice.

Letter grade only (A-F). (Lecture-problems 1 hour)

130. Surveying and Mapping (1)

Corequisites: CE 130L and MAE 172 or CEM 121.

Theory and practice of plane surveying, including the use of instruments for measuring distances, angles, and elevations. Plotting of surveying data and topographic mapping. Fundamentals of construction layout. Integration of data with surveying software.

Letter grade only (A-F). (Lecture-Problems 1 hour)

130L. Surveying and Mapping Laboratory (1)

Corequisite: CE 130.

Fundamentals of surveying methods as applied to construction layout. Use of level and total station for location and control of structures, vertical and horizontal control, and area determination.

Letter grade only (A-F). Not open for credit to students with credit in CE 131. (Laboratory 3 hours)

200. Materials for Civil Engineering (1)

Prerequisites: CHEM 111A and PHYS 151 all with a grade of "C" or better and consent of department undergraduate advisor.

Corequisite: CE 200L

Basic properties of materials in civil engineering, including concrete, masonry, steel, wood, asphalt and composites.

Letter grade only (A-F). (Lecture 1 hour)

200L. Materials for Civil Engineering Laboratory (1)

Prerequisites: CHEM 111A and PHYS 151 all with a grade of "C" or better and consent of department undergraduate advisor.

Co-requisite: CE 200.

Laboratory testing of basic properties of materials in civil engineering, including concrete, masonry, steel, wood, asphalt and composites.

Letter grade only (A-F). (Laboratory 3 hours)

205. Analytical Mechanics I (Statics) (3)

Prerequisite: PHYS 151 with a grade of "C" or better. Prerequisite/Corequisite: MATH 123.

Application of the mechanics of equilibrium to force systems using analytical and graphical solutions of problems involving structures and machines.

Letter grade only (A-F). (Lecture 2 hours, Activity 2 hours). Same course as CE 205H. Not open for credit to students with credit in CE 205H.

205H. Analytical Mechanics I (Statics) (3)

Prerequisite: PHYS 151 with a grade of "C" or better.

Prerequisite/Corequisite: MATH 123.

Application of the mechanics of equilibrium to force systems using analytical and graphical solutions of problems involving structures and machines.

Letter grade only (A-F). CE 205H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CE 205. (Lecture 2 hours, Activity 2 hours)

206. Computer Programming and Civil Engineering Applications I (1)

Prerequisites: MATH 122, PHYS 151 all with a grade of "C" or better.

Corequisite: CE 206L

Introduction to programming and application of computers to elementary civil engineering problems.

Letter grade only (A-F). (Lecture-Problems 1 hour)

206L. Computer Programming and Civil Engineering Applications Laboratory (1)

Prerequisites: MATH 122, PHYS 151 all with a grade of "C" or better.

Corequisite: CE 206

Hands-on application of computers and programming to elementary civil engineering problems.

Letter grade only (A-F). (Laboratory 3 hours)

UPPER DIVISION

307. Probability and Statistics in Civil Engineering (2)

Prerequisites: CE 206

Analysis of uncertainties, and applications of the basic theories of probability and statistics in civil engineering areas of geotechnical, environmental, water resources, structural and transportation engineering.

Letter grade only (A-F). (Lecture-problems 1 hour, Lab 3 hrs)

325. Transportation Safety and Sustainability (3)

Prerequisites: Completion of GE Foundation Requirements

Introduction to transportation systems and various modes of transportation: land, air, and water; legislations affecting transportation practices; transportation safety; impacts of transportation on the environment; sustainable transportation: transit, bicycles, and pedestrians. (Lecture-Problems 3 hours). Letter grade only (A-F).

326. GIS Laboratory for Civil Engineers (1)

Prerequisites: CE 130, CE 130L, CE 206 all with a grade of "C" or better.

Fundamentals of geographic information systems (GIS); spatial and network analyses. Hands-on application of GIS software to solve civil engineering problems.

(Laboratory 3 hours) Letter grade only (A-F).

335. Fluid Mechanics (3)

Prerequisites: MATH 224 and C E 205 all with a grade of "C" or better.

Properties of fluids, fluid statics, fluid dynamics, dynamic similitude, flow of compressible and incompressible fluids in closed conduits.

Letter grade only (A-F). (Lecture-Problems 3 hours). Same course as CE 335H. Not open for credit to students with credit in CE 335H.

335H. Fluid Mechanics (3)

Prerequisites: MATH 224 and C E 205 all with a grade of "C" or better.

Properties of fluids, fluid statics, fluid dynamics, dynamic similitude, flow of compressible and incompressible fluids in closed conduits.

Letter grade only (A-F). CE 335H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CE 335. (Lecture-problems 3 hours)

336. Fluid Mechanics Laboratory (1)

Prerequisite: ENGL 100 or GE Composition (Area A1) all with a grade of "C" or better.
Prerequisite/Corequisite: CE 335.

Experiments in and study of the phenomena of fluid flow.

Letter grade only (A-F). (Laboratory 3 hours)

345. Geotechnical Engineering I (3)

Corequisites: MAE 373; GEOL 370.
Prerequisite: Consent of Department Undergraduate Advisor.

Soil mechanics applied to engineering structures. Soil exploration, identification, classification, drainage, stability and bearing capacity.

Letter grade only (A-F). (Lecture-Problems 3 hours). Same course as CE 359H. Not open for credit to students with credit in CE 359H.

345H. Geotechnical Engineering I (3)

Corequisites: MAE 373; GEOL 370.

Prerequisite: Consent of Department Undergraduate Advisor.

Soil mechanics applied to engineering structures. Soil exploration, identification, classification, drainage, stability and bearing capacity.

Letter grade only (A-F). CE 345H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CE 345. (Lecture-problems 3 hours)

346. Geotechnical Engineering Laboratory (1)

Prerequisite: ENGL 100 or GE Composition (Area A1) all with a grade of "C" or better.
Corequisite: CE 345.

Laboratory investigation and experiments in the phenomena of soil mechanics.

Letter grade only (A-F). (Laboratory 3 hours)

359. Structural Analysis I (3)

Prerequisite: MAE 373 with a grade of "C" or better.

Analysis of structures including trusses, beams, and frames, conjugate beam, virtual work, energy methods, approximate methods, and influence lines. Use of code based finite element computer programs in analysis of frame and truss type structures.

Letter grade only (A-F). (Lecture-Problems 3 hours). Same course as CE 359H. Not open for credit to students with credit in CE 359H.

359H. Structural Analysis I (3)

Prerequisite: MAE 373 with a grade of "C" or better.

Analysis of structures including trusses, beams, and frames, conjugate beam, virtual work, energy methods, approximate methods, and influence lines. Use of code based finite element computer programs in analysis of frame and truss type structures.

Letter grade only (A-F). CE 359H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CE 359. (Lecture-problems 3 hours)

364. Environmental Engineering I: Fundamentals (3)

Prerequisites: CHEM 111A, BIOL 200/BIOL 201 or MICR 200 all with a grade of "C" or better.
Prerequisite/Corequisite: CE 335.

Introduction to the fundamental physical, chemical and biological processes affecting air and water quality. Models of transport and transformation of impurities. Emphasis on theory underlying the design of water quality control technologies.

Letter grade only (A-F). (Lecture-Problems 3 hours). Same course as CE 364H. Not open for credit to students with credit in CE 364H.

364H. Environmental Engineering I: Fundamentals (3)

Prerequisites: CHEM 111A, BIOL 200/MICR 200 all with a grade of "C" or better.

Prerequisite/Corequisite: CE 335.

Introduction to the fundamental physical, chemical and biological processes affecting air and water quality. Models of transport and transformation of impurities. Emphasis on theory underlying the design of water quality control technologies.

Letter grade only (A-F). CE 364H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CE 364. (Lecture-problems 3 hours)

365. Environmental Engineering Laboratory (1)

Prerequisite/Corequisite: CE 364.

Experiments in routine water quality analysis and environmental engineering applications.

Letter grade only (A-F). (Laboratory 3 hours)

370. Analytical Mechanics (3)

Prerequisites: PHYS 151 with a grade of "C" or better.
Prerequisite/Corequisite: MATH 123.

Fundamental principles of statics, kinematics and kinetics, with application to idealized structures and systems.

Intended for Electrical Engineering majors. Not open for credit to Civil or Mechanical Engineering majors. Letter grade only (A-F). (Lecture-Problems 3 hours)

404. Laboratory Techniques (1)

Prerequisites: ENGL 100 or GE Composition (Area A1) with a grade of "C" or better., senior standing in Civil Engineering and consent of instructor.

Study in the techniques of organizing and directing of the civil engineering laboratory.

May be repeated to maximum of 3 units. Letter grade only (A-F). (Conference 1 hour, Laboratory 3 hours)

405. Selected Topics in Civil Engineering (3)

Prerequisites: Senior standing in civil engineering and consent of instructor.

Selected topics from recent advances in civil engineering. Course content will vary from year to year.

Letter grade only (A-F). May be repeated to a maximum of 6 units. Topics announced in *Schedule of Classes*. (Lecture-Problems 3 hours)

406. Project Cost-Benefit Analysis (3)

Prerequisite: GE Foundation requirements.

Systematic evaluation of the economic and social benefits and costs of projects. Decision-making in an environment of limited resources, environmental and economic constraints, and uncertainty. The economy of multi-year projects, selection among competing independent alternatives, before and after tax analyses, replacement economy and inflation.

Letter grade only (A-F). (Lecture-Problems 3 hours). Same course as CE 406H. Not open for credit to students with credit in CE 406H.

406H. Project Cost-Benefit Analysis (3)

Prerequisite: GE Foundation requirements.

Systematic evaluation of the economic and social benefits and costs of projects. Decision-making in an environment of limited resources, environmental and economic constraints, and uncertainty. The economy of multi-year projects, selection among competing independent alternatives, before and after tax analyses, replacement economy and inflation.

Letter grade only (A-F). CE 406H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CE 406. (Lecture-Problems 3 hours)

408. Special Problems (1-3)

Prerequisite: Senior standing in civil engineering.

Assigned topics in technical literature or laboratory projects and report on same.

Letter grade only (A-F).

426. Transportation Engineering (3)

Prerequisite: CE 345 with a grade of "C" or better.
Corequisite: CE 406.

Integrative learning course on transportation engineering. Characteristics of driver, pedestrian, vehicle, and road; traffic flow; intersection design and control, planning, and geometric design; safety issues. Team project, oral presentations, and written reports required.

Letter grade only (A-F). (Lecture-Discussion 3 hours). Same course as CE 426H. Not open for credit to students with credit in CE 426H.

426H. Transportation Engineering (3)

Prerequisite: CE 345 with a grade of "C" or better.

Corequisite: CE 406.

Integrative learning course on transportation engineering. Characteristics of driver, pedestrian, vehicle, and road; traffic flow; intersection design and control, planning, and geometric design; safety issues. Team project, oral presentations, and written reports required.

Letter grade only (A-F). CE 426H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in CE 426. (Lecture-Discussion 3 hours)

427. Highway Design (2)

Prerequisite: CE 345 with a grade of "C" or better.

Corequisite: CE 427L

Geometric design of highways and streets. Route location and earthwork computation. Introduction to roadside and pavement design. Design problems in highway engineering.

Letter grade only (A-F). (Lecture-Problems 3 hours)

427L. Highway Design Laboratory (1)

Co-requisite: CE 427.

Geometric highway design project, horizontal alignment, vertical alignment, cross section, earthwork calculation, environmental impact, use of software application.

Letter grade only (A-F). (Laboratory 3 hours)

428. Highway Engineering Materials (2)

Prerequisites: CE 200 and CE 345 all with a grade of "C" or better.

Corequisite: CE 428L

Design and properties of highway materials, including aggregates, asphalt binder, and mixtures. Hot Mix Asphalt (HMA) aggregate gradation, blending procedure, volumetrics, design, plant operation, and lay down. Superpave binder testing and specifications.

(Lecture 2 hours) Letter grade only (A-F).

428L. Highway Engineering Materials Laboratory (1)

Co-requisite: CE 428.

Laboratory testing for aggregate, asphalt binder, and asphalt concrete mixture.

Letter grade only (A-F). (Laboratory 3 hours)

429. Traffic Engineering (2)

Corequisite: CE 426, CE 429L.

Capacity and level of service analyses of highway facilities. Intersection signal timing design. Introduction to traffic control devices. Volume, speed and delay studies. Use of traffic data for design, planning and operational levels of analyses.

Letter grade only (A-F). Graduate students required to do extra projects. (Lecture-Problems 3 hours)

429L. Traffic Engineering Laboratory (1)

Corequisites: CE 426, CE 429

Laboratory activities on traffic flow theory, capacity and level of service analyses, signal timing, parking lot design, and travel demand forecasting; traffic volume, speed and delay studies. Use of traffice engineering software.

(Laboratory 3 hours) Letter grade only (A-F). Not open for credit to student with credit in CE 430.

435. Hydrology and Water Resources Engineering (3)

Prerequisite: C E 335 with a grade of "C" or better.

Fundamental surface and ground water hydrology concepts and quantitative methods. Selected topics and procedures of the hydrological cycle. Planning, development and management of water resource surface systems.

Letter grade only (A-F). (Lecture-Problems 3 hours)

437. Engineering Hydraulics (3)

Prerequisites: C E 335, MATH 370A all with a grade of "C" or better.

Analysis of steady flow in pipe and pipeline networks, and centrifugal pump systems. Theory and analysis of uniform and non-uniform flow in open conduits. Design of lined and unlined channels, computations of critical, gradually, and rapidly varied flows.

Letter grade only (A-F). (Lecture-Problems 3 hours)

438. Hydraulic Engineering Design I (2)

Corequisites: CE 437, CE 438L

Application of hydraulic principles to the design of dams, water courses, water systems and their related structures and devices.

Letter grade only (A-F). (Lecture 2 hours)

438L. Hydraulic Design I Laboratory (1)

Corequisite: CE 437 and CE 438

Computer laboratory applications to the design of water courses, water systems and their related structures and devices

Letter grade only (A-F). (Laboratory 3 hours)

439. Fundamentals of Groundwater Flow and Contaminant Transport (3)

Corequisite: CE 437

Introduction to principles of groundwater flow and contaminant transport. Groundwater remediation methods. Mathematical description of flow and transport in the subsurface with software applications.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

445. Geotechnical Engineering II (3)

Prerequisites: CE 345, CE 346 all with a grade of "C" or better.

Methods of design and construction of various geotechnical engineering projects utilizing theory of soil mechanics.

Letter grade only (A-F). (Lecture-Problems 3 hours)

446./542. Geotechnical Projects (3)

Prerequisite: CE 345 with a grade of "C" or better.

Design and problem solving oriented geotechnical projects utilizing soil mechanics theory and experimental methods according to the state-of-the-art practice.

Letter grade only (A-F). Graduate students required to do additional readings and write a research term paper to deal with current topics in geotechnical engineering. (Lecture-Problems 3 hours).

454. Structures Laboratory (1)

Prerequisite: CE 359 with a grade of "C" or better.
Corequisite: CE 459.

Laboratory examination of structural concepts. Utilize computer simulation modeling techniques in combination with structural tests.

Letter grade only (A-F). (Lecture 3 hours) Not open for credit to students with credit in CE 491.

455. Structural Steel Design (3)

Prerequisite: CE 359 with a grade of "C" or better.

Detailed design of components with typical codes and specifications.

Letter grade only (A-F). (Lecture-Problems 3 hours)

456. Timber Design (3)

Prerequisite: CE 359 with a grade of "C" or better.

Design of various structural elements made of wood material subjected to both vertical and lateral loads. Application of current building codes and specifications in timer design.

Letter grade only (A-F). (Lecture-Problems 3 hours)

458. Structural Analysis II (3)

Prerequisite: CE 359 with a grade of "C" or better.

Solution of indeterminate truss and frame structures using moment distribution and slope deflection methods. Introduction to matrix methods. Energy theorems and virtual work principles. Use of code based finite element computer programs in the analysis of indeterminate structural systems.

Letter grade only (A-F). (Lecture-Problems 3 hours)

459. Reinforced Concrete Design I (3)

Prerequisites: C E 200 and CE 359 all with a grade of "C" or better.

Theory and design of structural elements of reinforced concrete, analysis by working stress and ultimate strength design theories.

Letter grade only (A-F). (Lecture-Problems 3 hours)

464. Environmental Engineering II: Unit Processes (3)

Prerequisites: CE 335 and CE 364 all with a grade of "C" or better.

Civil engineering applications of the fundamentals of chemical reactions, kinetics of biochemical systems, gas transfer systems, liquid/solid separations, solubility equilibria, adsorption, ion exchange and membrane processes.

Letter grade only (A-F). (Lecture-Problems 3 hours)

466. Environmental Systems Design (3)

Prerequisite: CE 335 and CE 364 with a grade of "C" or better.

Principles of water treatment plant design, including intake stations, rapid and mixing tanks, clarifiers, filters and disinfection basins as well as wastewater treatment plant design, including primary, secondary and tertiary treatment with hydraulic profiles, equipment lists and control systems.

Letter grade only (A-F). (Lecture-Problems 3 hours)

481. Professional Practice In Civil Engineering (1)

Prerequisite: Senior standing.

Topics related to practice of civil engineering profession. Professional society meetings and readings.

Letter grade only (A-F). (Lecture-Problems 1 hour)

490. Senior Design Project (3)

Prerequisite(s): CE 459; completion of all 300-level engineering courses for the civil engineering major all with a grade of "C" or better and consent of department undergraduate advisor.

Prerequisite(s)/Corequisite(s): CE 426, CE 437.

Capstone design that fulfills integrative capstone design course. A supervised design team project, incorporating all aspects from concept to completed design. Technical aspects, social, environmental, and economic issues considered. Ethical concepts discussed. Oral presentations and written reports are required.

Letter grade only (A-F). (Lecture-Problems 2 hrs, Design lab 3 hrs)

495. Seismic Design I (3)

Prerequisites: CE 459 with a grade of "C" or better.

Elements of lateral-force design in steel, concrete, masonry, and timber structures. Application of current building codes.

Letter grade only (A-F). (Lecture 3 hours)

497. Senior Problem Directed Studies (2)

Prerequisites/Corequisites: CE 406, CE 481, CE 490.

Directed study on assigned topics or lab/field studies practicum and report on same.

Letter grade only (A-F).

GRADUATE LEVEL

500. Engineering Analysis I (3)

Prerequisites: MATH 370A with a grade of "C" or better.

Application of analytical methods to engineering problems. Differential equations and series solutions, Bessel functions and Legendre polynomials, boundary value and eigenvalue problems, Fourier series, partial differential equations, vector analysis.

Letter grade only (A-F). (Lecture-Problems 3 hours)

501. Engineering Analysis II (3)

Prerequisite: MATH 370A with a grade of "C" or better.

Analysis of engineering mechanics by matrix theory and complex variables; introduction to numerical techniques.

Letter grade only (A-F). (Lecture-Problems 3 hours)

502. Finite Element Method and Applications (3)

Prerequisite: CE 458 with a grade of "C" or better or consent of instructor

Introduction of the theory of finite element method and its application to mechanics of structures and solids. Variational calculus, discretization of continuum, discrete element stiffness matrices, displacement and force vector, direct stiffness formulation, and solution methods for linear equations.

(Lecture-Problems 3 hours) Letter grading only (A-F).

503. Selected Topics in Civil Engineering (3)

Prerequisites: Graduate standing and consent of instructor.

Selected topics, with laboratory work required, from the most recent developments in civil engineering.

Letter grade only (A-F). May be repeated to a maximum of 6 units. Topics announced in the *Schedule of Classes*. No more than 6 units of CE 503 or CE 504 may be counted for the Master's Degree. (Lecture-Problems 2 hours, Laboratory 3 hrs)

504. Selected Topics in Civil Engineering (3)

Prerequisite: Graduate standing or consent of instructor.

Selected topics from recent developments in civil engineering.

Letter grade only (A-F). May be repeated to a maximum of 6 units. Topics announced in the *Schedule of Classes*. No more than 6 units of CE 503 and/or CE 504 may be counted for the master's degree. (Lecture-Problems 3 hrs)

508. Probabilistic and Statistical Methods in Engineering Applications (3)

Prerequisite: Graduate standing or consent of instructor.

Civil Engineering applications of nondeterministic models and decision theory. Applications of proven statistical computer programs.

Letter grade only (A-F). (Lecture-Problems 3 hours)

509. Computational Methods in Civil Engineering (3)

Prerequisite: Graduate standing or consent of instructor.

Numerical analysis and computer methods applied to various areas of civil engineering. Application of proven computer methods, including special problem-oriented languages.

Letter grade only (A-F). (Seminar 3 hrs)

516. Timber Design II (3)

Prerequisite: CE 359 and CE 456 all with a grade of "C" or better.

Structural behavior of timber buildings/wood structures under seismic load. Analysis/design of nonrectangular buildings, horizontal diaphragms and shearwalls. Analysis/design of member under biaxial bending and axial force. Load/resistance factor design (LRFD) for wood construction. Current building codes/ specifications in advanced timber design.

Letter grade only (A-F). (Lecture-Problems 3 hours)

517. Reinforced Masonry Design (3)

Prerequisite: CE 359 with a grade of "C" or better.

Theory, design and application of reinforced masonry (brick and block) in compliance with latest Building Code. Earthquake provisions. Construction and specifications. Design of high rise buildings, industrial buildings and retaining walls.

Letter grade only (A-F). Graduate students required to do a design project and assigned readings from journals and research papers. (Lecture-Problems 3 hours)

520. Seaport Planning and Design (3)

Prerequisite: CE 426 with a grade of "C" or better or consent of instructor.

Planning and design of seaports and facilities as access systems. Support transportation, use analysis and ocean transport crafts. Site selection and comprehensive planning.

Letter grade only (A-F).(Lecture-Problems 3 hours)

522. Transportation Planning (3)

Prerequisite: C E 426 with a grade of "C" or better or consent of instructor.

Planning of transportation facilities in urban setting; application of travel forecasting and analytical models in the planning process; evaluation of transportation alternatives and impacts; transportation system and demand management techniques.

Letter grade only (A-F). (Lecture-Problems 3 hours)

526. Pavement Engineering (3)

Corequisite: C E 427 or consent of instructor.

Aggregate, binder systems. Theory and design of pavement structures.

Letter grade only (A-F). (Lecture-Problems 3 hours)

528. Advanced Highway Materials (3)

Prerequisite: CE 428 with a grade of "C" or better or consent of instructor.

Hot mix asphalt design methods and lay down methods. Distress identification and rehabilitation procedures of highway materials.

(Lecture-Discussion 3 hours) Letter grade only (A-F)

529. Advanced Traffic Engineering (3)

Prerequisite/Corequisite: CE 426 or consent of instructor.

Analysis of arterial streets traffic operations. Queuing Analysis; Signal timing coordination and optimization; Use of traffic optimization and simulation computer models to solve problems.

Letter grade only (A-F). (Lecture-Problems 3 hours)

530. Groundwater Flow: Principles and Modeling (3)

Prerequisite: CE 437 with a grade of "C" or better or consent of instructor.

Principles of water flow in the saturated and unsaturated zone. Well hydraulics. Numerical modeling of groundwater flow in the subsurface with computer applications. Groundwater artificial recharge and saline water intrusion.

(Lecture 3 hrs). Letter grade only (A-F).

532. Sediment Transportation (3)

Prerequisite: C E 437 with a grade of "C" or better.

Phenomena of sediment transportation related to streams and marine environments.

Letter grade only (A-F). (Lecture-Problems 3 hours)

533. Groundwater Contaminant Transport: Principles and Modeling (3)

Prerequisites: CE 437, CE 530 all with a grade of "C" or better or consent of instructor.

Mechanisms of contaminant transport in groundwater. Analysis of groundwater remediation methods and alternatives. Numerical modeling of flow and transport in the subsurface. Software applications.

(Lecture 3 hrs). Letter grade only (A-F).

535. Advanced Hydrology (3)

Prerequisite: Graduate standing or consent of instructor.

Theory and application of surface hydrology. Hydrologic statistics, dynamic wave routing, frequency analysis and risk analysis. Simulation of design flows, flood forecasting, flood plain analysis and hydrologic design. Mathematical models, numerical methods in analysis and evaluation.

Letter grade only (A-F). (Lecture-Problems 3 hours)

536. Urban Surface Water Management (3)

Prerequisite: CE 437 with a grade of "C" or better or consent of instructor.

Planning and design of facilities to control flooding, erosion, sedimentation, and non-point source pollution for urban storm water runoff management. Presentation of analysis and design methodologies, structural and non-structural measures for management, and master planning principles.

Letter grade only (A-F). Lecture-Problems 3 hours)

538. Hydraulic Engineering Design II (3)

Prerequisites: C E 437, CE 438 all with a grade of "C" or better or consent of instructor.

Design of water supply networks, hydraulic transitions, controls and structures. Hydraulic power conversion. River engineering. Water resources systems.

Letter grade only (A-F). (Lecture-Problems 3 hours)

542./446. Geotechnical Projects (3)

Prerequisite: CE 345 with a grade of "C" or better.

Design and problem solving oriented geotechnical projects utilizing soil mechanics theory and experimental methods according to the state-of-the-art practice.

Letter grade only (A-F). Graduate students required to do additional readings and write a research term paper to deal with current topics in geotechnical engineering. (Lecture-Problems 3 hours).

543. Waste Management and Landfill Engineering (3)

Prerequisite: Graduate standing or consent of instructor.

Advanced principles and practices of landfill engineering for waste management and subsurface flow problems. Presentation of research and case studies in geotechnical aspects of waste management and landfill engineering.

Letter grade only (A-F). (Lecture-Problems 3 hours)

546. Foundation Engineering (3)

Prerequisite: CE 345 with a grade of "C" or better or consent of instructor.

Foundation, explorations, stress and deformation relationships and design of various footings, piles, piers and caissons. Analysis of lateral loads and design of retaining structures, machinery foundations and foundation dewatering.

Letter grade only (A-F). (Lecture-Problems 3 hours)

547. Geotechnical Earthquake Engineering (3)

Prerequisite: CE 345 with a grade of "C" or better or consent of instructor.

Theory and behavior of dynamically loaded soil. Analysis, design and mitigation of geotechnical projects subjected to earthquake loading. Topics include: soil liquefaction, slope stability, retaining structures, and site response analysis.

Letter grade only (A-F). (Lecture-Problems 3 hours)

548. Advanced Soil Mechanics (3)

Prerequisite: C E 345 with a grade of "C" or better or consent of instructor.

Stress-strain time relationship of soils. Theory and methods of analysis with special emphasis on the applications and limitations in soil engineering.

Letter grade only (A-F). (Lecture-Problems 3 hours)

549. Retaining Structure and Slope Stability (3)

Prerequisite(s): CE 345 or equivalent.

Theory of earth pressures, retaining structures, design of retaining walls, sheet piles, mechanically stabilized earth, soil nails, anchored and braced excavation. Theory of slope stability, including shear strength, design charts, limit equilibrium analysis, seepage analysis, staged construction, and rapid drawdown.

Letter grade only (A-F). (Lecture-Problems 3 hours).

551. Prestressed Concrete (3)

Prerequisite: C E 459 with a grade of "C" or better.

Principles of prestressed concrete. materials used, applications to structural design, review of existing specifications.

Letter grade only (A-F). (Lecture-Problems 3 hours)

552. Theory of Plates and Shells (3)

Prerequisite: Completion of C E Graduate MATH Requirement.

Review of theory of elasticity; formulation of general equation of bending of thin elastic plates; methods of obtaining exact and approximate solutions; membrane and bending theories of shells with emphasis on cylindrical shells and shells of revolution.

Letter grade only (A-F). (Lecture-Problems 3 hours)

553. Behavior and Design of Steel Structures (3)

Prerequisite: C E 455 with a grade of "C" or better.

Study of torsion, unsymmetrical bending, stability. Plastic design, code provisions and commentary. Design of complete structural systems in steel.

Letter grade only (A-F). (Lecture-Problems 3 hours)

554. Analysis and Design with Composite Materials (3)

Prerequisite: Graduate standing or consent of instructor.

Mechanics of composite materials with design applications in aerospace, civil engineering and construction. Lab experiments on composite samples. Project required with canned computer programs.

(Lecture-Problems 3 hrs) Letter grade only (A-F).

555. Earthquake Analysis and Design (3)

Prerequisite/Corequisite: CE 495 or consent of instructor.

Advanced computational methods to evaluate responses of structural systems subjected to earthquake ground motions. Time-history and response spectrum analysis for various structural systems. Innovative earthquake design of buildings and other structures.

Letter grading only (A-F). (Lecture-Problems 3 hours)

557. Advanced Structural Analysis (3)

Prerequisite: C E 458 with a grade of "C" or better or consent of instructor.

Virtual forces and displacements, strain energy and complementary energy. Force and displacement matrix methods. Computer applications to planar and space frames, trusses, floor beams and shear wall systems.

(Lecture-Problems 3 hours) Letter grade only (A-F).

558. Dynamics of Structures (3)

Prerequisite: CE 458 with a grade of "C" or better or consent of instructor.

Response of structures and structural components having one or more degrees of freedom. Damping and inelastic action; earthquake and nuclear blasts, dynamic resistance of structural elements and structures, elastic and inelastic response of structures.

(Lecture-Problems 3 hours) Letter grade only (A-F).

562. Water Treatment System Design (3)

Prerequisite: C E 364 with a grade of "C" or better or consent of instructor.

Design of physical and chemical processes for water treatment plants, intake stations, predisinfection units, rapid mixing tanks, slow mixing tanks, clarifiers, granular filtration tanks and post disinfection basins, hydraulics profiles, equipment lists and control systems.

(Lecture-Problems 3 hours) Letter grade only (A-F).

563. Wastewater Treatment System Design (3)

Prerequisite: C E 562 with a grade of "C" or better or consent of instructor.

Design of physical and chemical biological processes for wastewater treatment, including primary, secondary and tertiary treatment combined with hydraulics profiles, equipment lists and control systems at the plants.

(Lecture-Problems 3 hours) Letter grade only (A-F).

564. Environmental Health Engineering (3)

Prerequisite: CE 364 with a grade of "C" or better or consent of instructor.

Health and safety aspects of environmental quality and related engineering systems. Regulatory aspects. Projects and case studies.

(Lecture-Problems 3 hours) Letter grade only (A-F).

567. Liquid and Solid Waste Project Planning and Management (3)

Prerequisite: CE 364 with a grade of "C" or better or consent of instructor.

The presentation of research and case studies of liquid and solid waste project planning and management.

Letter grade only (A-F). (Lecture-Problems 3 hours)

570. Engineering Management Principles and Practices (3)

Prerequisites: CE 406 with a grade of "C" or better, graduate standing or consent of instructor.

Transition of engineers into management. Analysis of technical manager's functions at lower and middle levels as support to corporate management. Principles of engineering management and applications to private and public sector organizations. Case studies of practices in different technical organizations.

Letter grade only (A-F).(Lecture 3 hours)

571. Construction Planning and Cost Control (3)

Prerequisite: Graduate standing or consent of instructor.

Planning, scheduling and resource allocation for a complex construction project. Topics include traditional critical path method, advanced computer expert systems and optimization techniques for construction planning and cost control.

Letter grade only (A-F). (Lecture-Problems 3 hours)

573. Engineering Specifications, Law and Contracts (3)

Prerequisite: Graduate standing or consent of instructor.

Application of law of contracts to construction contracts. Legal matters of concern to engineers.

(Lecture-Problems 3 hours) Letter grade only (A-F).

574. Methods, Analysis and Design of Construction Operations (3)

Prerequisite: CE 571 with a grade of "C" or better or consent of instructor.

Equipment, methods, analysis and design of a construction operation, from site work improvement and data acquisition to modeling and design. Particular attention will be paid to interfacing between design and construction activities and work method development, productivity and safety.

(Lecture-Problems 3 hours) Letter grade only (A-F).

576. Construction Organization and Management (3)

Prerequisite: Graduate standing or consent of instructor.

An introduction to construction organization, control concepts and labor, emphasizing the business aspects of construction management. Topics include legal framework, finance in construction management, labor, accounting and other decision making in the construction business.

(Lecture-Problems 3 hours) Letter grade only (A-F).

577. Accounting and Finance in Construction Management (3)

Prerequisite: CE 406 with a grade of "C" or better or consent of instructor.

Economics and business aspects in construction, financing structure, methodology, and project financial evaluation. Emphasis is on financial aspects in property acquisition, development, construction, and project management.

(Lecture-Problems 3 hours) Letter grade only (A-F).

578. Management of Advanced Technologies in Construction (3)

Prerequisite: Consent of instructor.

New development of advanced technology as applied to construction industry. Productivity and competitiveness in construction on the basis of new technology. Comparison of construction innovation in the U.S., Japan, and other countries.

(Lecture-problems 3 hours) Letter grade only (A-F).

581. Sustainability and Green Construction (3)

Prerequisite: Graduate standing or consent of instructor.

Comprehensive coverage of the green building design and construction practices through high-performance, market-leading design, construction, and operation practices. Presents the green operations and management of new construction and major renovation projects, with emphasis on green building rating systems.

(Lecture 3 hours) Letter grade only (A-F).

582. Management of Productivity and Quality (3)

Prerequisite: CE 570 with a grade of "C" or better or consent of instructor.

System approaches to quality and productivity in construction. Total Quality Management (TQM) in construction and management. Investigation of methods and strategies for improving competitiveness at the company level. Domestic and international competitiveness in the construction business.

(Lecture-Problems 3 hours) Letter grade only (A-F).

585. Utility Rehabilitation and Construction (3)

State of infrastructure systems with a focus on underground facilities, diagnostic and evaluation techniques of underground utility pipes, planning, equipment, materials and methods for rehabilitation and construction of sewer and water mains using Trenchless (i.e. NO-DIG) Technology.

(Lecture-Problems 3 hours). Letter grade only (A-F).

602. Seminar in Civil Engineering (3)

Prerequisite: Graduate Standing or consent of instructor.

Presentation of research in special fields of structures, transportation, environmental, urban, geotechnical, water resources, or construction management. May be repeated once for credit. No more than six units of CE 602.

(Lecture-Problems 3 hours) Letter grade only (A-F).

629. Traffic Operations (3)

Prerequisite: CE 429 or CE 529 all with a grade of "C" or better, or consent of instructor.

Principles of traffic flow. Highway traffic operations. Evaluation of quality of traffic operations including long-range impact on efficient use of the systems and on safety. Identification and evaluation of measures of effectiveness. Travel demand management strategies and intelligent transportation system applications.

(Lecture-Problems 3 hours) Letter grade only (A-F).

630. Mathematical Modeling in Hydraulic Engineering (3)

Prerequisite: CE 437 with a grade of "C" or better or consent of instructor.

Numerical techniques for solving hydraulic problems in water supply, waste water disposal and storm drainage systems. Prediction of important parameters by mathematical modeling on problems encountered in artificial channels, rivers, estuaries and marine environments.

(Lecture-Problems 3 hours) Letter grade only (A-F).

640./740. Mathematical Modeling in Geotechnical Engineering (3)

Prerequisite: Graduate standing or consent of instructor.

Mathematical modeling techniques used in geotechnical engineering. Application of proven computer programs.

M.S. students register in CE 640; Ph.D. students register in CE 740. Ph.D. students will be required to complete a more rigorous computer project. (Lecture-Problems 3 hours) Letter grade only (A-F).

696. Research Methods (1)

Prerequisite: Candidacy or consent of instructor.

Bibliographical and library techniques and resources. Preparation and presentation of theses and directed studies technical papers.

Letter grade only (A-F).

697. Directed Studies (3)

Prerequisites: Advancement to candidacy for degree of Master of Science in Civil Engineering, and CE 696 or consent of directed studies faculty advisor.

MSCE and MSE degree candidates in Civil Engineering and Interdisciplinary Areas need to have either CE 697 or CE 698 as their program requirement. Theoretical and experimental problems in civil engineering requiring intensive analysis.

Letter grade only (A-F).

698. Thesis (2-6)

Prerequisites: Advancement to candidacy for degree of Master of Science in Civil Engineering, and CE 696 or consent of directed studies faculty advisor.

Planning, preparation and completion of a thesis and/or project in the field of civil engineering.

Letter grade only (A-F). May be repeated to a maximum of 6 units.

699. Thesis (3-9)

Prerequisite: Admission to candidacy for degree of Civil Engineer. Corequisite: C E 696 or written consent of faculty advisor.

Planning, preparation and completion of a thesis in the field of civil engineering practice.

Letter grade only (A-F). May be repeated to a maximum of 9 units.

740./640. Mathematical Modeling in Geotechnical Engineering (3)

Prerequisite: Graduate standing or consent of instructor.

Mathematical modeling techniques used in geotechnical engineering. Application of proven computer programs.

M.S. students register in CE 640; Ph.D. students register in CE 740. Ph.D. students will be required to complete a more rigorous computer project. (Lecture-Problems 3 hours) Letter grade only (A-F).

Construction Management Courses (CEM)

LOWER DIVISION

121. Construction Drawing I (2) F

An introduction to conventional and computer aided drafting techniques in the relation of drawings for construction. Interpretation of details in construction drawings/blueprints and reference materials. Laboratory: Drafting plans for a residential building using the techniques introduced in the course.

(Lecture 1 hr, laboratory 3 hrs) Letter grade only (A-F).

125. Fundamentals of Construction (3)

Survey of the professional activities and environments of Construction Education. Overview of residential, commercial, institutional, industrial, and heavy civil construction and associated codes, standards, and ethical boundaries. Areas of focus to include type of foundations, materials, contract documents, working drawings and vocabulary.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

200. Concrete Construction (1)

Prerequisite: CEM 125 with a grade of "C" or better. Corequisite: CEM 200L.

Concrete composition, Concrete mix design technology, physical properties of concrete, use of admixtures, concrete batching, curing, testing. Includes physical testing of designed mixes. Modern concepts as fundamental solution to concrete construction challenges. New developments in concrete chemistry and strength theory.

Letter grade only (A-F). Not open for credit to students with credit in CEM 235. (Lecture-Discussion 1 hour)

200L. Concrete Construction Laboratory (1)

Corequisite: CEM 200.

Laboratory exercises in support of CEM 200, Concrete Construction. Develop concrete mix designs and prepare concrete samples for testing, such as compressive strength, slump and air entrainment, and aggregate testing.

(Laboratory 3 hours) Letter grade only (A-F). Not open for credit to students with credit in CEM 235L.

201. Cost Accounting for Construction Engineering (3)

Theoretical Practical and concepts of cost accounting. Variable and fixed costs, break-even point, interrelationships of cost, volume and profits; job-order accounting, general and flexible budgeting, standard costs; product costing methods; cost allocation; inventory planning; control and valuation; joint product.

(Lecture-Problems 3 hours) Letter grade only (A-F).

202. Probability and Statistics for Construction Engineering Management (2)

Prerequisite: High School Algebra.

Statistics and probability theories, sampling, correlation, regression applied to Construction Management. Projects on simulation using statistical packages

(1 hour lecture, 2 hours activity.) Letter grade only (A-F).

204. Applied Mechanics–Statics (3)

Prerequisites: MATH 122 and PHYS 100A all with a grade of "C" or better.

Provides an overview of the principles of statics as it relates to building structures and machines. Equilibrium of forces. Free body diagrams. Force components. Bending moments. U.S. and S.I. units of measurements.

(Lecture 2 hours, Activity 2 hours) Letter grade only (A-F).

206. Trends in Construction Engineering Management (2)

Prerequisites: CEM 121 and CEM 125 all with a grade of "C" or better.

Introduction to current trends including emerging technologies and practices in Construction Management (CEM). Applications of the emerging technologies and practices in CEM problem solving.

(Lecture 1 hr, laboratory 3 hrs) Letter grade only (A-F).

225. Residential and Light Commercial Construction Practices and Estimating (3)

Prerequisites: CEM 121, CEM 125 with a grade of "C" or better.
Corequisites: CEM 200, CEM 200L.

Introductory course in planning, design, and construction of residential and light commercial buildings including materials, equipment, construction/assembly methods, quantity take-off, and building codes/standards. Field trips or visual presentation is required.

(Seminar 2 hours and Activity 2 hours) Letter grade only (A-F).

UPPER DIVISION

304. Applied Mechanics Strength of Materials (2)

Prerequisite: CEM 204 with a grade of "C" or better.

Strength of structural materials and applications in building structures and machines. Mechanical properties of materials, structural behaviors of load resisting components associated with construction processes.

(Lecture-Discussion 1 hr, Activity 2 hrs) Letter grade only (A-F).

310. Communication in Engineering Profession (3)

Prerequisites: ENGL 100 or GE Composition (Area A1), COMM 110 all with a grade of "C" or better and Senior standing.

Basic concepts for understanding/practice of communication in world of business for managers and professionals. Language/ conversations in business and role in coordinating actions, resolving breakdowns in work and customer satisfaction. Business writing formats, formal report, business conversation. International, technical, and linguistic developments in business communication.

(Lecture - Discussion 3 hours) Letter grade only (A-F).

315. Construction Safety (2)

Prerequisite: CEM 225 or CE 200 all with a grade of "C" or better.

Terminology, safety functions, accident costs, workman's compensation and liability laws, O.S.H.A., governmental and non-governmental codes, regulations and field safety methods pertinent to the construction industry. Field trips.

Not open for credit to students with credit in CEM 328. (Lecture 1 hour , Activity 2 hours) Letter grade only (A-F).

320. Operations Management in Contemporary Organizations (3)

Prerequisites: MGMT 300, ENGR 310 all with a grade of "C" or better.

Overview of Managerial and organizational theories and practices - introduction to concepts, methods to analyze and improve operations performance in construction and in service organizations. Decision-making and problem-solving processes for organizations. management Effectiveness and efficiency at the organizational, process level, and performer level.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

324. Commercial, Institutional and Industrial Construction Practices and Estimating (3)

Prerequisites: CEM 315 with a grade of "C" or better.

Fundamental of commercial construction, including building layout, shallow and deep foundations, introduction to formwork systems, high strength, heavy and light weigh concrete, framing, flooring and roofing systems, construction and expansion joints, masonry and steel construction. Quantity takeoff.

(Lecture-Discussion 2 hours, Activity 2 hours). Letter grade only (A-F).

335. Soil Mechanics Technology (2)

Prerequisite: CEM 304 with a grade of "C" or better.
Corequisite: CEM 335L.

Soil Composition, description, and classification; soil compaction; determination of physical properties of soils.

(Lecture-Problems 2 hours) Letter grade only (A-F).

335L. Soil Mechanics Technology Laboratory (1)

Prerequisite: CEM 304 with a grade of "C" or better.
Corequisite: CEM 335.

Laboratory investigations and experiments in the phenomena of soil mechanics. Field trips.

(Laboratory 3 hours) Letter grade only (A-F).

365. Mechanical Equipment for Buildings (2)

Prerequisite: PHYS 100B with a grade of "C" or better.
Corequisite: CEM 324.

Principles and current practices in water supply, waste disposal, heating, ventilating, air conditioning and fire protection.

(Lecture 1 hour and Activity 2 hours) Letter grade only (A-F).

373. Fundamentals of Integrated Project Delivery (3)

Prerequisite: Junior standing.

General overview of the attributes of all major project delivery systems, procurement methodologies and contracting appraoches.

(2 hrs lecture, 2 hrs activities) Letter grade only (A-F).

375. Electrical Equipment for Buildings (2)

Prerequisites: CEM 324, PHYS 100B all with a grade of "C" or better.

Principles and current practices in the application of electrical equipment and material utilization, sound and signal systems.

(Lecture 1 hour, Activity 2 hours) Letter grade only (A-F).

404. Structural Design I (2)

Prerequisite: CEM 304 with a grade of "C" or better.

Fundamentals of design for structural concrete and masonry buildings in compliance with current building codes.

(Lecture 1 hour, Activity 2 hours) Letter grade only (A-F).

409. Directed Studies in Construction Engineering Management (3)

Prerequisites: Senior standing in CEM or consent of instructor.

Advanced work of a technical nature within area of specialization on an experimental or research basis.

Letter grade only (A-F). Not open to students who have previously obtained 1-2 units of this course.

421. Construction Planning and Scheduling (3)

Prerequisite: CEM 324 with a grade of "C" or better.

Planning and scheduling of construction projects by graphic charts and Critical Path Method (CPM) networks utilizing manual and computer methods.

Letter grade only (A-F). Field trips. (Lecture-Discussion 2 hrs, Activities 2 hrs)

425. Earthwork and Civil Works Construction Practices (2)

Prerequisite: CEM 324, CE 406 all with a grade of "C" or better.

Fundamentals of earthmoving operations, including volume calculation and mass diagrams, soil protection and dewatering systems, volume change characteristics and fundamentals of moving earth, equipment selection, management and economics.

(Seminar 1 hour and Activity 2 hours) Letter grade only (A-F).

426. Business and Construction Law (3)

Prerequisites: CEM 324; BLAW 220 all with a grade of "C" or better.

Contractors license, mechanics lien, subdivision laws; public works projects, bid and bid requirements. Litigation and legal trends in affirmative action, design professional's liability. Administrative procedures of contractors. Study documentation, claims, waivers, arbitration, bonding, insurance, and indemnification. Discuss ethical practices.

(Lecture-Discussion 3 hrs.) Letter grade only (A-F).

429. Advanced Estimating and Bidding (3)

Prerequisite: CEM 315 with a grade of "C" or better.
Corequisite: CEM 425.

Concept and practices involved in the total estimate bidding process in construction, form initial project selection for submission of final bids. A complete project estimate and bid is prepared by each study.

(Lecture 2 hours, Activity 2 hours) Letter grade only (A-F).

431. Construction Cost Control (3)

Prerequisites: CE 406 and CEM 421 all with a grade of "C" or better.

Establishing and controlling construction projects cost through utilization of procedures, techniques and systems commonly used to control resources allocated and to be expended on construction projects.

(2 hrs lecture, 2 hrs activities) Letter grade only (A-F).

432. Facility Administration (3)

Prerequisite: CEM 421 with a grade of "C" or better.

Management skills for facility management. Emphasis is placed on the management functions of planning, organizing, directing and controlling. topics include: negotiation; communication; performance measurement; job enrichment; motivation; contracting services and interpersonal relationships.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

433. Facility Finance Management (3)

Corequisite: CEM 432.

Analysis of financial management strategies associated with facility management. Topics include: buy-lease considerations; building efficiency; leasing considerations; cost control and record keeping; facility capitalization; facility budgeting; cost benefit analysis and financial reports.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

434. Facility and Property Management (3)

Prerequisite: CEM 433 with a grade of "C" or better.

Principles of facility and property management. Topics include: property development; cost benefit analysis; site selection; architectural design; layout plans; building engineering; specifications; stacking and blocking plans; aesthetic standards; renovation and contracting standards.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

436. Facility Operations Management (3)

Prerequisite: CEM 432 with a grade of "C" or better.

Analysis of the functions of facility operations management. Topics include: building systems; mechanical systems; energy management; electrical systems; trades operations; grounds maintenance; custodial; furniture and equipment; waste removal contracting services; furniture standards; security systems and planned maintenance.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

438. Structural Design II (2)

Prerequisite: CEM 304 with a grade of "C" or better.

Simplified designs for steel and wood structures in accordance with current building codes. Selection of structural steel and wood systems with structural characteristics of members and connections.

(Lecture 1 hour, Activity 2 hours) Letter grade only (A-F).

443. Principles of Design-Build Project Delivery (3)

Prerequisite: CEM 373 with a grade of "C" or better.

General overview and unique distinguish essential elements of design-duild project delivery and how to make the mental-shift needed to transition from traditional Design-Bid-Build to design-build project delivery.

(2 hrs lecture, 2 hrs activities) Letter grade only (A-F).

476. Construction and Maintenance of Infrastructure Facilities (2)

Prerequisites: CEM 425 with a grade of "C" or better.

Comprehensive coverage of the construction principles and technologies embraced by the heavy civil industry. The course presents the construction methods and maintenance practices of heavy civil projects, with emphasis on utility pipes, bridges and roads.

(Lecture 1 hour - Activity 2 hours) Letter grade only (A-F).

485. CEM Senior Seminar (3)

Prerequisites: CEM 429 and CEM 431 all with a grade of "C" or better or consent of instructor.

Advanced work of a technical nature within the construction industry. All students will be required to participate into the Bid Competitions.

(Lecture 2 hours, Activity 2 hours). Letter grade only (A-F).

486. Infrastructure Management (2)

Prerequisites: CEM 476 and CE 406 all with a grade of "C" or better.

Integrated approach to infrastructure management theories and practices including: tools, models and applied systems. The course presents the principles required to manage, preserve and improve the performance of infrastructure systems, with emphasis on utility pipes, bridges and roads.

(1 hr lecture, 2 hrs activities) Letter grade only (A-F).

490. Construction Project Management (3)

Prerequisites: CEM 426, CEM 429 and CEM 431 all with a grade of "C" or better.

Integrative learning capstone design course. A supervised design team project, incorporating all aspects of project management of design-build projects. Technical aspects, social, environmental, and economic issues considered. Ethical concepts discussed. Oral presentations and written reports are required

(2 hrs lecture, 2 hrs activities) Letter grade only (A-F).

COMPUTER ENGINEERING AND COMPUTER SCIENCE

College of Engineering

Department Chair: Burkhard Englert

Department Office: Engineering & Computer Sciences (ECS) 552
Telephone: (562) 985-4285
Website: http://www.csulb.edu/colleges/coe/cecs

Faculty: Mehrdad Aliasgari, ~~Shaonaz~~ Shadnaz Asgari, Anastasios Chassiakos, Michael Chelian, Todd Ebert, Burkhard Englert, Darin Goldstein, Min He, Michael Hoffman, Ken James, Tom Johnson, Shui Lam, Tracy Bradley Maples, Alvaro Monge, Frank Murgolo, Thinh Nguyen (Emeritus) , Xiaolong Wu, Biogit Penuzeustadler

Undergraduate Advisors: Michael Chelian, ~~Frank Murgolo~~ Alvaro Mouge

Graduate Advisor: Tom Johnson

General Education Advising: Academic Advising - Horn Center

Minor and Certificate Advisor: Michael Chelian, Alvaro Mouge

Administrative Support Coordinator: Robin Ikemi

Administrative Support Assistant: Karyl Anthony

Students desiring detailed information should contact the department for referral to one of the faculty advisors.

Career Possibilities

Computer Engineer • Software Engineer • Systems Analyst • Hand-held Appliance Programmer • Web Application Developer • Mainframe Programmer • Applications Programmer • LAN/WAN Administrator • Systems Administrator • Computer Service Representative • Database Administrator • Technical Services Manager • Telecommunications Analyst (Some of these, and other careers, require additional education or experience. For more information, see www.careers.csulb.edu.)

ABET Accreditation

The Bachelor of Science in Computer Engineering is accredited by the Engineering Accreditation Commission and the the Bachelor of Science in Computer Science is accredited by the Computing Accreditation Commission of ABET, http://www.abet.org.

Advisory Board

The Department of Computer Engineering and Computer Science is supported by an Advisory Board composed of engineers, computer scientists, and business executives in the Southern California area. This liaison helps the department keep its curricula responsive to the needs of the community.

Undergraduate Degree Programs

The degree in Computer Engineering focuses on computer hardware (design, construction, and operation of computer systems). The Computer Science degree places more emphasis on computer software (databases and user development). The high school student planning to enter either program is advised to pursue a strong program in science and mathematics.

Students will receive a comprehensive education in computer engineering and/or computer science, as well as the sciences and humanities, and will be able to communicate effectively. They will be able to design systems, components or processes that meet performance, cost, time, safety, and quality requirements. They will understand professional responsibilities and will be able to analyze the social and ethical implications of their work.

Undergraduate Programs

Bachelor of Science in Computer Engineering (120 units)

This program provides students with a strong background in mathematics, physics, and engineering science. Courses, especially those in the junior and senior years, emphasize an open-ended, design-oriented approach to solving engineering problems. Teamwork, communication skills, and an interdisciplinary approach to problem solving are integrated into the senior computer engineering design courses.

Program Educational Objectives

After graduation and engaging in the profession of Computer Engineering for a few years, our graduates will have:

- become a part of California's high technology workforce, and made significant contributions to Computer Engineering through the research, design and development of a wide range of embedded systems and system-on-chip applications.
- helped further the state's economic growth by developing innovative ideas, and translating them into commercial products that benefit society.
- functioned effectively as team members and/or leaders in multidisciplinary and multicultural environments.
- recognized the societal and global context of their work and understood professional and ethical responsibilities.
- continued the pursuit of lifelong learning through such activities as graduate school, distance education, professional training and membership in professional societies and been able to adapt to new engineering tools.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Computer Engineering). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Computer Engineering must also

meet similar major specific requirements. To become fully admitted into the Computer Engineering major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower-Division Major Requirements:
MATH 122 (Calculus I), MATH 123 (Calculus II), PHYS 151 (Mechanics & Heat)

General Education Foundations Courses:
Written Communication, Oral Communication, and Critical Thinking

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 122 within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 123 and PHYS 151 within one calendar year.

Requirements

Lower Division:

Take all of the following courses:

CECS 100 Critical Thinking in the Digital Information Age (3)
Prerequisite/Corequisite: ENGL 100 or its equivalent all with a grade of "C" or better.

CECS 105 Introduction to Computer Engineering and Computer Science (1)
Prerequisites: None.

CECS 174 Introduction to Programming and Problem Solving (3)
Prerequisite: CECS 100 and MATH 113 (or equivalent) all with a grade of "C" or better.

CECS 201 Computer Logic Design I (3)
Prerequisite: MATH 113 or equivalent all with a grade of "C" or better.

CECS 211 Principles of Computer Engineering I (3)
Prerequisite: MATH 122 with a grade of "C" or better.

CECS 228 Discrete Structures With Computing Applications I (3)
Prerequisites: CECS 174 and MATH 113 or equivalent all with a grade of "C" or better.

CECS 229 Discrete Structures With Computing Applications II (3)
Prerequisites: MATH 123 and CECS 228 both with a grade of "C" or better.

CECS 262 Introduction to Embedded System Programming (3)
Prerequisites: CECS 174 and CECS 201 all with a grade of "C" or better.

CECS 271 Introduction to Numerical Methods (3)
Prerequisites: CECS 174 and MATH 123 all with a grade of "C" or better.

CECS 274 Object Oriented Programming and Data Structures (3)
Prerequisite: CECS 174 with a grade of "C" or better.

CECS 282 C++ for Java Programmers (3)
Prerequisite: CECS 274 with a grade of "C" or better.

ENGR 101 Intro to the Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122.

ENGR 102 Academic Success Skill (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113.

MATH 123 Calculus II (4)
Prerequisite: A grade of "C" or better in MATH 122.

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

Take one of the following choices:

PHYS 152 Electricity and Magnetism (4)
Prerequisite: PHYS 151; Prerequisite/Corequisite: MATH 123.

or both of the following:

EE 210 Electro-Magnetic Foundations in EE (3)
Prerequisite: PHYS 151 with a grade of "C" or better. Corequisites: MATH 123, EE 210L.

EE 210L Electro-Magnetic Foundations in EE Lab (1)
Corequisite: EE 210.

A Science Elective – Take four units of approved elective to be selected from:

BIOL 200, PHYS 254 and PHYS 255, CHEM 111A

Upper Division:

Take all of the following courses:

CECS 301 Computer Logic Design II (3)
Prerequisites: CECS 174, CECS 201 all with a grade of "C" or better.

CECS 311 Principles of Computer Engineering II (3)
Prerequisites: CECS 201 and CECS 211 all with a grade of "C" or better.

CECS 326 Operating Systems (3)
Prerequisites: CECS 282 and either CECS 285 or CECS 346 all with a grade of "C" or better.

CECS 346 Microprocessors and Controllers I (3)
Prerequisites: CECS 211 and CECS 262 all with a grade of "C" or better.

CECS 347 Microprocessors and Controllers II (3)
Prerequisites: CECS 301, CECS 311, and CECS 346 all with a grade of "C" or better.

CECS 360 Integrated Circuit Design Software (3)
Prerequisites: CECS 301, CECS 346, MATH 123 or MATH 222 all with a grade of "C" or better.

CECS 440 Computer Architecture (3)
Prerequisites: CECS 346 with a grade of "C" or better.

CECS 447 Microprocessors and Controllers III (3)
Prerequisite: CECS 347 with a grade of "C" or better.

CECS 460 System on Chip Design (3)
Prerequisite: CECS 360 with a grade of "C" or better.

CECS 463 System on Chip Applications (3)
Prerequisite: CECS 360 with a grade of "C" or better.

CECS 490A Computer Engineering Senior Project I (3)
Prerequisites: CECS 347 with a grade of "C" or better, senior standing.

CECS 490B Computer Engineering Senior Project II (3)
Prerequisites: CECS 490A with a grade of "C" or better and consent of instructor.

EE 380 Probability, Statistics and Stochastic Modeling (3)
Prerequisites: MATH 123; (EE 202 or CECS 271 or CECS 274) all with a grade of "C" or better.

Take three units of approved elective to be selected from:
CECS 343, CECS 406, CECS 451, CECS 461, CECS

474, CECS 475, CECS 497; EE 386, EE 486; CE 406; ECON 300; CEM 310 (or ENGL 317); ENGR 350; MATH 370A.

A grade of "C" or better must be achieved in all required and elective courses. BIOL 200, CHEM 111A, CE 406; CEM 310; CECS 100, CECS 105, CECS 174, CECS 201, CECS 211, CECS 228, CECS 262, CECS 271, CECS 274, CECS 282, CECS 301, CECS 311, CECS 326, CECS 343, CECS 346, CECS 347, CECS 360, CECS 406, CECS 440, CECS 447, CECS 451, CECS 460, CECS 461, CECS 463, CECS 474, CECS 475, CECS 490A, CECS 490B, CECS 497; ECON 300; EE 210 and EE 210L, EE 380, EE 386, EE 486; ENGL 317; ENGR 101, ENGR 102, ENGR 350; MATH 122, MATH 123, MATH 224, MATH 247, MATH 370A; PHYS 151, PHYS 152, PHYS 254, PHYS 255.

Bachelor of Science in Computer Science (120 units)

This degree is designed to prepare graduates for a variety of professional careers in the computer field. The curriculum is designed to provide a balance between the theoretical and practical aspects of computer science. Extensive laboratory time is required for these courses, and design and analysis experiences are emphasized.

Program Educational Objectives

Our students following graduation will be able

- to enter California's high technology workforce, and make significant contributions through the research, design and development of software and networked computer systems.
- to help further the state's economic growth by developing innovative ideas, and translating them into commercial products that benefit society.
- to function effectively as a team member and/or leader in multidisciplinary and multicultural environments.
- to recognize the societal and global context of their work and to understand professional and ethical responsibilities.
- to pursue lifelong learning through such activities as graduate school, distance education, professional training and membership in professional societies and to be able to adapt to new engineering tools.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Computer Science). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Computer Science must also meet similar major specific requirements. To become fully admitted into the Computer Science major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower-Division Major Requirements:
MATH 122 (Calculus I), MATH 123 (Calculus II), PHYS 151 (Mechanics & Heat)

General Education Foundations Courses:
Written Communication, Oral Communication, and Critical Thinking

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 122 within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 123 and PHYS 151 within one calendar year.

Requirements

Lower Division:

Take all of the following courses:

CECS 100 Critical Thinking in the Digital Information Age (3)
Prerequisite/Corequisite: ENGL 100 or GE Composition (Area A1).

CECS 105 Introduction to Computer Engineering and Computer Science (1)
Prerequisites: None.

CECS 174 Introduction to Programming and Problem Solving (3)
Prerequisite: CECS 100 and MATH 113 (or equivalent) all with a grade of "C" or better.

CECS 201 Computer Logic Design I (3)
Prerequisite: MATH 113 or equivalent all with a grade of "C" or better.

CECS 228 Discrete Structures With Computing Applications I (3)
Prerequisites: CECS 174 and MATH 113 or equivalent all with a grade of "C" or better.

CECS 229 Discrete Structures with Computing Applications II (3)
Prerequisites: MATH 123 and CECS 228 both with a grade of "C" or better.

CECS 274 Object Oriented Programming and Data Structures (3)
Prerequisite: CECS 174 with a grade of "C" or better.

CECS 277 Object Oriented Application Development (3)
Prerequisite: CECS 274 with a grade of "C" or better.

CECS 282 C++ for Java Programmers (3)
Prerequisite: CECS 274 with a grade of "C" or better.

CECS 285 Computer Organization and Assembly Language Programming (3)
Prerequisites: CECS 201, CECS 274 all with a grade of "C" or better.

ENGR 101 Intro to the Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122.

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113.

MATH 123 Calculus II (4)
Prerequisite: A grade of "C" or better in MATH 122.

Take a minimum of 12 units of approved science-electives to include a two-semester science sequence chosen from the following groups of courses:

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

PHYS 152 Electricity and Magnetism (4)
Prerequisite: PHYS 151; Prerequisite/Corequisite: MATH 123.

or

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

EE 210 Electro-Magnetic Foundations in EE (3)
Prerequisite: PHYS 151 with a grade of "C" or better.
Corequisites: MATH 123, EE 210L.

EE 210L Electro-Magnetic Foundations in EE Lab (1)
Corequisite: EE 210.

or

CHEM 111A General Chemistry (5)
Prerequisites: A passing score on the Chemistry Placement Examination.
Corequisite: MATH 109 or higher.

CHEM 111B General Chemistry (5)
Prerequisites: CHEM 111A and MATH 113 or MATH 115 or MATH 117 or MATH 119A or MATH 122 all with a grade of "C" or better.

Remaining units to be chosen from the following:
BIOL 153, 200, 205, 207.

Upper Division:

Take all of the following courses:

CECS 323 Database Fundamentals (3)
Prerequisites: CECS 228 and (CECS 277 or CECS 282) all with a grade of "C" or better.

CECS 326 Operating Systems (3)
Prerequisites: CECS 282 and either CECS 285 or CECS 346 all with a grade of "C" or better.

CECS 327 Introduction to Networks and Distributed Computing (3)
Prerequisite: CECS 326 with a grade of "C" or better.

CECS 328 Data Structures and Algorithms (3)
Prerequisite: CECS 228 with a grade of "C" or better; Corequisite: CECS 277.

CECS 341 Computer Architecture and Organization (3)
Prerequisites: CECS 285 with a grade of "C" or better.

CECS 343 Introduction to Software Engineering (3)
Prerequisites: CECS 277 or CECS 282 all with a grade of "C" or better.

EE 380 Probability, Statistics and Stochastic Modeling (3)
Prerequisites: MATH 123; (EE 202 or CECS 271 or CECS 274) all with a grade of "C" or better.

ENGR 350 Computers, Ethics and Society (3)
Prerequisites: 3 units from GE Category A.1 (Writing) and 3 units from GE Category D (Social and Behavioral Science).

Take one course from the following:

CEM 310 Communications in Engineering Profession (3)
Prerequisites: ENGL 100, COMM 110 all with a grade of "C" or better and Senior standing.

ENGL 317 Technical Writing (3)
Prerequisites: GE Foundation requirements, upper-division standing, and a previous composition course, i.e., ENGL 100, ENGL 101, ENGL 102, ENGL 300, or equivalents.

Take three units of study in formal languages and computation to be chosen from the following courses:
CECS 424, CECS 444

Take 12 units of upper division courses chosen from:

Take three units of core electives chosen from the following: CECS 419, CECS 424, CECS 428, CECS 429, CECS 444, CECS 445, CECS 448, CECS 449, CECS 451, CECS 474, CECS 478, MATH 323

Take three units of applied electives to be chosen from the following: CECS 455, CECS 470, CECS 472, CECS 475, CECS 476

Take 6 units of a two-semester capstone senior project sequence chosen from the following groups of courses:
- CECS 491A and CECS 491B, or
- CECS 492A and CECS 492B, or
- CECS 493A and CECS 493B

A grade of "C" or better is required in the following courses:
BIOL 153, BIOL 200, BIOL 205, BIOL 207; CEM 310; CHEM 111A, CHEM 111B; CECS 100, CECS 105, CECS 174, CECS 201, CECS 228, CECS 274, CECS 277, CECS 282, CECS 285, CECS 323, CECS 326, CECS 327, CECS 328, CECS 341, CECS 343, CECS 491A, CECS 491B, CECS 492A, CECS 492B, CECS 493A, CECS 493B; EE 210 and EE 210L, EE 380; ENGL 317; ENGR 101, ENGR 102, ENGR 350; MATH 122, MATH 123, MATH 222, MATH 224, MATH 233, MATH 247, MATH 380; PHYS 151, PHYS 152.

Bachelor of Science in Engineering Technology

Technology and Engineering Education Option

For requirements, see the description in the Engineering Technology Programs section of this catalog.

Minor in Computer Science

Requirements

A minimum of 21 units.

Take all of the following:

CECS 174 Introduction to Programming and Problem Solving (3)
*"C" or better required.
Prerequisite: CECS 100 and MATH 113 (or equivalent) all with a grade of "C" or better.

CECS 228 Discrete Structures with Computing Applications (3)
*"C" or better required.
Prerequisites: CECS 174 and MATH 113 or equivalent all with a grade of "C" or better.

CECS 274 Object Oriented Programming and Data Structures (3)
*"C" or better required.
Prerequisite: CECS 174 all with a grade of "C" or better.

CECS 323 Database Fundamentals (3)
Prerequisites: CECS 228 and (CECS 277 or CECS 282) all with a grade of "C" or better.

Take one of the following courses:

CECS 277 Object Oriented Application Development (3)
*"C" or better required.

Prerequisite: CECS 274 with a grade of "C" or better.

CECS 282 C++ for Java Programmers

*"C" or better required.
Prerequisite: CECS 274 with a grade of "C" or better.

Take two courses selected from the following:
CECS 328, CECS 343, CECS 419, CECS 428, CECS 445, CECS 451, CECS 455, CECS 470, CECS 475, CECS 497

Minor in Web Technologies and Applications

Open to all majors except those seeking a B.S. Engineering Technology, Option in Technology and Engineering Education. The minor is conferred concurrently with the BS/BA degree.

This minor will provide the technical skills not included in non-technical degrees, but required for success in a highly technical world. Students will gain an understanding of the system design process and learn to acquire and evaluate information from the internet and to communicate information via the internet including ethical issues encountered. In addition, students will learn to create a robust, useable, and accessible website.

Requirements

A minimum of 18 units as specified below.

Complete the 12 core units:

CECS 100 Critical Thinking in the Digital Information Age (3)
Prerequisite/Corequisite: ENGL 100 or GE Composition (Area A1).

CECS 110 Beginning Web Design (3)

*"C" or better required.
Prerequisites: None.

CECS 200 Intermediate Web Design (3)

*"C" or better required.
Prerequisite: CECS 110 with a grade of "C" or better.
Prerequisite/Corequisite: CECS 100.

CECS 300 Design of Dynamic Web Sites (3)
Prerequisite: CECS 200 with a grade of "C" or better.

Complete 6 units from the following list of electives:
ART 366; CECS 323, CECS 410, CECS 412, CECS 470; ENGR 350; ETEC 435; IS 380, IS 445, IS 484; MKTG 437; PSY 327

Minor in Computer Science Applications

This minor is not open to students majoring in Computer Science or Computer Engineering.

This minor is designed to prepare students to write small programs and to maintain and upgrade PC software and hardware as well as understand how to set up a local area network. In addition it prepares students to be able to design and implement web applications.

Requirements

Completion of 18 units.

Complete the 12 core units:

CECS 110 Beginning Web Design (3)

*"C" or better required.
Prerequisites: None.

CECS 174 Intro to Programming & Problem Solving (3)
Prerequisite: CECS 100 and MATH 113 (or equivalent) all with a grade of "C" or better.

CECS 200 Intermediate Web Design (3)
Prerequisite: CECS 110 with a grade of "C" or better.
Prerequisite/Corequisite: CECS 100.

CECS 410 Computers and Networks (3)
Prerequisite: Course design assumes familiarity with computers.

Complete 6 units from the following list of electives:
CECS 300, CECS 412; IS 300, IS 340, IS 343; ETEC 435.

Certificate in Web Technologies and Applications

Open to all majors except those with or seeking a B.S. Engineering Technology, Option in Technology and Engineering Education. The certificate is conferred as a post-baccalaureate certificate or concurrently with the BS/BA degree.

This certificate will prepare students to work with a variety of technologies including computers and related technologies and the proper setup and operation of equipment along with valuable troubleshooting skills. Students will gain an understanding of the system design process and learn to acquire and evaluate information from the internet and to communicate information via the internet including ethical issues. They will learn to create a robust, useable, and accessible website.

Please be aware that this program is not eligible for Financial Aid unless pursued concurrently with a degree program.

Requirements

A minimum of 24 units as specified below

Complete the 18 core units:

CECS 100 Critical Thinking in the Digital Information Age (3)
Prerequisite/Corequisite: ENGL 100 or GE Composition (Area A1)

CECS 110 Beginning Web Design (3)

*"C" or better required.
Prerequisites: None.

CECS 200 Intermediate Web Design (3)

*"C" or better required.
Prerequisite: CECS 110 with a grade of "C" or better.
Prerequisite/Corequisite: CECS 100.

CECS 300 Design of Dynamic Web Sites (3)
Prerequisite: CECS 200 with a grade of "C" or better.

CECS 410 Computers and Networks (3)
Prerequisite: Course design assumes familiarity with computers.

CECS 412 Intro to Computer Network Architectures (3)
Prerequisite: Familiarity with computers.

Complete 6 units from the following list of electives:
ART 366; CECS 323, CECS 470; ENGR 350; ETEC 435; IS 380, IS 445, IS 484; MKTG 437; PSY 327

Graduate Programs

Mission

The mission of the graduate program in Computer engineering and Computer Science at CSULB is to provide a high-quality educational experience and the technical specialization required to become successful leaders in industry. The program also prepares the students to pursue advanced degrees if they so desire. The graduate program involves advanced courses in analysis and design in computer software and hardware. The students may choose to do a thesis or take a comprehensive examination as the culmination of their program.

Program Objectives

Graduates of the MS program will:

1. have technical competency in their field of study.
2. have technical knowledge and skills needed to conduct independent and/or innovative research.
3. keep current with state of the art technologies and advancements in their area.

Master of Science in Computer Science

Admission Procedures

To be considered for admission the graduate applicant must have earned a bachelor's degree in computer engineering, computer science or sufficient background in computer engineering or computer science from a college or university with a minimum grade point average (GPA) of 2.7 in the last 60 semester or 90 quarter upper division major units attempted. The general Graduate Record Examination (GRE) is strongly recommended.

Option in Computer Engineering

This option offers advanced study in the theory, analysis, design and applications of both computer hardware and software.

Prerequisites

1. A bachelor's degree in computer engineering, computer science or sufficient background in computer engineering from a college or university with a minimum grade point average (GPA) of 2.7 in the last 60 semester units or 90 quarter upper division major units attempted.

2. The general Graduate Record Examination (GRE) is strongly recommended.

Requirements

Students must complete a minimum of 30 graduate and approved upper-division course units including the following:

1. At least 21 units at the graduate level of instruction;
2. 12 units of required courses consisting of:
   A. CECS 460 System on Chip Design (3)
      Prerequisite: CECS 360 with a grade of "C" or better..
   B. CECS 530 Advanced Computer Architecture I (3)
      *"C" or better required.
      Prerequisite: CECS 341 or CECS 440 with a grade of "C" or better.
   C. One course from the following:
      CECS 531 Advanced Computer Architecture II (3)
      Prerequisite: CECS 530 with a grade of "C" or better.
      CECS 546 Fault Tolerant Computing Systems (3)
      Prerequisite: CECS 341 or CECS 440 with a grade of C or better.
   D. One course from the following:
      CECS 526 Advanced Operating Systems (3)
      Prerequisites: CECS 228 and CECS 326 all with a grade of "C" or better.
      CECS 528 Advanced Analysis of Algorithms (3)
      Prerequisites: CECS 328, MATH 380 or EE 380 all with a grade of "C" or better.
3. All students must complete one of the following:
   A. Comprehensive examination
   B. Project with oral presentation, which requires 3 units of CECS 697, an oral defense, and submission of a formal written report of the project to be approved by a committee of 3 faculty members that includes the supervising faculty of the project.
      To be eligible for the option a student must:
      a) have advanced to candidacy,
      b) have maintained a GPA of 3.3 or above in the MSCS coursework,
      c) have been nominated by a faculty member to undertake a project under that faculty member's supervision, and
      d) have had a project proposal approved by the CECS Graduate Curriculum Committee.
   C. Thesis with oral defense, which requires a total of 6 units. At least 3 of the units must be taken from CECS 698 and the remaining units may be taken from either CECS 697 or CECS 698. To be eligible for the option a student must:
      a) have advanced to candidacy,
      b) have maintained a GPA of 3.3 or above in the MSCS coursework,
      c) have been nominated by a faculty member to undertake a thesis under that faculty member's supervision, and
      d) have had a thesis proposal approved by the CECS Graduate Curriculum Committee.

Option in Computer Science

This option offers advanced study in software development and engineering, networking, operating systems, distributed computing, artificial intelligence, security, and analysis of algorithms.

Prerequisites

1. A bachelor's degree in computer science, computer engineering or sufficient background in computer science from a college or university with a minimum grade point average (GPA) of 2.7 in the last 60 semester or 90 quarter upper division major units attempted.
2. The general Graduate Record Examination (GRE) is strongly recommended.

Requirements

Students must complete a minimum of 30 graduate and approved upper-division course units including the following:

1. At least 21 units at the graduate level of instruction;
2. 12 units of required courses consisting of:
   A. CECS 528 Advanced Analysis of Algorithms (3)
      Prerequisites: CECS 328, MATH 380 or EE 380 all with a grade of "C" or better.
   B. One course from the following:
      CECS 526 Advanced Operating Systems (3)
      Prerequisites: CECS 228 and CECS 326 with a grade of "C" or better.
      CECS 530 Advanced Computer Architecture I (3)

Prerequisite: CECS 341 or CECS 440 with a grade of "C" or better.

C. Two courses from the following:
CECS 521, CECS 531, CECS 543, CECS 546, CECS 572, CECS 575

3. All students must complete one of the following:
A. Comprehensive examination
B. Project with oral presentation, which requires 3 units of CECS 697, an oral defense, and submission of a formal written report of the project to be approved by a committee of 3 faculty members that includes the supervising faculty of the project. To be eligible for the option a student must:
a) have advanced to candidacy,
b) have maintained a GPA of 3.3 or above in the MSCS coursework,
c) have been nominated by a faculty member to undertake a project under that faculty member's supervision, and
d) have had a project proposal approved by the CECS Graduate Curriculum Committee.
C. Thesis with oral defense which requires a total of 6 units. At least 3 of the units must be taken from CECS 698 and the remainig units may be taken from either CECS 697 or CECS 698. To be eligible for the option a student must:
a) have advanced to candidacy,
b) have maintained a GPA of 3.3 or above in the MSCS coursework,
c) have been nominated by a faculty member to undertake a thesis under that faculty member's supervision, and
d) have had a thesis proposal approved by the CECS Graduate Curriculum Committee.

Advancement to Candidacy for Both Options

Students applying for advancement to candidacy must:
1. have completed all undergraduate deficiencies with grades of "C" or better;
2. have attained an overall grade point average (GPA) of 3.0;
3. have completed at least 12 units of required courses applicable to the degree with a GPA of at least 3.0 for the completed units;
4. have fulfilled the Graduation Writing Assessment Requirement (GWAR);
5. and have their plans of studies approved by the CECS department graduate advisor.

Computer Engineering and Computer Science Courses (CECS)

LOWER DIVISION

100. Critical Thinking in the Digital Information Age (3)

Prerequisite/Corequisite: ENGL 100 or GE Composition (Area A1).

Help students develop critical thinking skills using technical software. Main topics include: identifying engineering issues for investigation, developing planning and problem solving strategies, locating pertinent information and examples, critically analyzing these sources, forming and testing hypotheses, synthesizing and organizing results for effective communication, and developing transferable problem solving skills.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

105. Introduction to Computer Engineering and Computer Science (1)

Introduction to the fields of computer engineering and computer science. Current and future trends and challenges in various fields of computing. Social, ethical and economical issues related to computing technology. Exploration of career and professional development opportunities.

(Lecture 1 hour) Letter grade only (A-F).

110. Beginning Web Design (3)

Introduction to HTML and CSS using modern tools, following the W3C guidelines for coding. Web sites designed with usability and accessibility principles implemented. Overview of graphics, video, sound, JavaScript and Dreamweaver.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

174. Introduction to Programming and Problem Solving (3)

Prerequisite: CECS 100 and MATH 113 (or equivalent) all with a grade of "C" or better.

Introduction to basic concepts of computer science and fundamental techniques for solving problems using the Java programming language. Structured problem solving, object-oriented programming, programming style. Applications to numerical and non-numerical problems.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

200. Intermediate Web Design (3)

Prerequisite: CECS 110 with a grade of "C" or better.
Prerequisite/Corequisite: CECS 100.

Intermediate HTML and CSS using Dreamweaver, following the W3C guidelines for coding. Web sites designed with usability and accessibility principles implemented.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

201. Computer Logic Design I (3)

Prerequisite: MATH 113 or equivalent all with a grade of "C" or better.

Basic topics in combinational and sequential switching circuits with applications to the design of digital devices. Introduction to Electronic Design Automation (EDA) tools. Laboratory projects with Field Programmable Gate Arrays (FPGA).

(Lecture 2 hours, lab 3 hours) Letter grade only (A-F).

202. The Digital Information Age (3)

Prerequisite: GE Foundation requirements.

The introduction and use of common-place digital and electronic devices and how this technology affects our society. Topics include advances in 3D imaging, 3D printing, Processors, Memory, Security and Privacy.

(Lecture 3 hours) Letter grade only (A-F).

211. Principles of Computer Engineering I (3)

Prerequisite: MATH 122 with a grade of "C" or better.

Basic principles of analysis and design of computer-based circuits. Application of transistors, logic families, digital, devices in computer and embedded processor interfacing, importance of phasors and the complex plane. Basic DC/AC circuit fundamentals. Laboratory safety.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

228. Discrete Structures with Computing Applications (3)

Prerequisites: CECS 174 and MATH 113 or equivalent all with a grade of "C" or better.

An introduction to discrete mathematics with applications towards computing. Topics include sets, functions, logic, relations, graphs, trees, recursion, combinatorics, and mathematical reasoning.

Letter grade only (A-F). (Lecture 2 hours, laboratory/problem session 3 hours)

229. Discrete Structures with Computing Applications II (3)

Prerequisites: MATH 123 and CECS 228 both with a Grade of "C" or better

This is the second course in a two-course sequence in computing applications of discrete structures. Topics include applications of computer arithmetic and matrices in computer systems. Programming assignments in Python will be provided.

Letter grade only (A-F). (Lecture 2 hours, Laboratory 3 hours)

262. Introduction to Embedded System Programming (3)

Prerequisites: CECS 174 and CECS 201 all with a grade of "C" or better.

Introduction to embedded system architecture, memory organization and programming using C. Interfacing with external I/O devices, Use of internal special function registers. Development tools and extended C instructions unique to embedded systems. Course will be taught using an embedded processor development board.

(Lecture 2 hours, laboratory 3 hours.) Letter grade only (A-F).

271. Introduction to Numerical Methods (3)

Prerequisites: CECS 174 and MATH 123 all with a grade of "C" or better.

Matrix computations. Linear algebra fundamentals. Numerical methods for algebraic equations. Systems of linear equations. Curve fitting. Least squares. Interpolation. Fourier transform. Frequency domain concepts. Numerical integration and differentiation. Ordinary differential equations. Use of MATLAB or equivalent for algorithm implementation.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

274. Object Oriented Programming and Data Structures (3)

Prerequisite: CECS 174 with a grade of "C" or better.

Disciplined methods of design, coding and testing using the Java programming language. Data abstraction, object-oriented design. Introduction to data structures (linked lists, stacks, queues and trees.) Recursion. Sorting and searching.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

277. Object Oriented Application Development (3)

Prerequisite: CECS 274 with a grade of "C" or better.

Advanced introduction to the fundamentals of computer science and software engineering methodology. Advanced programming techniques and design methodology typically used in large programming projects using the Java programming language.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

282. C++ for Java Programmers (3)

Prerequisite: CECS 274 with a grade of "C" or better.

Structured and Object Oriented Programming in C++. Common features and differences between Java and C++. Pointers, references, and memory management, stream I/O, classes, operator overloading, exception handling, STL.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

285. Computer Organization and Assembly Language Programming (3)

Prerequisites: CECS 201, CECS 274 all with a grade of "C" or better.

Study of computer organization and assembly language programming using embedded processor based systems to solve practical problems. Laboratory projects using embedded system software development and hardware simulation tools. Hands-on projects using hardware prototyping boards.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

UPPER DIVISION

300. Design of Dynamic Web Sites (3)

Prerequisite: CECS 200 with a grade of "C" or better.

Dynamic Web design using modern tools. Creation of domains, using hosting services and content management systems. Website portability, usability and accessibility.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

301. Computer Logic Design II (3)

Prerequisites: CECS 174, CECS 201 all with a grade of "C" or better.

Sequential logic emphasizing Finite State Machine design & analysis, timing analysis of sequential logic, Introduction to Data Path, Control and Memory. Use of Electronic Design Automation (EDA) tools for design, simulation, verification. Laboratory projects with Field Programmable Gate Arrays (FPGA's).

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

311. Principles of Computer Engineering II (3)

Prerequisites: CECS 201 and CECS 211 all with a grade of "C" or better.

Embedded system components. Bipolar and MOS devices and switching circuits. Embedded systems signal processing with operational amplifiers. Digital/analog interfacing including A/D and D/A converters. Schematic capture, analysis and implementation of embedded signal processing algorithms. Fundamentals of digital communication.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

323. Database Fundamentals (3)

Prerequisites: CECS 228 and (CECS 277 or CECS 282) all with a grade of C or better.

Fundamental topics on database management. Topics include entity-relationship models, database design, data definition language, the relational model, data manipulation language, database application programming and normalization.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

326. Operating Systems (3)

Prerequisites: CECS 282 and either CECS 285 or CECS 346 all with a grade of "C" or better.

The structure and functions of operating systems. Interrupt handling, processes and interprocess communication, memory management, resource scheduling, information sharing and protection. Project implementation in C/C++.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

327. Introduction to Networks and Distributed Computing (3)

Prerequisite: CECS 326 with a grade of "C" or better.

Introduction to Distributed Computing and Inter-process Communication. Networking Protocols, Client Server Paradigm, Peer-to-Peer Networking, Sockets and Sockets API, Distributed Objects, Cloud Computing.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

328. Data Structures and Algorithms (3)

Prerequisite: CECS 228 with a grade of "C" or better.
Corequisite: CECS 277.

A broad view of data structures and the structure-preserving operations on them. Abstract data types, algorithms, complexity. Programming projects to exemplify these concepts.

341. Computer Architecture and Organization (3)

Prerequisites: CECS 285 with a grade of "C" or better.

Review of logic design. Instruction set architecture. Arithmetic logic units. Data path and control. Pipelining and performance. Memory system organization and design. Virtual memory and paging. I/O interfacing. Vector and array processing. Distributed computing and supercomputing. Contemporary computer designs.

(Lecture 2 hours, laboratory, 3 hours) Letter grade only (A-F).

343. Introduction to Software Engineering (3)

Prerequisites: CECS 277 or CECS 282 all with a grade of "C" or better.

Principles of software engineering, UML, modeling large software systems, requirements elicitation, object oriented analysis and design using UML, introduction to design patterns, implementation of large systems, software testing, project management, the software lifecycle. Semester long programming project.

Letter grade only (A-F). (Lecture 2 hours, lab 3 hours)

346. Microprocessors and Controllers I (3)

Prerequisites: CECS 211 and CECS 262 all with a grade of "C" or better.

Intro microprocessor/controller, embedded programming and design. Basic computer organization, representation of information and instruction, addressing techniques, input/output, assembly language programming. Introduction to assemblers, linkage editors and loaders. Study of the 8051. Design of microprocessor-based systems.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

347. Microprocessors and Controllers II (3)

Prerequisites: CECS 301, CECS 311, and CECS 346 all with a grade of "C" or better.

Study of embedded processor applications and interfacing. Embedded systems design, control of external devices, embedded programming in C and assembly. A/D and D/A converters, digital signal processing, motor and LCD controllers. Laboratory implementation of embedded designs and hardware-assisted debugging.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

360. Integrated Circuit Design Software (3)

Prerequisites: CECS 301, CECS 346, MATH 123 or MATH 222 all with a grade of "C" or better.

Introduction to Computer Aided Design tools used in the design and fabrication of integrated circuits. Discussion of the IC fabrication process, the layout and routing of basic gates, transistor level design of gates, synthesis and RTL level design, floor planning, and IC development costs.

(Lecture 2 hours, lab 3 hours) Letter grade only (A-F).

406. Selected Topics in Computer Science (3)

Prerequisite: Senior standing in the computer science major.

Each offering is based upon an area of computer science and technology in which recent advances have been made.

Letter grade only (A-F). May be repeated to a maximum of 6 units with different topics in different semesters. Topics announced in the *Schedule of Classes*. (Lecture 2 hours, laboratory 3 hours)

410. Computers and Networks (3)

Prerequisite: Course design assumes familiarity with computers.

Gain practical, hands-on experience in installing hardware and software on a PC. Learn what a computer network is and how it is similar to the telephone network. Learn the parts that make up a computer and a network.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

412. Introduction to Computer Network Architectures (3)

Prerequisite: Familiarity with computers

Beginning course in computer networking designed to provide a grasp of network architectures through lecture/hands-on laboratory assignments. Overview of networking concepts and design essentials. Networking media and NICs. Network communications/protocols focusing on TCP/IP. Local area networks. Networking administration. Networking problems.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

419./519. Theory of Computation (3)

Prerequisite: CECS 328 with a grade of "C" or better.

Finite Automata and regular expressions. Pushdown automata and context-free languages. Turing machines and computability. Computational complexity.

Letter grade only (A-F). Additional projects required for CECS 519. (Lecture-problems 3 hours)

424. Organization of Programming Languages (3)

Prerequisites: CECS 326 and CECS 328 all with a grade of "C" or better.

Understanding the variety of programming languages and the design trade-offs between current programming language paradigms. Comparison of programming languages in their design, implementation, and run-time supports. Includes programming projects.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

428. Analysis of Algorithms (3)

Prerequisite: CECS 328 with a grade of "C" or better.

Applications of standard combinatorial techniques to applied programming problems. Rigorous analysis of correctness/complexity of algorithms. Advanced graph algorithms are emphasized. Topics include shortest paths on graphs, sorting, string matching, union find problem, divide-and-conquer technique, and weighted-edge problem.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

429./529. Search Engine Technology (3)

Prerequisites: CECS 323 and CECS 328, MATH 380 or EE 380 all with a grade of "C" or better.

Models, algorithms, and evaluation of the retrieval of information from a collection of documents. Document preprocessing. Indexing and searching. Retrieval evaluation. Search engines.

Additional projects required for CECS 529. (Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

440. Computer Architecture (3)

Prerequisites: CECS 346 with a grade of "C" or better.

Review of logic design. Register transfer and micro-operations. Basic computer organization. Central processor organization. Microprogram control organization. Arithmetic processor design. Arithmetic algorithms. Input-output organization. Memory organization.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

444. Compiler Construction (3)

Prerequisites: CECS 285 and CECS 328 all with a grade of "C" or better.

Syntax directed compiler study. Organization of a compiler and overall design: parsing, semantic analysis, optimization and code generation.

(Lecture 3 hours, laboratory 3 hours) Letter grade only (A-F).

445. Software Design and Architecture (3)

Prerequisites: CECS 343 with a grade of "C" or better and senior standing .

In-depth look at software design, design patterns, frameworks, architectures and middleware architectures. Component based design including COM, Corba, and .Net. Fundamentals of software metrics, measuring software qualities. Basics of software evolution, reengineering, and reverse engineering. A semester long team project.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

447. Microprocessors and Controllers III (3)

Prerequisite: CECS 347 with a grade of "C" or better.

Embedded system applications and techniques. Real-time multi-tasking systems, schedulers, kernels, and operating systems for embedded processors. Advanced I/O technologies - CAN, I2C, Ethernet. Embedded Internet applications. Polling vs. interrupt handling. Lab implementation of embedded designs and hardware-assisted debugging.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

448. User Interface Design (3)

Prerequisite: CECS 343 with a grade of "C" or better or consent of instructor.

Evaluation, design and programming of user interface systems. Fundamentals of human cognition, system characteristics, and the interaction between humans and systems. Usability methods and user/task-centered design. Tools for designing and building user interfaces, with emphasis on rapid applications development.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

449. Computer Graphics (3)

Prerequisites: MATH 247, CECS 282 and CECS 328 all with a grade of "C" or better.

Introduction to the theory and practice of computer graphics, Graphics systems, 2-D and 3-D modeling, transformations, viewing transformations, projections, rendering techniques.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

451. Artificial Intelligence (3)

Prerequisites: CECS 277 and CECS 328 all with a grade of "C" or better.

Introduction to the history and implementation of artificial intelligence agents. Topics include search, constraint satisfaction, game-playing, logical agents, belief networks, optimal sequential decision systems. Project implementation.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

453. Mobile Application Development (3)

Prerequisite: CECS 328 with a grade of "C" or better or consent of the instructor.

Languages and application programming interfaces for mobile device platforms. Development of thick and thin client applications for mobile devices.

Letter grade only (A-F). (Lecture 2 hours, Laboratory 3 hours)

455. Introduction to Game Programming (3)

Prerequisite: CECS 328 with a grade of "C" or better or consent of instructor.

Introduction to game programming and graphics. “Slow” games. Real-time games with no adversary. Adversarial real-time games in 2-D.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

460. System on Chip Design (3)

Prerequisite: CECS 360 with a grade of "C" or better.

Complete System on Chip (SOC) design flow from design specification to working SOC. Creation of RTL level modules designed for reuse, integration of Intellectual Property (IP) for RTL and physical level IP, IC verification, creation of self-checking test benches for designs.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

461./561. Hardware/Software Co-design (3)

Prerequisite: CECS 341 or CECS 440 all with a grade of "C" or better.

Introduction to top-down methods for hardware/software system-on-chip co-design. Design flow – system specification, software implementation, hardware synthesis, system design, and verification. Process optimization with various design decisions emphasized. Projects/case studies using system-level design methods and tools.

Additional projects required for CECS 561. (Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

463. System on Chip (SOC) Applications (3)

Prerequisite: CECS 360 with a grade of "C" or better.

System on Chip (SOC) design applications. Study of a variety of signal processing SOC designs and ASIC algorithms. Class projects emphasizing hardware/software integration with use of FPGA/CPLD devices. Design reviews, specification, team design implementation with project planning and tracking for system level design applications.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

470. Web Programming and Accessibility (3)

Prerequisites: CECS 323 and CECS 343 all with a grade of "C" or better.

Introduction to World-Wide Web development. Accessibility issues. Web architecture, standards, and programming, emphasizing XML technologies and cascading style sheets. Visual design principles and information architecture. Client-side and server-side programming and protocols. Development for adaptive technologies and mobile devices.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

472. Computer Network Programming (3)

Prerequisites: CECS 326 all with a grade of "C" or better.

Fundamentals of computer network programming. Client-server programming. Concepts of computer network programming including the RPC Procedure Call, CORBA, multicasts, and broadcasts.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

474. Computer Network Interoperability (3)

Prerequisite: CECS 326 with a grade of "C" or better.

Overview of computer network theory and practice from a systems perspective. Topics include network infrastructure, local area network (LAN) protocols, wide area network (WAN) protocols, switching technologies, Internet Protocol (IP), Transmission Control Protocol (TCP), network security, and network configuration, design, and performance.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

475. Application Programming Using .NET (3)

Prerequisite: CECS 343 with a grade of "C" or better.

Introduction to enterprise application development utilizing the .NET environment. Topics include object-oriented design, events, databases, multithreading, web server applications, web services and cloud computing. Individual projects as well as a team project required.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

476. System and Network Administration (3)

Prerequisites: CECS 326 with a grade of "C" or better.

Introduction to the management and administration of Unix systems and TCP/IP networks. Managing users, local and network file systems, electronic mail, print queues. Establishing and managing a network.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

478. Introduction to Computer Security (3)

Prerequisite: CECS 328 with a grade of "C" or better.

Controlling the risk of computer security. Security threats and vulnerabilities in the development and use of computer systems. Tools and controls that can reduce or block these threats. Law, privacy and ethics.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

490A. Computer Engineering Senior Project I (3)

Prerequisites: CECS 347 with a grade of "C" or better, senior standing.

The first in a two-course capstone senior project in computer engineering that fulfills GE integrative learning. Students work in teams to define a problem, complete a design and provide both a written report and a multimedia presentation at the end of the semester.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

490B. Computer Engineering Senior Project II (3)

Prerequisites: CECS 490A, with a grade of "C" or better and consent of instructor.

Second of a two-semester capstone senior project in computer engineering that fulfills GE integrative learning. Student teams will build, program and verify operation of project started in prior design course. Student teams must submit a written report, give an oral multimedia presentation and provide a working demonstration.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

491A. Software Engineering Project I (3)

Prerequisites: ENGR 350 and CECS 343 all with a grade "C" or better.

First course in a two-course capstone design sequence that fulfills integrative learning. Design of a commercial grade software application including requirements analysis, functional, architectural and detailed design, emphasizing written communication, teamwork and the Object-Oriented Methodology.

Letter grade only (A-F), (Lecture 2 hours, laboratory 3 hours)

491B. Software Engineering Project II (3)

Prerequisite: CECS 491A with a grade "C" or better.

Second course in a two-course capstone design sequence that fulfills integrative learning. Implementation, testing, packaging and deployment of the system designed in CECS 491A emphasizing written communication, teamwork and the Object-Oriented Methodology.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

492A. Distributed and Cloud Computing Project I (3)

Prerequisites: ENGR 350, CECS 327 and CECS 343 all with a grade "C" or better.

First course in a two-course capstone design sequence. Design of a distributed or cloud computing application. Design experience, including detailed requirement analysis, design decisions, teamwork, written reports and oral presentation.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

492B. Distributed and Cloud Computing Project II (3)

Prerequisite: CECS 492A with a grade "C" or better.

Second course in a two-course capstone design sequence. Implementation of a distributed or cloud computing application. Implementation experience, including detailed documentation, testing and evaluation of the implementation, teamwork, written reports and oral presentation.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

493A. Database Web Application Project I (3)

Prerequisites: CECS 323 and CECS 343 all with a grade "C" or better.

Corequisite: ENGR 350.

First of a two-course capstone senior project in computer science that fulfills GE integrative learning. Propose, design, and prototype a data-intensive web application. Object-oriented modeling, analysis and software engineering. Teamwork, written report and oral presentation required.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

493B. Database Web Application Project II (3)

Prerequisite: CECS 493A with a grade "C" or better .

Second of a two-course capstone senior project in computer science that fulfills GE integrative learning. Design, implement, test and deploy a data-intensive web application. Requires object oriented and test-driven development. Teamwork, written report and oral presentation required.

Letter grade only (A-F). (Lecture 2 hours, laboratory 3 hours)

495. Computational Physiology (3)

Prerequisite: EE 380 with a grade of "C" or better

This course will introduce students to cardiovascular (heart) and cerebrovascular (brain) systems and signals, and the computational methods to analyze related signals, and detect/predict a physiological event of interest.

Same course as: EE 495. Not open for credit to students with credit in EE 495.

Letter Grade only (A-F). (Lecture 2 hours, Laboratory 3 hours).

496. Computer Science Problem Solving (1)

Prerequisites: CECS 274 with a grade of "C" or better and consent of instructor.

Problem solving in Computer Science. Theory necessary to solve computer science problems and the solutions to the problems. Problems studied will involve applications of graph theory, data structures, recursion, and algorithms.

(Lecture 1 hour) May be repeated to a maximum of 6 units in different semesters. Letter grade only (A-F).

497. Directed Studies (1–3)

Prerequisite: Consent of instructor.

Assigned study in topics in current computer literature or computer-related projects with a final report.

May be repeated to a maximum of 6 units with written consent of the Department Chair.

GRADUATE LEVEL

519./419. Theory of Computation (3)

Prerequisite: CECS 328 with a grade of "C" or better.

Finite Automata and regular expressions. Pushdown automata and context-free languages. Turing machines and computability. Computational complexity.

Additional projects required for CECS 519. (Lecture-problems 3 hours) Letter grade only (A-F).

521./621. Database Architecture (3)

Prerequisites: CECS 328 and CECS 323 or CECS 421 all with a grade of "C" or better.

Relational database design theory-a rigorous approach. Security, recovery, transaction management, distributed databases and query optimization.

Master's students register in CECS 521 or CECS 621; Ph.D. students register in CECS 621. Additional projects required for CECS 621. (Lecture-problems 3 hours) Letter grade only (A-F).

524./624. Advanced Topics in Programming Languages (3)

Prerequisite: CECS 424 with a grade of "C" or better.

Intensive study of languages of current interest which support object-oriented, client-server, and multimedia applications (e.g. JAVA).

Master's students register in CECS 524 or CECS 624; Ph.D. students register in CECS 624. Additional projects required for CECS 624. (Lecture-problems 3 hours) Letter grade only (A-F).

526./626. Advanced Operating Systems (3)

Prerequisites: CECS 228 and CECS 326 all with a grade of "C" or better.

Theoretical foundations of concepts applied in the design of operating systems. Control of concurrent processes, deadlocks, mutual exclusion, virtual memory, resource management and scheduling.

Master's students register in CECS 526 or CECS 626; Ph.D. students register in CECS 626. Additional projects required for CECS 626. (Lecture–problems 3 hours) Letter grade only (A-F).

528./628. Advanced Analysis of Algorithms (3)

Prerequisites: CECS 328, MATH 380 or EE 380 all with a grade of "C" or better.

Theoretical analysis of algorithms. Divide and conquer, dynamic programming and greedy algorithms; basic search and traversal techniques including search trees; sorting; matrix manipulations; NP–completeness.

Master's students register in CECS 528 or CECS 628; Ph.D. students register in CECS 628. Additional projects required for CECS 628. (Lecture–problems 3 hours) Letter grade only (A-F).

529./429. Search Engine Technology (3)

Prerequisites: CECS 323 and CECS 328, MATH 380 or EE 380 all with a grade of "C" or better.

Models, algorithms, and evaluation of the retrieval of information from a collection of documents. Document preprocessing. Indexing and searching. Retrieval evaluation. Search engines.

Additional projects required for CECS 529. (Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

530./630. Advanced Computer Architecture I (3)

Prerequisite: CECS 341 or CECS 440 all with a grade of "C" or better.

Fundamentals of computer architecture. Description of architecture and description languages. Basic computer design and central processor implementation. Memory hierarchy and input/output. Pipelining. Vector processor, multiprocessor systems and dataflow machines.

Master's students register in CECS 530 or CECS 630; Ph.D. students register in CECS 630. Additional projects required for CECS 630. (Lecture-problems 3 hours) Letter grade only (A-F).

531./631. Advanced Computer Architecture II (3)

Prerequisite: CECS 530 with a grade of "C" or better.

Advanced computer architecture with emphasis on parallel processing. Vector processors and multiprocessor systems. Dataflow computation. RISC/CISC. Hypercube. Parallel software. Applications in artificial intelligence, signal/image processing, neural network and optical computing.

Master's students register in CECS 531 or CECS 631; Ph.D. students register in CECS 631. Additional projects required for CECS 631. (Lecture–problems 3 hours) Letter grade only (A-F).

532. Memory Design and Implementation (3)

Prerequisite: CECS 341 or CECS 440 all with a grade of "C" or better.

Logic design and operation, physical design and operation, performance characteristics, design trade-offs, energy consumption of modern memory hierarchies, memory errors and error correction.

Letter grade only (A-F). (Lecture-problems 3 hours)

543./643. Advanced Software Engineering (3)

Prerequisite: CECS 343 all with a grade of "C" or better.

Study of software engineering as a broad, problem–solving discipline. Includes structured programming and software project management.

Master's students register in CECS 543 or CECS 643; Ph.D. students register in CECS 643. Additional projects required for CECS 643. (Lecture-problems 3 hours) Letter grade only (A-F).

544./644. Software Testing and Verification (3)

Prerequisite: CECS 543 with a grade of "C" or better.

Testing/verification techniques for software development including black box, white box, incremental, top-down and bottom-up, static and dynamic, performance, regression, thread, and stress testing. Object-oriented software testing with a hierarchical approach. Metrics for test, and verification will be introduced.

Master's students register in CECS 544 or CECS 644; Ph.D. students register in CECS 644. Additional projects required for CECS 644. (Lecture-problems 3 hours) Letter grade only (A-F).

545./645. Software Architecture (3)

Prerequisite: CECS 543 with a grade of "C" or better.

Includes architectural styles, pipes and filters, data abstraction and object-oriented organization, event-based, implicit invocation, layered systems, repositories, interpreters, process control, distributed processes, domain-specific software & heterogeneous architectures. Component-based design patterns & case studies.

Master's students register in CECS 545 or CECS 645; Ph.D. students register in CECS 645. Additional projects required for CECS 645. (Lecture-problems 3 hours) Letter grade only (A-F).

546./646. Fault Tolerant Computing Systems (3)

Prerequisite: CECS 341 or CECS 440 with a grade of "C" or better.

Fault tolerant techniques are studied as tools to assure the reliability and continuous availability of computing systems. Case studies of modern fault tolerant systems reviewed. Software fault tolerant systems studied as alternatives to verification and validation approaches to software reliability.

Master's students register in CECS 546 or CECS 646; Ph.D. students register in CECS 646. Additional projects required for CECS 646. (Lecture–problems 3 hours) Letter grade only (A-F).

547./647. Software Maintenance, Reengineering and Reuse (3)

Prerequisite: CECS 343 or equivalent with a grade of "C" or better.

Introduction to software maintenance, defect management, corrective, adaptive and perfective maintenance. Evolution of legacy software systems. Program comprehension techniques, reverse engineering, restructuring, refactoring of software systems. Software re-engineering, data reverse engineering. Software reuse. Impact analysis, regression testing.

Master's students register in CECS 547 or CECS 647; Ph.D. students register in CECS 647. Additional projects required for CECS 647. (Lecture-problems 3 hours) Letter grade only (A-F).

549./649. Advanced Computer Graphics (3)

Prerequisite: CECS 449 with a grade of "C" or better.

Three-dimensional representations, transformations and viewing. Color models and modeling methods. Hidden-line and hidden-surface removal. Lighting and shading. Visual realism. Topics of current interest.

Master's students register in CECS 549 or CECS 649; Ph.D. students register in CECS 649. Additional projects required for CECS 649. (Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

550./650. Pattern Recognition Using Artificial Intelligence (3)

Prerequisite: CECS 451 with a grade of "C" or better or consent of instructor.

General concepts of pattern recognition and trainable classifiers, decision theory, supervised learning, non-parametric techniques, rule-based systems and neural networks.

Master's students register in CECS 550; Ph.D. students register in CECS 650. Additional projects required for CECS 650. (Lecture-problems 2 hours, laboratory 3 hours) Not open for credit to students with credit in CECS 750. Letter grade only (A-F).

551./651. Advanced Artificial Intelligence (3)

Prerequisite: CECS 451 with a grade of "C" or better.

Advanced concepts in artificial intelligence. Topics include knowledge acquisition and representation, fuzzy logic, logical reasoning, multi-sensor integration, Dempster-Shafer's theory of evidential reasoning, real-time expert systems and neural networks.

Master's students register in CECS 551 or CECS 651; Ph.D. students register in CECS 651.Additional projects required for CECS 651. (Lecture-problems 3 hours) Letter grade only (A-F).

552. Computer Simulation and Modeling (3)

Prerequisites: EE 380 (or MATH 380) and CECS 326 all with a grade of "C" or better.

Studies of general purpose and special simulation software. Model verification including graphical models Applications in various areas.

Master's students register in CECS 552 or CECS 652; Ph.D. students register in CECS 652. Additional projects required for CECS 652. (Lecture-problems 3 hours) Letter grade only (A-F).

553./653. Machine Vision (3)

Prerequisite: Graduate standing in engineering or computer science.

Discussion and laboratory implementation of current research in vision and image understanding. Topics include image formation, early processing, segmentation, relational structures in 2-D and 3-D, motion, stereo, 3-D reconstruction, morphological methods and computer architecture for machine vision.

Master's students register in CECS 553 or CECS 653; Ph.D. students register in CECS 653. Additional projects required for CECS 653. (Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

561./461. Hardware/Software Co-design (3)

Prerequisite: CECS 341 or CECS 440 all with a grade of "C" or better.

Introduction to top-down methods for hardware/software system-on-chip co-design. Design flow – system specification, software implementation, hardware synthesis, system design, and verification. Process optimization with various design decisions emphasized. Projects/case studies using system-level design methods and tools.

Additional projects required for CECS 561. (Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

570./670. Concurrent Parallel Programming (3)

Prerequisite: CECS 328, or CECS 341, or CECS 440 all with a grade of "C" or better.

Introduction to concurrent and parallel programming for multiprocessing and distributed systems. Computational models and paradigms. Parallel programming languages and programming tools. Portable parallel programming and mapping techniques. Heterogeneous concurrent programming. Concurrent programming on local networks on workstations and personal computers.

Master's students register in CECS 570 or CECS 670; Ph.D. students register in CECS 670. Additional projects required for CECS 670. (Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

572./672. Advanced Computer Networking (3)

Prerequisite: CECS 474 with a grade of "C" or better

Advanced concepts in computer network theory and practice. Computer network design and standards for local area networks (LANs) and wide area networks (WANs). Computer network configuration and performance issues.

Master's students register in CECS 572 or CECS 672; Ph.D. students register in CECS 672. Additional projects required for CECS 672. (Lecture-problems 3 hours) Letter grade only (A-F).

574./674. Topics in Distributed Computer Systems (3)

Prerequisite: CECS 526 or CECS 572 or CECS 626 or CECS 672 all with a grade of "C" or better.

Network operating systems vs distributed operating systems, research and design issues of distributed operating systems, resources and resource management in distributed systems, communication security and user authentication.

Master's students register in CECS 574; Ph.D. students register in CECS 674. Additional projects required for CECS 674. (Lecture–problems 3 hours) Letter grade only (A-F). Not open for credit to students with credit in CECS 673 or CECS 773.

575./675. Object–Oriented Analysis and Design (3)

Prerequisites: CECS 475 and CECS 343 or CECS 543 all with a grade of "C" or better.

An object–oriented approach to software development based on modeling objects from the real world. Object–oriented methodology from problem statement through analysis, system design, and object design. Implementation of object–oriented designs in various target environments. Case studies.

Master's students register in CECS 575 or CECS 675; Ph.D. students register in CECS 675. Additional projects required for CECS 675.

(Lecture-problems 3 hours) Letter grade only (A-F).

579. Information Security (3)

Prerequisite: CECS 328 with a grade of "C" or better.

Course Description: Symmetric cryptosystems, stream ciphers, pseudorandom functions, message authentication codes (MACs), collision resistant hash functions, number theory and cryptographic hardness assumptions, public-key encryption (El-Gamaland RSA), digital signature schemes

Letter grade only (A-F). (Lecture-problems 3 hours)

590./690. Selected Topics in Computer Science (3)

Prerequisites: Graduate standing and consent of instructor.

Each offering is based on an area in computer science and technology in which recent advances have been made.

Letter grade only (A-F). May be repeated to a maximum of 6 units with consent of department. Topics announced in the *Schedule of Classes*. Master's students register in CECS 590 or CECS 690; Ph.D. students register in CECS 690. Additional projects required for CECS 690. (Lecture-problems 3 hours)

621./521. Database Architecture (3)

Prerequisites: CECS 328 and CECS 323 (or CECS 421) all with a grade of "C" or better.

Relational database design theory-a rigorous approach. Security, recovery, transaction management, distributed databases and query optimization.

Master's students register in CECS 521 or CECS 621; Ph.D. students register in CECS 621. Additional projects required for CECS 621. (Lecture-problems 3 hours) Letter grade only (A-F).

624./524. Advanced Topics in Programming Languages (3)

Prerequisite: CECS 424 with a grade of "C" or better.

Intensive study of languages of current interest which support object-oriented, client-server, and multimedia applications (e.g. JAVA).

Master's students register in CECS 524 or CECS 624; Ph.D. students register in CECS 624. Additional projects required for CECS 624. (Lecture-problems 3 hours) Letter grade only (A-F).

626./526. Advanced Operating Systems (3)

Prerequisites: CECS 228 and CECS 326 all with a grade of "C" or better.

Theoretical foundations of concepts applied in the design of operating systems. Control of concurrent processes, deadlocks, mutual exclusion, virtual memory, resource management and scheduling.

Master's students register in CECS 526 or CECS 626; Ph.D. students register in CECS 626. Additional projects required for CECS 626. (Lecture–problems 3 hours) Letter grade only (A-F).

628./528. Advanced Analysis of Algorithms (3)

Prerequisites: CECS 328, MATH 380 or EE 380 all with a grade of "C" or better.

Theoretical analysis of algorithms. Divide and conquer, dynamic programming and greedy algorithms; basic search and traversal techniques including search trees; sorting; matrix manipulations; NP–completeness.

Master's students register in CECS 528 or CECS 628; Ph.D. students register in CECS 628. Additional projects required for CECS 628. (Lecture–problems 3 hours) Letter grade only (A-F).

630./530. Advanced Computer Architecture I (3)

Prerequisite: CECS 341 or CECS 440 all with a grade of "C" or better.

Fundamentals of computer architecture. Description of architecture and description languages. Basic computer design and central processor implementation. Memory hierarchy and input/output. Pipelining. Vector processor, multiprocessor systems and dataflow machines.

Master's students register in CECS 530 or CECS 630; Ph.D. students register in CECS 630. Additional projects required for CECS 630. (Lecture-problems 3 hours) Letter grade only (A-F).

631./531. Advanced Computer Architecture II (3)

Prerequisite: CECS 530 with a grade of "C" or better.

Advanced computer architecture with emphasis on parallel processing. Vector processors and multiprocessor systems. Dataflow computation. RISC/CISC. Hypercube. Parallel software. Applications in artificial intelligence, signal/image processing, neural network and optical computing.

Master's students register in CECS 531 or CECS 631; Ph.D. students register in CECS 631. Additional projects required for CECS 631. (Lecture–problems 3 hours) Letter grade only (A-F).

643./543. Advanced Software Engineering (3)

Prerequisite: CECS 343 all with a grade of "C" or better.

Study of software engineering as a broad, problem–solving discipline. Includes structured programming and software project management.

Master's students register in CECS 543 or CECS 643; Ph.D. students register in CECS 643. Additional projects required for CECS 643.

(Lecture-problems 3 hours) Letter grade only (A-F).

644./544. Software Testing and Verification (3)

Prerequisite: CECS 543 with a grade of "C" or better.

Various types of software testing and verification techniques for software development including black box, white box, incremental, top-down and bottom-up, static and dynamic, performance, regression, thread, and stress testing. Discussion of object-oriented software testing with a hierarchical approach. Metrics in complexity for testing, test, and verification plan will be introduced. Automatic software testing and some case studies.

Master's students register in CECS 544 or CECS 644; Ph.D. students register in CECS 644. Additional projects required for CECS 644. (Lecture-problems 3 hours) Letter grade only (A-F).

645./545. Software Architecture (3)

Prerequisite: CECS 543 with a grade of "C" or better.

Includes architectural styles, pipes and filters, data abstraction and object-oriented organization, event-based, implicit invocation, layered systems, repositories, interpreters, process control, distributed processes, domain-specific software & heterogeneous architectures. Component-based design patterns & case studies.

Master's students register in CECS 545 or CECS 645; Ph.D. students register in CECS 645. Additional projects required for CECS 645. (Lecture-problems 3 hours) Letter grade only (A-F).

646./546. Fault Tolerant Computing Systems (3)

Prerequisite: CECS 341 or CECS 440 with a grade of "C" or better.

Fault tolerant techniques are studied as tools to assure the reliability and continuous availability of computing systems. Case studies of modern fault tolerant systems reviewed. Software fault tolerant systems studied as alternatives to verification and validation approaches to software reliability.

Master's students register in CECS 546 or CECS 646; Ph.D. students register in CECS 646. Additional projects required for CECS 646. (Lecture–problems 3 hours) Letter grade only (A-F).

647./547. Software Maintenance, Reengineering and Reuse (3)

Prerequisites: CECS 343 or equivalent all with a grade of "C" or better.

Introduction to software maintenance, defect management, corrective, adaptive and perfective maintenance. Evolution of legacy software systems. Program comprehension techniques, reverse engineering, restructuring, refactoring of software systems. Software re-engineering, data reverse engineering.

Master's students register in CECS 547 or CECS 647; Ph.D. students register in CECS 647. Additional projects required for CECS 647. (Lecture-problems 3 hours) Letter grade only (A-F).

649./549. Advanced Computer Graphics (3)

Prerequisite: CECS 449 with a grade of "C" or better.

Three-dimensional representations, transformations and viewing. Color models and modeling methods. Hidden-line and hidden-surface removal. Lighting and shading. Visual realism. Topics of current interest.

Master's students register in CECS 549 or CECS 649; Ph.D. students register in CECS 649. Additional projects required for CECS 649. (Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F).

650./550. Pattern Recognition Using Artificial Intelligence (3)

Prerequisite: CECS 451 with a grade of "C" or better or consent of instructor.

General concepts of pattern recognition and trainable classifiers, decision theory, supervised learning, non-parametric techniques, rule-based systems and neural networks.

Master's students register in CECS 550; Ph.D. students register in CECS 650. Additional projects required for Ph.D. students. (Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

651./551. Advanced Artificial Intelligence (3)

Prerequisite: CECS 451 with a grade of "C" or better.

Advanced concepts in artificial intelligence. Topics include knowledge acquisition and representation, fuzzy logic, logical reasoning, multi-sensor integration, Dempster-Shafer's theory of evidential reasoning, real-time expert systems and neural networks.

Master's students register in CECS 551 or CECS 651; Ph.D. students register in CECS 651. Additional projects required for CECS 651. (Lecture-problems 3 hours) Letter grade only (A-F).

653./553. Machine Vision (3)

Prerequisite: Graduate standing in engineering or computer science.

Discussion and laboratory implementation of current research in vision and image understanding. Topics include image formation, early processing, segmentation, relational structures in 2-D and 3-D, motion, stereo, 3-D reconstruction, morphological methods and computer architecture for machine vision.

Master's students register in CECS 553 or CECS 653; Ph.D. students register in CECS 653. Additional projects required for CECS 653. (Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

670./570. Concurrent Parallel Programming (3)

Prerequisite: CECS 328, or CECS 341, or CECS 440 all with a grade of "C" or better.

Introduction to concurrent and parallel programming for multiprocessing and distributed systems. Computational models and paradigms. Parallel programming languages and programming tools. Portable parallel programming and mapping techniques. Heterogeneous concurrent programming. Concurrent programming on local networks on workstations and personal computers.

Master's students register in CECS 570 or CECS 670; Ph.D. students register in CECS 670. Additional projects required for CECS 670. (Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

672./572. Advanced Computer Networking (3)

Prerequisite: CECS 474 with a grade of "C" or better

Advanced concepts in computer network theory and practice. Computer network design and standards for local area networks (LANs) and wide area networks (WANs). Computer network configuration and performance issues.

Master's students register in CECS 572 or CECS 672; Ph.D. students register in CECS 672. Additional projects required for CECS 672.

(Lecture-problems 3 hours) Letter grade only (A-F).

674./574. Topics in Distributed Computer Systems (3)

Prerequisite: CECS 526 or CECS 572 or CECS 626 or CECS 672 all with a grade of "C" or better.

Network operating systems vs distributed operating systems, research and design issues of distributed operating systems, resources and resource management in distributed systems, communication security and user authentication.

Master's students register in CECS 574; Ph.D. students register in CECS 674. Additional projects required for CECS 674. (Lecture–problems 3 hours) Letter grade only (A-F). Not open for credit to students with credit in CECS 773.

675./575. Object–Oriented Analysis and Design (3)

Prerequisites: CECS 475 and CECS 343 or CECS 543 all with a grade of "C" or better.

An object–oriented approach to software development based on modeling objects from the real world. Object–oriented methodology from problem statement through analysis, system design, and object design. Implementation of object–oriented designs in various target environments. Case studies.

Master's students register in CECS 575 or CECS 675; Ph.D. students register in CECS 675. Additional projects required for CECS 675.

(Lecture-problems 3 hours) Letter grade only (A-F).

690./590. Selected Topics in Computer Science (3)

Prerequisites: Graduate standing and consent of instructor.

Each offering is based on an area in computer science and technology in which recent advances have been made.

Letter grade only (A-F). May be repeated to a maximum of 6 units with consent of department. Topics announced in the *Schedule of Classes*. Master's students register in CECS 590 or CECS 690; Ph.D. students register in CECS 690. Additional projects required for CECS 690. (Lecture-problems 3 hours)

694. Seminar in Computer Science (3)

Prerequisite: 6 units of 500- or 600-level CECS courses.

Intensive study of a broad selection of conceptual and theoretical problems in computer science. A written student research project and an oral presentation are required.

Letter grade only (A-F).

697. Directed Research (1-3)

Prerequisite: Classified Graduate standing.

Theoretical and experimental problems in computer science and engineering requiring extensive research. Advancement to candidacy and program GPA of at least 3.0 are required. Graduate advisor and project supervisor must be consulted prior to registration.

Independent Study. Letter grade only (A-F).

698. Thesis or Industrial Project (3-6)

Prerequisite: Advancement to Candidacy.

Planning, preparation, completion of thesis or equivalent industrial project report on a suitable topic in computer engineering and computer science following the library's prescribed format. Requires consultation with Graduate Advisor and submission of Agreement for Independent Study form each semester.

May be repeated to a maximum of 6 units in the same semester.

ELECTRICAL ENGINEERING
College of Engineering

Department Chair: Anastasios Chassiakos

Department Office: Engineering and Computer Science (ECS) 561
Telephone: (562) 985-5102/5103
Website: http://www.csulb.edu/colleges/coe/ee

Faculty: James Ary, Chin Chang, Anastasios G. Chassiakos, Christopher Druzgalski, Fumio Hamano, Kenneth James, I-Hung Khoo, Rajendra Kumar (emeritus), Tulin E. Mangir (emeritus), Mohammad Mozumdar, Bahram Shahian, Robert Teng, Chit-Sang Tsang, Mahmoud Wagdy, Fei Wang, Ray Wang, Heu-Geul (Henry) Yeh

Undergraduate Advisors

Electrical Engineering: Fei Wang
Computer Engineering Technology: I-Hung Khoo
Electronics Engineering Technology: I-Hung Khoo

Extension Program Advisor/Coordinator for Electrical Engineering: I-Hung Khoo

Graduate Advisor: James Ary

Biomedical Engineering Advisor: Maryam Moussavi

Administrative Coordinator: Clarice Ross

Students desiring detailed information should contact the department office for referral to one of the faculty advisors.

Career Possibilities

Electrical Engineer • Systems Engineer • Electronics Engineer • Communications Engineer • Electrical Design Engineer • Sales Engineer • Electronics Test Engineer • Research Engineer • Consultant • Manufacturer's Representative • Safety Engineer • Quality Control Specialist • Production Manager (Some of these, and other careers, require additional education or experience. For more information, see www.careers.csulb.edu.)

Advisory and Development Council

The Department of Electrical Engineering is supported by an Advisory and Development Council consisting of outstanding engineers and executives from industry and government in southern California. Its function is to form a liaison between the University and industry and to keep the administration and faculty informed of modern engineering practices. This ensures that the curricula are kept up-to-date. It also advises on placement opportunities before and after graduation.

ABET Accreditation

The Bachelor of Science in Electrical Engineering offered at the Long Beach campus is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. The Electrical Engineering Extension Program offered at Lancaster University Center, Lancaster, CA is undergoing accreditation review in 2014- 2015.

Undergraduate Programs

Bachelor of Science in Electrical Engineering (120 units)

The objectives of the Bachelor of Science in Electrical Engineering Program are to prepare students to be successful and advance in their chosen careers in industry, academia, and public institutions, making significant contributions to the field of electrical engineering. These objectives are achieved by providing students:

1. a solid foundation in basic science, mathematics, and EE practices and major design skills to maintain high employability, adaptability, and an ability to develop and apply new technology;
2. effective communication skills to be able to progress in their careers;
3. an awareness of ethical and societal responsibilities;
4. an ability to work effectively in a team environment.

The bachelor's degree in electrical engineering is designed to prepare graduates for responsible engineering positions in design, development, research, applications, and operation in the fields of communications, control systems, digital signal processing systems, electromagnetics, digital and analog electronic circuits, physical electronics, computer-aided design and power systems. The curriculum is built around a strong basic core of mathematics, physics and engineering science. This is followed by intermediate courses in electrical engineering topics and finally a senior elective sequence including a senior design seminar and terminating in a capstone design course.

By choice of senior elective sequence, comprehensive coverage is provided in any one of the above fields.

Laboratory facilities are available in the engineering buildings allowing for basic as well as more advanced laboratory instruction in electronics, digital signal processing, control systems, microelectronics, communications, power, and digital systems.

Extension Program

The undergraduate program in electrical engineering is also offered as an extension program at Lancaster University Center, Lancaster, CA as part of the Antelope Valley Engineering Programs. This special program offered through the College of Continuing and Professional Education (CCPE) only accepts upper division transfer students with specific admission requirements. The extension program is a cohort-based model, allowing students to proceed as a group through the program in a prescribed lock-step sequence.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Electrical Engineering). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Electrical Engineering at the Long Beach campus must also meet similar major specific requirements. To become fully admitted into the Electrical Engineering major at the Long Beach campus, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum

cumulative 2.5 GPA and complete the following lower-division courses:

Core Lower Division Major Requirements (grade of "C" or better required):

MATH 122 (Calculus I), MATH 123 (Calculus II), PHYS 151 (Mechanics & Heat)

General Education Foundations Courses:

Written and Oral Communication

To be admitted to the Electrical Engineering Extension Program offered at Lancaster University Center, all prospective students must have a minimum cumulative 2.5 GPA on all transferable course work attempted, and complete course work equivalent to the following:

Core Lower Division Major Requirements – 33 units (grade of C or better required):

- MATH 122 (Calculus I), MATH 123 (Calculus II), MATH 224 (Calculus III), PHYS 151 (Mechanics & Heat), PHYS 152 (Electricity & Magnetism), PHYS 254 (Modern Physics), EE 202 (Computer Methods), CECS 100 (Computer Programming), and EE 211/211L (Electrical Circuits with lab)

General Education Courses - 27 units:

- Category A – 6 units (Written and Oral Communication
- Category C – 9 units (Humanities, Arts)
- Category D – 9 units (US history, Constitution & American Ideals, Social Science)
- Category E – 3 units (Self-Integration)

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an advisor to determine if the student's performance in the courses merits an additional semester to complete the requirements.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 122 within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 123 and PHYS 151 within one calendar year.

Requirements

Core:

Take all the following courses:

EE 186 Introduction to Programming and Applications for Electrical Engineers (3)
Prerequisite/Corequisite: ENGL 100.

EE 200 Trends in Electrical Engineering (1)
Prerequisites: None.

EE 201 Digital Logic Design (3)
Prerequisite: None

EE 202 Computer Methods in Engineering (3)
Prerequisites: MATH 123 with a grade of "C" or better.

EE 211 Electric and Electronic Circuits I (3)
Prerequisites: (EE 210/210L or PHYS 152) and (MATH 123 or equivalent) all with a grade of "C" or better.

EE 211L Electric Circuits Laboratory (1)
Prerequisite/Corequisite: EE 211.

ENGR 101 Intro to the Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122.

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113, or a grade of "C" or better in MATH 117.

MATH 123 Calculus II (4)
Prerequisite: A grade of "C" or better in MATH 122.

MATH 224 Calculus III (4)
Prerequisite: A grade of "C" or better in MATH 123 or MATH 222.

MATH 370A Applied Mathematics I (or equivalent) (3)
Prerequisites: A grade of "C" or better in MATH 123. Exclude freshmen.

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

EE 301 Digital System Design (3)
Prerequisite: EE 201 with a grade of "C" or better.

EE 310 Signals and Systems (3)
Prerequisites: EE 211; and MATH 370A or equivalent all with a grade of "C" or better. Corequisite: EE 202.

EE 330 Analog Electronic Circuits I (4)
Prerequisite: EE 211, EE 211L both with a grade of "C" or better.

EE 346 Microprocessor Principles and Applications (3)
Prerequisites: EE 201, EE 202 all with a grade of "C" or better.

EE 350 Energy Conversion Principles (3)
Prerequisites: (EE 202 or equivalent) and EE 211 and EE 211L all with a grade of "C" or better, or consent of instructor.

EE 360 Electromagnetic Fields (3)
Prerequisites: MATH 224, EE 310 all with a grade of "C" or better.

EE 370 Control Systems (3)
Prerequisite: EE 310 all with a grade of "C" or better.

EE 370L Control Systems Laboratory (1)
Prerequisite/Corequisite: EE 370.

EE 380 Probability, Statistics & Stochastic Modeling (3)
Prerequisites: MATH 123; (EE 202 or CECS 271 or CECS 274 or CECS 275) all with a grade of “C” or better.

EE 382 Communications Systems I (3)
Prerequisite: EE 310 all with a grade of "C" or better.

EE 386 Digital Signal Processing (3)
Prerequisites: EE 310 or CECS 301 all with a grade of "C" or better.

Take one of the following choices:

PHYS 152 Electricity and Magnetism (4)
Prerequisite: PHYS 151 with a grade of "C" or better. Prerequisite/Corequisite: MATH 123.

or both of the following:

EE 210 Electro-Magnetic Foundations in EE (3)
Prerequisite: PHYS 151 all with a grade of "C" or better. Corequisites: MATH 123, EE 210L.

EE 210L Electro-Magnetic Foundations in EE Lab (1)
Prerequisite/Corequisite: EE 210.

Select one course from the following:

PHYS 254 Applied Modern Physics (3)
Prerequisite: PHYS 152 or EE 210; Prerequisite/Corequisite: MATH 224.

EE 220 Materials Sciences for Electrical Engineers (3)
Prerequisites: MATH 224 and (EE 210 and EE 210L) all with a grade of "C" or better.

Each of the foregoing courses must be completed with a grade of "C" or better as well as ENGL 100 or equivalent.

Other required courses are:

EE 400D Electrical Engineering Design Project (3)
Prerequisites: EE 301, EE 330, EE 370, EE 382 and EE 386 all with a grade of "C" or better; or consent of instructor.

EE 430 Analog Electronic Circuits II (3)
Prerequisite: EE 330 with a grade of "C" or better.
Prerequisite/Corequisite: EE 370.

EE 430L Analog Electronics II Laboratory (1)
Prerequisite/Corequisite: EE 430.

Each BSEE student must propose course work consisting of a capstone design course supported by at least two related courses, which form an area of in-depth study as approved by the EE Undergraduate Advisor. Possible areas of study include but are not limited to power, digital signal processing, controls, communications and electronics. A list showing the required supporting courses and capstone design course for each area of study is available from the EE Undergraduate Advisor. Combinations of the above areas of study or another area of study may be proposed to the EE Undergraduate Advisor. Additional elective courses must be chosen from EE 400 level courses to total at least 12 units. The entire program must total at least 120 units.

A grade of "C" or better is required for the capstone senior design course in the area of specialization.

Concurrent and/or Summer Enrollment in Another College

Students who wish to take coursework in a community college or another college to meet curricular requirements while enrolled as an undergraduate in the Department of Electrical Engineering must petition the EE Undergraduate Advisor for prior approval to enroll in specific courses. This policy is for either concurrent enrollment or summer enrollment. Prior approval for transfer credit for upper division major courses may generally be approved for no more than six semester units, subject to approval by the EE Undergraduate Advisor and the EE Department Chair who may require sufficient information to determine if each requested course is deemed equivalent to an EE course at CSULB. Exceptions require approval by vote of the EE Undergraduate Curriculum Committee.

Bachelor of Science in Engineering

Option in Biomedical and Clinical Engineering (120 units)

The Department of Electrical Engineering administers an option in Biomedical and Clinical Engineering that allows the student to acquire substantive competence in biomedical engineering and biology. The program builds upon a strong base of biology, mathematics, physics, chemistry, and engineering science to develop a clinically oriented biomedical engineer to serve medical and industrial needs. It includes a core of standard electrical engineering courses as well as courses and laboratories in biomedical engineering, anatomy, physiology and biology. Elective units are available in the senior year to explore individual areas of interest.

Students planning to attend medical, dental or other health professional or graduate schools in Biomedical Engineering may select courses in Chemistry and/or Biology with the approval of the Biomedical Engineering advisor.

Laboratory facilities in the field of biomedical engineering are available in the engineering buildings; and laboratory facilities for anatomy and physiology are available on campus. Computer systems are available to simulate biological systems and to collect, process and display physiological data.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Biomedical & Clinical Engineering). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Biomedical & Clinical Engineering must also meet similar major specific requirements. To become fully admitted into the Biomedical & Clinical Engineering major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower-Division Major Requirements:
MATH 122 (Calculus I), MATH 123 (Calculus II), PHYS 151 (Mechanics & Heat)

General Education Foundations Courses:
Written Communication, Oral Communication, and Critical Thinking

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 122 within one calendar year.

Transfer Students: A grade C or better must be achieved in MATH 123 and PHYS 151 within one calendar year.

Requirements

Lower Division

Take all of the following courses:

BIOL 207 Human Physiology (4)
Prerequisites: GE Foundation requirements.

CHEM 111A General Chemistry (5)
Prerequisites: A passing score on the Chemistry Placement Examination.
Corequisite: MATH 109 or higher.

EE 200 Trends in Electrical Engineering (1)
Prerequisites: None.

EE 201 Digital Logic Design (3)
Prerequisite: None.

EE 202 Computer Methods in Engineering (3)
Prerequisites: MATH 123 with a grade of "C" or better.

EE 211 Electric and Electronic Circuits I (3)
Prerequisites: (EE 210/210L or PHYS 152) and (MATH 123 or equivalent) all with a grade of "C" or better.

EE 211L Electric Circuits Laboratory (1)
Prerequisite/Corequisite: EE 211.

ENGR 101 Intro to the Engineering Profession (1)

Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122.

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113.

MATH 123 Calculus II (4)
Prerequisite: A grade of "C" or better in MATH 122.

MATH 224 Calculus III (4)
Prerequisite: A grade of "C" or better in MATH 123 or MATH 222.

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

Take one of the following choices:

PHYS 152 Electricity and Magnetism (4)
Prerequisite: PHYS 151; Prerequisite/Corequisite: MATH 123.

Or both of the following:

EE 210 Electro-Magnetic Foundations in EE (3)
Prerequisite: PHYS 151 all with a grade of "C" or better. Corequisites: MATH 123, EE 210L.

EE 210L Electro-Magnetic Foundations in EE Lab (1)
Prerequisite/Corequisite: EE 210

Select one course from the following:

PHYS 254 Applied Modern Physics (3)
Prerequisite: PHYS 152 or EE 210; Prerequisite/Corequisite: MATH 224.

EE 220 Materials Sciences for Electrical Engineers (3)
Prerequisites: MATH 224 and (EE 210 and EE 210L) all with a grade of "C" or better

Each of the foregoing courses must be completed with a grade of "C" or better as well as ENGL 100 or equivalent. The interdisciplinary courses as well as the Communications Studies (COMM) courses required for General Education must be taken for a letter grade.

Upper Division:

Take all of the following courses which must be completed with a "C" or better:

EE 301 Digital System Design (3)
Prerequisite: EE 201 with a grade of "C" or better.

EE 310 Signals and Systems (3)
Prerequisites: EE211; and MATH 370A all with a grade of "C" or better or equivalent. Corequisite: EE 202.

EE 330 Analog Electronic Circuits I (4)
Prerequisite: EE 211, EE 211L both with a grade of "C" or better.

EE 346 Microprocessor Principles and Applications (3)
Prerequisites: EE 201, EE 202 all with a grade of "C" or better.

EE 370 Control Systems (3)
Prerequisite: EE 310 all with a grade of "C" or better.

EE 370L Control Systems Laboratory (1)
Prerequisite/Corequisite: EE 370.

EE 382 Communication Systems I (3)
Prerequisite: EE 310 with a grade of "C" or better.

EE 386 Digital Signal Processing (3)
Prerequisites: EE 310 or CECS 301 all with a grade of "C" or better.

EE 400D Electrical Engineering Design Project (3)
Prerequisites: EE 301, EE 330, EE 370, EE 382 and EE 386 all with a grade of "C" or better; or consent of instructor.

EE 406 Medical Instrumentation and Measurements (3)
Prerequisite: EE 330 with a grade of "C" or better or consent of instructor or graduate standing.

EE 406L Biomedical Engineering Laboratory (1)
Prerequisite/Corequisite: EE 406.

EE 407 Applications of Computers in Medicine (3)
Prerequisite: EE 346 with a grade of "C" or better or consent of instructor or graduate standing.

EE 412. Fractals in Engineering (3)
Prerequisite: EE 310 with a grade of "C" or better or graduate standing.

EE 430 Analog Electronic Circuits II (3)
Prerequisite: EE 330 with a grade of "C" or better. Prerequisite/Corequisite: EE 370.

MATH 370A Applied Mathematics I (3)
Prerequisites: A grade of "C" or better in MATH 123. Not open to Freshmen.

Take two additional approved biomedical electives to at least 120 units.

Bachelor of Science in Electronics Engineering Technology

For requirements and courses, see description in the Engineering Technology Programs section of this catalog.

Bachelor of Science in Computer Engineering Technology

For requirements and courses, see description in the Engineering Technology Programs section of this catalog.

Graduate Programs

Master of Science in Electrical Engineering

This program affords an opportunity for engineers and others to advance their competency in analysis and design to better meet the high technology needs of local industry. Each student selects two core courses and three graduate courses in one area of emphasis, and the remaining courses must augment and support the area of emphasis. Some current examples of areas of emphasis are biomedical, communications, computer/communication networks and security, control systems and robotics, digital signal processing, digital and computer systems, electromagnetics and optics, electronics, networks and filters, and power. Students may create other areas of emphasis with the approval of the graduate advisor. Students will choose one of the three alternatives: thesis, project, and comprehensive exam. Successful completion of a thesis provides a unifying culmination to the program, and an enhanced resume for future industrial or academic endeavor. A limited number of laboratory and teaching assistantships are available to qualified graduate students.

Prerequisites

1. A bachelor's degree from an accredited program in electrical engineering or a bachelor's degree from an accredited engineering, natural science or other appropriate program with the requirement that essential undergraduate deficiencies in electrical engineering are removed prior to Advancement to Candidacy.

2. The student should apply online at CSU Mentor. Do not send an application to the Department. International students should apply online at CSU Mentor or through the Center for International Education.

   To be considered for admission the prospective graduate student must have attained a GPA of at least 2.8 for the last 60 semester units (90 quarter units) attempted prior to entry in the MSEE program. The general Graduate Record Examination (GRE) is required.

   The student should apply online at CSU Mentor. Do not send an application to the Department. International students should apply online at CSU Mentor or through the Center for International Education.

Requirements

Take at least 2 out of the below 5 courses appropriate to area of emphasis and subject to graduate advisor approval:

EE 503 Advanced Systems Engineering (3)

EE 505 Advanced Engineering Mathematics for EE (3)
Prerequisites: Consent of instructor.

EE 508 Probability Theory and Random Processes (3)
Prerequisite: EE 380 with a grade of "C" or better.

EE 509 Network Theory (3)
Prerequisites: EE 386, or EE 430 all with a grade of "C" or better.

EE 511 Linear Systems Analysis (3)
Prerequisite: EE 470 all with a grade of "C" or better or equivalent mathematical maturity.

Complete 30 unit minimum in 400-, 500-, or 600-level courses as approved in advance by the graduate advisor.

Take one of the following three alternatives:

1. Thesis Alternative:
   500/600-level EE courses including core (15 units);
   EE 697 Directed Research (3);
   EE 698 Thesis or Industrial Project (6);
   400/500/600-level courses in EE (6 units);
   Comprehensive Oral Exam on Thesis.
2. Project Alternative:
   - 500/600-level EE courses including core (21 units);
   - EE 697 Directed Research (6) (on a capstone project);
   - 400/500/600-level EE courses (3 units);
   - Comprehensive Oral Exam on the capstone project.
3. Comprehensive Exam Alternative:
   500/600-level EE courses including core and at least three courses forming area of emphasis (24 units);
   400/500/600-level EE courses (6 units);
   Comprehensive Written and Oral Exam on the area of emphasis.

Tentative Program

Upon matriculation graduate students must consult with the graduate advisor and a tentative program must be approved by the advisor by a few weeks into the first semester. The program must contain two core courses and exhibit an area of emphasis comprised of at least three related graduate courses (500 or 600 level). Students should obtain the MSEE Handbook, which covers the procedures and requirements, from the advisor or Electrical Engineering Department office or Electrical Engineering web.

Advancement to Candidacy

At least one semester before the graduating semester students must advance to candidacy. To apply for advancement to candidacy students must satisfy the following requirements:

1. All deficiencies must have been made up with a GPA of at least 3.0.
2. Currently enrolled in a regular session.
3. Demonstration of competence in technical writing by passing an appropriate writing course such as ENGL 317, ENGL 417, ENGL 418, or ENGL 419 with a grade of "C" or better or by providing acceptable proof of technical writing ability to the graduate advisor. This requirement can be waived for thesis or project students upon recommendation of the graduate advisor.
4. Fulfillment of the Graduation Writing Assessment Requirement (GWAR).
5. Completion of at least 9 units as a graduate student in residence while maintaining both an overall GPA and a program GPA of at least 3.0. Students are advised to seek advancement before completing 15 units of the program.

Ph.D. in Engineering and Industrial Applied Mathematics

For requirements, see the description in the College of Engineering section of this catalog.

Courses (E E)

LOWER DIVISION

186. Introduction to Programming and Applications for Electrical Engineers (3)

Prerequisite/Corequisite: ENGL100 or equivalent

Introduction to programming using the C language, with emphasis on electrical engineering applications. Variables, conditional control flow loops, functions and program structure, pointers and arrays, input/output processing. Introduction to embedded system applications and development platforms.

Letter Grade only (A-F). (Lecture 2 hours, laboratory 3 hours).

200. Trends in Electrical Engineering (1)

Electrical Engineering as a profession. Nature of professional and design activities. Advances in Electrical Engineering. Current designs, future trends and challenges in various fields of Electrical Engineering.

(Lecture 1 hour) Letter grade only (A-F).

201. Digital Logic Design (3)

Practical design of digital circuits. Basic topics in combinational and sequential switching circuits with applications to the design of digital devices.

Letter grade only (A-F). (Lecture-problems 2 hours, laboratory 3 hours)

202. Computer Methods in Engineering (3)

Prerequisites: MATH 123 with a grade of "C" or better.

Introduction to MATLAB and numerical methods with applications to engineering. Programming in MATLAB. Introduction to SIMULINK and other MATLAB toolboxes.

(Lecture 2 hours, laboratory 3 hours) Letter grade only (A-F). Not open for credit to students with credit in ENGR 202.

210. Electro-Magnetic Foundations in Electrical Engineering (3)

Prerequisite: PHYS 151 all with a grade of "C" or better.
Corequisites: MATH 123, EE 210L.

Electric fields. Magnetic fields. Ohm's law. Kirchoff's laws. Physics of inductance and capacitance. Conservation of energy. Introduction to RL, RC and RLC circuits. Introduction to phasors. Introduction to electric machinery, computer electronics, electromagnetic radiation, and communication.

(Lecture-problems 3 hours) Letter grade only (A-F).

210L. Electro-Magnetic Foundations in Electrical Engineering Laboratory (1)

Prerequisite/Corequisite: EE 210.

Laboratory experiments demonstrating behavior of resistive circuits; capacitors and inductors; transient RL and RC circuits; sinusoidal (phasor) RL, RC and RLC circuits; motors, generators, and transformers.

Letter grade only (A-F).

211. Electric and Electronic Circuits (3)

Prerequisites: (EE 210/210L or PHYS 152) and (MATH 123 or equivalent) all with a grade of "C" or better.

Linear circuit analysis techniques including circuit transformations, mesh and node analyses. Thevenin's, Norton's, Superposition, and Maximum Power Transfer theorems. Transient analysis of RL, RC and RLC circuits. Phasors. Power concepts. Nonlinear circuits including diodes. Circuit solution using PSpice.

(Lecture-problems 3 hours) Letter grade only (A-F).

211L. Electric Circuits Laboratory (1)

Prerequisite/Corequisite: EE 211.

Laboratory investigation of Ohm's Law, Kirchhoff's Laws, voltage and current division, mesh and nodal analysis, Thevenin and Norton equivalents, superposition, simple RL, RC, RLC circuits, phasors. Use of voltmeters, ammeters, ohmmeters and oscilloscopes. Identification of unknown elements.

(Laboratory 3 hours) Letter grade only (A-F).

220. Materials Sciences for Electrical Engineers (3)

Prerequisites: MATH 224 and EE 210 all with a grade of "C" or better.

Basic principles of optical and wave propagation. Introduction to quantum electronics. Fundamental aspects of photonics and materials sciences and their relevance to solid state electronic circuits.

Letter grade only (A-F). (Lecture-problems 3 hours)

260. Analytical Methods for Electromagnetics (4)

Prerequisite: EE 210 or PHYS 152 or equivalent all with a grade of "C" or better.

Fundamental concepts and analytical methods for electromagnetics.

(Lecture 3 hours, problem session 2 hours.) Letter grade only (A-F).

UPPER DIVISION

301. Digital System Design (3)

Prerequisite: EE 201 with a grade of "C" or better.

FPGA based digital design. Implementation of FPGA digital hardware systems based on the algorithms and implementation requirements using hardware description languages, optimization, logic synthesis, place and route methods. Implementation of finite state machines.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F). Same course as EE 301H. Not open for credit to students with credit in EE 301H.

301H. Digital System Design (3)

Prerequisite: EE 201 with a grade of "C" or better.

FPGA based digital design. Implementation of FPGA digital hardware systems based on the algorithms and implementation requirements using hardware description languages, optimization, logic synthesis, place and route methods. Implementation of finite state machines.

Letter grade only (A-F). EE 301H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in EE 301. (Lecture-problems 2 hours, laboratory 3 hours)

310. Signals and Systems (3)

Prerequisites: EE211; and MATH 370A or equivalent all with a grade of "C" or better.
Corequisite: EE 202.

Fundamental concepts of signals and systems. Laplace Transforms. Fourier Series. Fourier Transforms. Two-port parameters.

(Lecture-problems 3 hours) Letter grade only (A-F). Same course as EE 310H. Not open for credit to students with credit in EE 310H.

310H. Signals and Systems (3)

Prerequisites: EE211; and MATH 370A or equivalent all with a grade of "C" or better.

Corequisite: EE 202.

Fundamental concepts of signals and systems. Laplace Transforms. Fourier Series. Fourier Transforms. Two-port parameters.

Letter grade only (A-F). EE 310H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in EE 310. (Lecture-problems 3 hours)

315. Introduction to Systems Analysis (3)

Prerequisite: MATH 123 with a grade of "C" or better.

System definitions: linear, nonlinear, continuous, discrete. Analytical, and qualitative solution of nonlinear systems. Linear system analysis and solutions. Introduction to complex algebra. Discrete systems modeling, analysis, solutions. State space representation and stability analysis. Introduction to linear and matrix algebra.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

330. Analog Electronic Circuits I (4)

Prerequisites: EE 211, EE 211L both with a grade of "C" or better.

Analysis and design of diode, bipolar junction transistor, field-effect transistor (MOSFET and JFET), and CMOS circuits. Op-Amp linear and nonlinear circuit applications. Digital electronic circuits. Laboratory includes transistor and operational amplifier circuit design and CAD tools.

(Lecture-problems 3 hours, laboratory 3 hours) Letter grade only (A-F).

346. Microprocessor Principles and Applications (3)

Prerequisites: EE 201, EE 202 all with a grade of "C" or better.

Introduction to the design of modern RISC based microprocessors and microcontrollers. Programming problems written in C++ and assembly using the critical thinking skills learned in CECS100. Architectural principles learned in the classroom illustrated using the assembly programming language.

Letter grade only (A-F). (Lecture-problems 2 hours, lab 3 hours)

350. Energy Conversion Principles (3)

Prerequisites: (EE 202 or equivalent) and EE 211 and EE 211L, or consent of instructor all with a grade of "C" or better.

Electromechanical energy conversion. Power transformers. DC, synchoronous, and induction machines. Laboratory experiments on power electronics and rotating machinery.

Letter grade only (A-F). (Lecture-problems 2 hours, lab 3 hours). Same course as EE 350H. Not open for credit to students with credit in EE 350H.

350H. Energy Conversion Principles (3)

Prerequisites: (EE 202 or equivalent) and EE 211 and EE 211L, or consent of instructor all with a grade of "C" or better.

Electromechanical energy conversion. Power transformers. DC, synchoronous, and induction machines. Laboratory experiments on power electronics and rotating machinery.

Letter grade only (A-F). EE 350H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in EE 350. (Lecture-problems 2 hours, lab 3 hours).

360. Electromagnetic Fields (3)

Prerequisites: MATH 224, EE 310 all with a grade of "C" or better.

Electric and magnetic field theory including propagation of plane waves in lossless and dissipative media. Maxwell's equations. Transmission lines and waveguides.

(Lecture-problems 3 hours) Letter grade only (A-F). Not open for credit to students with credit in EE 460.

370. Control Systems (3)

Prerequisite: EE 310 with a grade of "C" or better.

Control systems analysis; block diagrams, signal flow graphs, stability criteria, root locus, frequency domain analysis. Examples of classical control system design.

Letter grade only (A-F). (Lecture-problems 3 hours). Same course at EE 370H. Not open for credit to students with credit in EE 370H.

370H. Control Systems (3)

Prerequisite: EE 310 with a grade of "C" or better.

Control systems analysis; block diagrams, signal flow graphs, stability criteria, root locus, frequency domain analysis. Examples of classical control system design.

Letter grade only (A-F). EE 370H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in EE 370. (Lecture-problems 3 hours).

370L. Control Systems Laboratory (1)

Prerequisite/Corequisite: EE 370.

Experiments which reinforce concepts learned in EE 370. Digital simulation modeling, analysis, and design. Real time applications.

Letter grade only (A-F). (Laboratory 3 hours)

380. Probability, Statistics, and Stochastic Modeling (3)

Prerequisites: MATH 123; (EE 202 or CECS 271 or CECS 274 or CECS 275) all with a grade of "C" or better.

Probability with an emphasis on computer modeling of probabilistic systems. Topics such as discrete and continuous random variables, moments, correlation, covariance, Markov processes and queuing theory presented from a mathematical foundation developed and exemplified with realistic computer simulations from students.

Letter grade only (A-F). (Lecture 2 hrs, Laboratory 3 hrs)

382. Communication Systems I (3)

Prerequisite: EE 310 with a grade of "C" or better.

Review of Fourier series and transforms. Introduction to passive, active, and digital filters. Basic elements of probability theory, statistics, concept of white noise, AM, DSB, SSB and vestigial modulation, narrowband and wideband FM.

Letter grade only (A-F). (Lecture-problems 2 hours, lab 3 hours). Same course as EE 382H. Not open for credit to students with credit in EE 382H.

382H. Communication Systems I (3)

Prerequisite: EE 310 with a grade of "C" or better.

Review of Fourier series and transforms. Introduction to passive, active, and digital filters. Basic elements of probability theory, statistics, concept of white noise, AM, DSB, SSB and vestigial modulation, narrowband and wideband FM.

Letter grade only (A-F). EE 382H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in EE 382. (Lecture-problems 2 hours, lab 3 hours)

386. Digital Signal Processing (3)

Prerequisites: EE 310 or CECS 301 all with a grade of "C" or better.

Introduction to discrete-time signals and systems, z-transform, digital filters, system design, and comparison to the analog counterparts. Multimedia-based laboratory experiments for discrete-time signals and systems in time and frequency domain, synthesis of digital sound/music with MATLAB or C.

Letter grade only (A-F). (Lecture-problems 2 hours, laboratory 3 hours). Same course as EE 386H. Not open for credit to students with credit in EE 386H.

386H. Digital Signal Processing (3)

Prerequisites: EE 310 or CECS 301 all with a grade of "C" or better.

Introduction to discrete-time signals and systems, z-transform, digital filters, system design, and comparison to the analog counterparts. Multimedia-based laboratory experiments for discrete-time signals and systems in time and frequency domain, synthesis of digital sound/music with MATLAB or C.

Letter grade only (A-F). EE 386H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in EE 386. (Lecture-problems 2 hours, laboratory 3 hours)

400D. Electrical Engineering Design Project (3)

Prerequisites: EE 301, EE 330, EE 370, EE 382 and EE 386 all with a grade of "C" or better; or consent of instructor

First integrative learning capstone design course. Project design, design for testability, safety, manufacturability, and other constraints such as performance, cost, packaging, codes and standards. Ethics, social and environmental impact. Teamwork, written communication and presentations

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

405. Selected Topics in Electrical Engineering (3)

Prerequisites: Senior standing in electrical engineering or consent of instructor or graduate standing.

Selected topics from recent advances in electrical engineering.

Letter grade only (A-F). May be repeated to a maximum of 6 units with undergraduate advisor consent. Topics announced in *Schedule of Classes*. (Lecture-problems 3 hours).

406. Medical Instrumentation and Measurements (3)

Prerequisite: EE 330 with a grade of "C" or better or consent of instructor or graduate standing.

Design and analysis of medical instruments, electrodes and amplifiers for measurement of physiological signals.

Letter grade only (A-F). (Lecture-problems 3 hours)

406L. Biomedical Engineering Laboratory (1)

Prerequisite/Corequisite: EE 406.

Laboratory study of medical instrumentation, transducers and computer data processing.

(Laboratory 3 hours) Letter grade only (A-F).

407. Applications of Computers in Medicine (3)

Prerequisite: EE 346 with a grade of "C" or better or consent of instructor or graduate standing.

Integrative learning capstone course with focus on principles of analysis and design of computing and data collection equipment for real-time on-line medical systems. Emphasis on written and oral communication and teamwork. (Lecture-problems, projects 3 hours) Letter grade only (A-F).

412. Fractals in Engineering (3)

Prerequisite: EE 310 with a grade of "C" or better or graduate standing.

Application of fractal geometry to system theory. Study of system dynamics leading to complex behaviors and chaos. Scaling laws, sensitivity to initial conditions, strange attractors, and i/f noise will also be discussed.

(Lecture-problems 3 hours). Letter grade only (A-F).

420. Solid State Electronic Devices (3)

Prerequisite: PHYS 254 with a grade of "C" or better or graduate standing.

Semiconductor crystal structure and growth. Carrier modeling, drift and diffusion currents. P-N junctions, diodes, solar cells and light-emitting diodes (LED). Bipolar junction transistor (BJT) biasing, linear and switched operation. Metal oxide semiconductor field effect transistor (MOSFET) operation. Solar cells, photovoltaics, and lasers.

Not open for credit to students with credit in EE 320. (Lecture-problems 3 hours) Letter grade only (A-F).

427./527. Digital Filter Design and Audio Processing (3)

Prerequisite: EE 386 with a grade of "C" or better or consent of instructor.

Digital filter design methods, filter architectures, round-off noise, implementation and applications to audio signal processing. Additional projects required for EE 527.

(Lecture-problems 3 hours) Letter grade only (A-F).

428./528. Speech Signal Processing (3)

Prerequisite/Corequisite: EE 486 or consent of instructor.

Principles and engineering applications of speech signal processing. Speech synthesis, recognition, encoding, and compression. Applications of neural networks.

Additional projects required for EE 528. (Lecture-problems 3 hours) Letter grade only (A-F).

430. Analog Electronic Circuits II (3)

Prerequisite: EE 330 with a grade of "C" or better.
Prerequisite/Corequisite: EE 370.

Differential pairs, current sources, output stages, and integrated operational amplifiers. Op-amp applications and practical issues. Frequency response. Computer-aided circuit analysis and design. Feedback amplifiers and stability. Oscillators.

(Lecture-problems 3 hours) Letter grade only (A-F). Same course as EE 430H. Not open for credit to students with credit in EE 430H.

430H. Analog Electronic Circuits II (3)

Prerequisite: EE 330 with a grade of "C" or better.

Prerequisite/Corequisite: EE 370.

Differential pairs, current sources, output stages, and integrated operational amplifiers. Op-amp applications and practical issues. Frequency response. Computer-aided circuit analysis and design. Feedback amplifiers and stability. Oscillators.

Letter grade only (A-F). EE 430H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in EE 430. (Lecture-problems 3 hours)

430L. Analog Electronics Laboratory II (1)

Prerequisite/Corequisite: EE 430.

Advanced transistor, operational amplifier, and linear-integrated circuits and systems design laboratory.

Not open for credit to students with credit in EE 433L. (Laboratory 3 hours) Letter grade only (A-F).

434./534. Mixed-Signal IC Design (3)

Prerequisites: EE 201 and EE 330 all with a grade of "C" or better or consent of instructor.

CMOS fabrication. Component layout. MOSFET modeling. Mixed-signal devices such as D/A and A/D converters and phase-locked loops. Substrate Noise coupling. System-on-chip considerations. Design using CAD tools.

Additional projects required for EE 534. (Lecture-problems 2 hours, Laboratory 3 hours) Letter grade only (A-F).

435./535A. Microelectronics (3)

Prerequisites: EE 201 and EE 330 all with a grade of "C" or better.

Theory of microelectronics integrated circuit design, IC fabrication technology, device characterization, modelling, digital and analog simulation tools, physical layout tools, digital standard cell library design, IC digital system designs, I/O pad design, full chip simulation and physical designs.

Additional projects required for EE535A. (Lecture-problems 3 hours) Letter grade only (A-F).

435L. Microelectronics Laboratory (1)

Corequisite: EE 435.

Laboratory evaluation of IC process steps. Wafer probe, packaging, and final test. Empirical device model formulation from test data.

Not open for credit to students with credit in EE 420L. (Laboratory 3 hours) Letter grade only (A-F).

436./536. Microfabrication and Nanotechnology (3)

Prerequisites: EE 330 and PHYS 254; or MAE 300 all with a grade of "C" or better.

Techniques and the technology of miniaturization of electrical, mechanical, optical, and opto-electronic devices in sizes from millimeters to nanometers. Design examples of sensors, microlenses, cantilevers, and micromotors, process fabrication.

Additional projects required for EE 536. (Lecture-problems 3 hours) Letter grade only (A-F).

442. Mechatronic Systems Design (3)

Prerequisites: (EE 202 and EE 346) or (MAE 300 and MAE 376) all with a grade of "C" or better, or consent of instructor

Sensor and actuator characteristics, selection criteria, and modeling. Simulation and design of mechatronic systems. Hardware implementation and interfacing using microcontroller. Hardware-in-the-loop (HIL) simulation.

Letter grade only (A-F). Same course as MAE 490G. Not open for credit to students with credit in MAE 490G. (Lecture-problems 3 hours)

443. System-on-Chip Architecture and Applications (3)

Prerequisite: EE 346 with a grade of "C" or better or consent of instructor or graduate standing.

Introduction to System-on-Chip Architecture by using ARM's MCU and MMU. Concepts and methodologies in designing a system-on-chip (SoC) based microprocessor core. Principles of modern SoC and processor design. Embedded applications based around SoC processor cores.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

444. Microprocessor Based System Design (3)

Prerequisites: EE 346 with a grade of "C" or better or graduate standing.

Study of microprocessor based systems and their integration with peripheral devices including sensors, actuators, and serial communications. Following a progressive lab sequence, over the semester the student will design and construct a modern RISC microcontroller based system.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F). Not open for credit to student with credit in EE 347.

447. Design of Electronic Systems (3)

Prerequisites: (EE 301 or 435) and EE 346 and EE 430 all with a grade of "C" or better, or graduate standing.

Prerequisitie/Corequisite: EE 400D or graduate standing.

Second integrative learning capstone course, focusing on the design of analog and digital systems. Extensive laboratory projects, written communication, and teamwork. Computer aided circuit/system analysis and design using hardware descriptive language (HDL), PSPICE, Matlab/Simulink, etc.

(Lecture-problems 2 hours. laboratory 3 hours) Letter grade only (A-F).

448./548. Wireless and Mobile Networks and Security in Wireless Networks (3)

Prerequisite: EE 482 with a grade of "C" or better or equivalent.

Wireless and Mobile Ad-hoc Networks and Security. Ad-hoc and geographic routing, resource discovery, MAC, IP-mobility, mobility modelling, wired-wireless networks, security aspects. Lab Projects will include use of tools such as OPNET, Ethereal, Sniffer, Scanner, IDS, etc.

Advanced project required for EE 548. (Lecture-problems 3 hours) Letter grade only (A-F).

450. Electronic Control of Motors (3)

Prerequisite: EE 350 with a grade of "C" or better or graduate standing.

Prerequisites/Corequisites: EE 370 or graduate standing.

Characteristics of semiconductor power switches. Modeling and application of control theory to various types of motors. Bidirectional and four-quadrant converter topologies for motion control. Selection of drives to control AC and DC motors. Uninterruptible power supplies and adjustable speed drives.

(Lecture-problems 3 hours) Letter grade only (A-F).

451. Electric Vehicles (3)

Prerequisites: EE 350 and (EE 370 or MAE 376) all with a grade of "C" or better; or graduate standing.

Electric propulsion systems for electric and hybrid electric vehicles. DC and AC motor drives. Brushless DC motors. Switched reluctance motors. Energy storage systems including batteries and supercapacitors. Electric Vehicle Mechanics and Drivetrain.

(Lecture-problems 3 hours) Letter grade only (A-F).

452. Computer Applications in Power Systems (3)

Prerequisite: EE 350 with a grade of "C" or better or consent of instructor or graduate standing.

Modeling of power generation, transmission, and distribution systems, load-flow analyses, short-circuit studies, voltage drop and power loss calculations, transient stability and optimal power flow analyses. Application of specialized computer software for power system design and analyses.

(Lecture-problems 3 hours) Letter grade only (A-F).

453./553. Protection of Power Systems (3)

Prerequisites: EE 310, EE 350 all with a grade of "C" or better.

Protective relays, instrument transformers, low-voltage and high-voltage circuit breakers, protection of generators and motors, transformer protection and transmission line protection. Relay coordination and commercial power systems. Application of computer programs for protective device coordination. Additional projects required for EE 553.

(Lecture-problems 3 hours) Letter grade only (A-F).

458. Design of Power System Components (3)

Prerequisites: EE 330 and (either EE 450 or EE 452 or EE 453) all with a grade of "C" or better; or graduate standing.

Prerequisitie/Corequisite: EE 400D or graduate standing.

Second integrative learning capstone course, focusing on the design of electrical, electronic, and electrochemical components required for power conversion, control, transmission, distribution, protection and measurements in electric power systems. Emphasis on written communication and teamwork.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

462. Electromagnetics and Applications to Wireless Systems (3)

Prerequisite: EE 310 with a grade of "C" or better or graduate standing.

Electromagnetic field theory including transmission lines, vector fields, electrostatics and magnetostatics.

Maxwell's equations and plane wave propagation. Waveguides and microstrip-RF circuit principles and devices. Radiation and antenna design. Wireless communication systems including satellite and cell-phone technologies.

Letter grade only (A-F). Not open for credit to students with credit in EE 460 or EE 464. (Lecture-problems 2 hours, laboratory 3 hours)

470. Digital Control (3)

Prerequisites: EE 370, EE 370L, and EE 386 all with a grade of "C" or better, or graduate standing.

Analysis and synthesis of digital control systems. General application of both the Z-transform and the state-space approach for discrete system design.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

471. Design of Control Systems (3)

Prerequisite: EE 370 with a grade of "C" or better or graduate standing.

Prerequisitie/Corequisite: EE 400D.

Second integrative learning capstone course, focusing on the design of compensators using root-locus and Bode-plot methods. Design of state-space control systems and observers. Computer-aided design. Emphasis on written communication and teamwork.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

474./574. Robot Modeling and Control (3)

Prerequisite: EE 370 with a grade of "C" or better.
Recommended: EE 511

Basic methodology for analysis and design of robotic manipulators. Classification of robots. Homogeneous transformations, kinematics, dynamics, trajectory planning and control of robots. Application of robots in flexible manufacturing. Advanced projects required for EE 574. EE 511 is recommended as a pre/corequisite.

(Lecture-problems 3 hours) Letter grade only (A-F).

476./576. Neural Networks and Fuzzy Logic (3)

Prerequisite: EE 386 with a grade of "C" or better or consent of instructor.

Principles and application of artificial neural networks and fuzzy logic. Mechanisms of supervised and unsupervised neural networks. Fuzzy control systems. Applications in signal processing, communications, control, and other areas.

Additional projects required for EE 576. Not open for credit to students with credit in EE 589/689. (Lecture-problems 3 hours) Letter grade only (A-F).

481./581. Satellite Communication Systems (3)

Prerequisite: EE 482 with a grade of "C" or better.

Basic orbital mechanics, link analysis, multiple access architectures and protocols, FDMA, TDMA, and CDMA systems. Synchronization techniques, modulation and coding techniques. Security and spread spectrum requirements. System design.

Additional projects required for EE 581. (Lecture-problems 3 hours) Letter grade only (A-F).

482. Communication Systems II (3)

Prerequisite: EE 382 with a grade of "C" or better or graduate standing.

Information sources and communication systems. Orthogonal series representation of signals, pulse and digital modulation techniques, band-pass digital communication systems, special topics in communications.

(Lecture-problems 3 hours) Letter grade only (A-F).

483. Digital Image Processing (3)

Prerequisite: EE 386 with a grade of "C" or better or graduate standing.

Image formation. Image detectors and their characteristics. Perception, image models. Sampling and quantization. Pixel relationships. Statistical characterization of discrete images - probability density models. Image fidelity criteria and image intelligibility. Image transforms. Image enhancement techniques.

(Lecture-problems 3 hours) Letter grade only (A-F).

486. Digital Signal Processing for Multimedia Communications (3)

Prerequisite: EE 386 with a grade of "C" or better or graduate standing.

Discrete-time signals and systems, discrete Fourier transform, fast Fourier transform, spectral estimation, interpolation and decimation, filter design and structures and applications to multimedia communications. Laboratory projects for image processing, FFT receiver, signal detection, digital phase-locked loop.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

488. Communication System Design (3)

Prerequisite/Corequisite: (EE 400D, EE 430, EE 430L, and EE 482), or graduate standing.

Second integrative learning capstone course, focusing on the design of communication systems/subsystems and their implementation in software and hardware. Emphasis on written communication and teamwork.

(Lecture-problems 2 hours, laboratory 3 hours). Letter grade only (A-F).

489. Digital Signal Processing Design (3) S

Prerequisities/Corequisites: (EE 400D and EE 486) or graduate standing.

Second integrative learning capstone course, focusing on the design of digital signal processing systems and implementation of digital filters with fixed-point digital signal processors. Emphasis on written communication and teamwork.
(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

490. Special Problems (1-3)

Prerequisites: Minimum G.P.A. of 2.5 and consent of instructor.

Assigned topics in technical literature or laboratory projects and reports.

May be repeated to a maximum of 6 units. Letter grade only (A-F).

495. Computational Physiology (3)

Prerequisite: EE 380 with a grade of "C" or better

This course will introduce students to cardiovascular (heart) and cerebrovascular (brain) systems and signals, and the computational methods to analyze related signals, and detect/predict a physiological event of interest.

Same course as: CECS 495. Not open for credit to students with credit in CECS 495.

Letter Grade only (A-F). (Lecture 2 hours, Laboratory 3 hours)

GRADUATE LEVEL

503. Advanced Systems Engineering (3)

Prerequisite: None

Modeling and analysis, and design of deterministic and stochastic systems. The building blocks of engineering optimization models ranging from network models with special structured, to unstructured linear and nonlinear optimization.

Letter grade only (A-F). (Lecture-problems 3 hours)

504. Introduction to Entrepreneurship for Engineers (3)

Prerequisite: Graduate standing in engineering or computer science.

Core business concepts and issues, essence of leadership. Understanding of finance, marketing, sales, and management issues from practical entrepreneurial perspective through classroom discussion, guest speakers' seminars, case study, and creation of business plan based on student's specific area of interest.

(Lecture-problems 3 hours) Letter grade only (A-F).

505. Advanced Engineering Mathematics for Electrical Engineers (3)

Prerequisite: Consent of instructor.

Boundary–value problems and generalized Fourier (or eigenfunction) expansions. Review of Fourier series. Fourier transforms (FT, FFT and STFT), wavelet transform and its computer implementation. Z–transform. Hilbert transform. Solutions of partial differential equations using methods of separation of variables, etc.

(Lecture–problems 3 hours) Letter grade only (A-F).

506./606. Theory and Practice of Biomedical Instrumentation (3)

Prerequisites: Graduate standing in engineering or natural sciences and either EE 406 with a grade of "C" or better or consent of instructor.

Advanced design concepts and practical utilization of biomedical instrumentation. Transduction of physiological parameters. Theory and practice.

Master's students register in EE 506; Ph.D. students register in EE 606. Additional projects required for EE 606. (Lecture-problems 3 hours) Letter grade only (A-F).

507./607. Advanced Biomedical Systems (3)

Prerequisites: Graduate standing in engineering or natural sciences and either EE 406 with a grade of "C" or better or consent of instructor.

Novel trends in biotechnology, design and organization of modern hospital systems, and utilization of advanced technologies. Modeling and simulation of physiological and medical systems.

Master's students register in EE 507; Ph.D. students register in EE 607. Additional projects required for EE 607. (Lecture-problems 3 hours) Letter grade only (A-F).

508. Probability Theory and Random Processes (3)

Prerequisite: EE 380 with a grade of "C" or better.

Probability spaces, random vectors and processes, convergence concepts, stationarity and ergodic properties, second-order moments and linear systems, correlation and spectral representations. Some applications of random processes.

(Lecture-problems 3 hours) Letter grade only (A-F).

509. Network Theory (3)

Prerequisite: EE 386 or EE 430 all with a grade of "C" or better.

Network classifications and study of non-linear circuits. Analysis of linear networks using topological and state-space techniques. Characterization of networks using scattering and other parameters. Tellegen's theorem and its application.

(Lecture-problems 3 hours) Letter grade only (A-F).

510. Circuit Synthesis (3)

Corequisite: EE 509.

Synthesis of passive lumped networks, cascade synthesis (link with filter synthesis), realization of commensurate distributed networks, discrete passive networks.

(Lecture-problems 3 hours) Letter grade only (A-F).

511. Linear Systems Analysis (3)

Prerequisite: EE 470 all with a grade of "C" or better or equivalent mathematical maturity.

Review of linear algebra and z-transforms. Continuous and discrete-time systems. Sampled data systems. State-space linear system analysis. Stability, reachability, and observability. Minimal realization. State feedback and pole assignment. Asymptotic observers. Examples of applications. Project on a related subject.

(Lecture-problems 3 hours) Letter grade only (A-F).

514. Advanced Circuit Synthesis and Design (3)

Prerequisite: EE 510 with a grade of "C" or better.

Scattering synthesis in (s-z) domains, wave digital filters. Lossless bounded-real two-pair and orthogonal digital filters with an emphasis on structures suitable for VLSI implementation.

(Lecture-problems 3 hours) Letter grade only (A-F).

526. High Speed Communication Circuits (3)

Prerequisite: EE 430 with a grade of "C" or better or consent of instructor

Design of integrated circuits for high speed data communication. Serial communication standards. Transceiver architecture. High speed and broadband circuit design techniques. Serializer, deserializer, clock recovery circuits. Channel equalization. Jitter and channel interference issues.

(Lecture-problems 3 hours) Letter grade only (A-F).

527./427. Digital Filter Design and Audio Processing (3)

Prerequisite: EE 386 with a grade of "C" or better or consent of instructor.

Digital filter design methods, filter architectures, round-off noise, implementation and applications to audio signal processing. Additional projects required for EE 527.

Not open for credit to students with credit in EE 513. (Lecture-problems 3 hours) Letter grade only (A-F).

528./428. Speech Signal Processing (3)

Prerequisite/Corequisite: EE 486 or consent of instructor.

Principles and engineering applications of speech signal processing. Speech synthesis, recognition, encoding, and compression. Applications of neural networks.

Additional projects required for EE 528. (Lecture-problems 3 hours) Letter grade only (A-F).

531. CMOS Electronics (3)

Prerequisite: EE 430 with a grade of "C" or better.

Electronic design automation CAD tools, silicon compilers, CMOS design, BiCMOS design (technologies, modeling, device characterization and simulation), CMOS and BiCMOS subcircuits, amplifiers, op-amps and systems.

(Lecture-problems 3 hours) Letter grade only (A-F).

532./632. Analog Signal Processing (3)

Prerequisite: EE 430 with a grade of "C" or better or consent of instructor.

Basic CMOS circuit techniques. Low-voltage and current-mode signal processing. Switched-capacitor (SC)and switched-current (SI) circuits such as amplifiers, integrators, S/H circuits, filters, oscillators, D/A and A/D converters, etc. Advanced techniques for corrections of nonideal behavior. Analysis and simulation projects.

Master's students register in EE 532; Ph.D. students register in EE 632. Additional projects required for EE 632. Letter grade only (A-F). (Lecture-problems 3 hours)

533. Quantum and Optical Electronics (3)

Prerequisite: EE 360 or EE 462 all with a grade of "C" or better or consent of instructor.

Modern quantum and optical concepts of relevance in lasers, fiber optics, optical technology and semiconductor solid state electronics. Basic theory and applications to state-of-the-art electronics engineering.

534./434. Mixed-Signal IC Design (3)

Prerequisites: EE 201 and EE 330 both with a grade of "C" or better or consent of instructor.

CMOS fabrication. Component layout. MOSFET modeling. Mixed-signal devices such as D/A and A/D converters and phase-locked loops. Substrate Noise coupling. System-on-chip considerations. Design using CAD tools.

Additional projects required for EE 534. (Lecture-problems 2 hours, Laboratory 3 hours) Letter grade only (A-F).

535. VLSI Design (3)

Prerequisite: EE 430 with a grade of "C" or better.

Techniques for designing Very Large Scale Integrated (VLSI) circuits using n-channel metal oxide semiconductors (n-MOS).

Not open for credit to students with credit in EE 520. (Lecture-problems 3 hours) Letter grade only (A-F).

535A./435. Microelectronics (3)

Prerequisites: EE 201 and EE 330 both with a grade of "C" or better or consent of instructor.

Theory of microelectronics integrated circuit design, IC fabrication technology, device characterization, modelling, digital and analog simulation tools, physical layout tools, digital standard cell library design, IC digital system designs, I/O pad design, full chip simulation and physical designs.

Letter grade only (A-F). Additional projects required for EE 535A. (Lecture-problems 3 hours)

536./436. Microfabrication and Nanotechnology (3)

Prerequisites: EE 330; EE 320 or PHYS 254; or MAE 300 all with a grade of "C" or better.

Techniques and technology of miniaturization of electrical, mechanical, optical, and opto-electronic devices in sizes from millimeters to nanometers are presented. Design examples of sensors, microlenses, cantilevers, and micromotors are covered and process fabrication using latest technology demonstrated.

Additional projects required for EE 536. (Lecture-problems 3 hours) Letter grade only (A-F).

540. Advanced Digital System and Computer Architecture (3)

Prerequisite: None
Strongly recommended: EE 546.

High level computer architectures including studies of network processors, security processing, embedded computers; system design and implementation approaches including ASIC's, SOC's, and networks on chip concepts. Simulation and design tools. Project required.

(Lecture-problems 3 hours) Letter grade only (A-F).

545. Computer Communication Networks (3)

Prerequisite: Consent of instructor.

Design and analysis of computer communications networks including their topologies, architectures, protocols, and standards. LAN, WAN environments and access methods. Ethernet, ATM, bridges, routers, gateways and intelligent hubs. TCP/IP and other Networking protocols. Load balancing, traffic monitoring, use of simulation tools.

(Lecture-problems-computer projects 3 hours) Letter grade only (A-F).

546. Advanced Microprocessors and Embedded Controllers II (3)

Prerequisite: None

Advanced concepts for embedded controllers, mobile processors, network processors, embedded Internet, and embedded Internet devices. Parallelism, multithreading, pipelining, coherence protocols, interconnection networks, clustering. Simulation and analysis tools. Project required.

(Lecture-problems 3 hours) Letter grade only (A-F).

547. Sensor Netwoks (3)

Prerequisite: Graduate Standing and consent of instructor.

Small and low power sensors and radio equipped modules replacing traditional wired sensor systems. Communication protocols and mesh networking in limited resource nodes, application development frameworks for sensor networks, modeling, simulation and virtualization.

(Lecture-problems 3 hours). Letter grade only (A-F).

548./448. Wireless and Mobile Networks and Security in Wireless Networks (3)

Prerequisites: EE 482 with a grade of "C" or better or equivalent.

Wireless and Mobile Ad-hoc Networks and Security. Ad-hoc and geographic routing, resource discovery, MAC, IP-mobility, mobility modelling, wired-wireless networks, security aspects. Lab Projects will include use of tools such as OPNET, Ethereal, Sniffer, Scanner, IDS, etc.

Advanced project required for EE 548. (Lecture-problems 3 hours) Letter grade only (A-F).

550. Power Electronics and Applications (3)

Prerequisites: EE 350 and EE 430 all with a grade of "C" or better.

Power converters: rectifiers, inverters, choppers and cycloconverters. PWM and PFM techniques. Harmonics and filters. Magnetics. Applications in motor controls in industrial systems, energy conversion, HVDC transmission, aircraft and spacecraft power systems.

(Lecture-problems 3 hours) Letter grade only (A-F).

551. Theory and Applications of DC/DC Converters (3)

Prerequisite: EE 550 with a grade of "C" or better or consent of instructor.

Modeling, analysis, design and application of DC/DC switch-mode converters.

(Lec-prob 3 hrs) Letter grade only (A-F).

552. Electric Drives and Applications (3)

Prerequisites: EE 370 and EE 452 all with a grade of "C" or better or consent of instructor.

Characteristics and applications of small electric machines including stepper motors, brushless DC motors, permanent-magnet synchronous motors and switched-reluctance motors. Motor performance, control and drive-circuit configurations.

(Lecture-problems 3 hours) Letter grade only (A-F).

553./453. Protection of Power Systems (3)

Prerequisites: EE 310 and EE 350 all with a grade of "C" or better.

Protective relays, instrument transformers, low-voltage and high-voltage circuit breakers, protection of generators and motors, transformer protection and transmission line protection. Relay coordination and commercial power systems. Application of computer programs for protective device coordination. Additional projects required for EE 553.

(Lecture-problems 3 hours) Letter grade only (A-F).

556. Solar Power Systems (3)

Prerequisite: Graduate Standing in EE or consent of instructor

Solar power systems requirements and analysis, criteria of environmental qualification, operation principles, design, fabrication, testing of key components. Process for device design, fabrication, testing methods, modeling and simulations. Solar thermal, solar power plants, satellite solar modules, Building Integrated Photovoltaics.

Letter grade only (A-F). (Lecture-problems 3 hours)

566. RF and Microwave Electronics (3)

Prerequisite: EE 360 or EE 462 with a grade of "C" or better or consent of instructor.

Transmission Lines, Waveguides, Matching Networks, MW Amplifier Design, MW Resonators Design, MW Oscillator Design, MW Mixer, Noise Analysis in Microwave Electronics and Network Analysis Methods.

(Lecture-problems 2 hours, Laboratory 3 hours). Letter grade only (A-F).

573. Autonomous Systems (3)

Prerequisite: EE 370

Corequisites: EE 511 or consent of instructor

Selected methodologies for analysis and design of autonomous mobile systems. Rotation, motion kinematics, modeling of mobile robots, control of robots, path planning and obstacle avoidance. Vision and 3D sensors, Kalman and particle filters, localization and mapping. Project is required.

Letter grade only (A-F). (Lecture-problems 3 hours)

574./474. Robot Modeling and Control (3)

Prerequisite: EE 370 with a grade of "C" or better.
Recommended: EE 511.

Basic methodology for analysis and design of robotic manipulators. Classification of robots. Homogeneous transformations, kinematics, dynamics, trajectory planning and control of robots. Application of robots in flexible manufacturing. Advanced projects required for EE 574. EE 511 is recommended as a pre/corequisite.

(Lecture-problems 3 hours) Letter grade only (A-F).

575./675. Non-Linear Control Systems (3)

Prerequisite: EE 511 with a grade of "C" or better or consent of instructor.

Methodologies and results dealing with stability and robust stabilization of non-linear systems applied to robotics, aerospace, artificial neural networks, etc. Phase plane analysis, limit cycles, Lyapunov stability theory and its extension, Positive real transfer matrix and passivity, feedback linearization and stabilization, tracking, robust control.

Ph.D. students register in EE 675. Advanced projects for EE 675 students. (Lecture-problems 3 hours) Not open for credit to students with credit in EE 775. Letter grade only (A-F).

576./476. Neural Networks and Fuzzy Logic (3)

Prerequisite: EE 386 with a grade of "C" or better or consent of instructor

Principles and application of artificial neural networks and fuzzy logic. Mechanisms of supervised and unsupervised neural networks. Fuzzy control systems. Applications in signal processing, communications, control, and other areas.

Additional projects required for EE 576. Not open for credit to students with credit in EE 589/689. (Lecture-problems 3 hours) Letter grade only (A-F).

580. Statistical Communication Theory (3)

Prerequisites: (EE 482, EE 505 and EE 508) all with a grade of "C" or better or consent of instructor.

Power spectral density of analog and digital communication signals. Matched filters. Signal-to-noise-ratio performance analysis for analog and pulse modulation systems. Vector space representation of digital signals. Error rate analysis for various signaling formats. Optimum digital receivers. Fading channels.

(Lecture-problems 3 hours) Letter grade only (A-F).

581./481. Satellite Communication Systems (3)

Prerequisite: EE 482 with a grade of "C" or better.

Basic orbital mechanics, link analysis, multiple access architectures and protocols, FDMA, TDMA, and CDMA systems. Synchronization techniques, modulation and coding techniques. Security and spread spectrum requirements. System design.

Additional projects required for EE 581. (Lecture-problems 3 hours) Letter grade only (A-F).

582. Spread Spectrum Communication Systems (3)

Prerequisite: EE 580 with a grade of "C" or better or consent of instructor.

Spread spectrum (SS) techniques. Direct sequence systems, frequency hopped systems. Generation and properties of pseudo random sequences. Electronic jamming and interference. Processing gain, carrier synchronization, code acquisition and tracking, information modulation and coding. Applications include ranging, CDMA etc.

(Lecture-problems 3 hours) Letter grade only (A-F).

583./683. Digital Image Processing (3)

Prerequisite: EE 505 with a grade of "C" or better or consent of instructor.

Acquiring Images. Correcting Imaging defects. Image enhancement. Segmentation and threshholding. Processing Binary images. Tomography. Three dimensional Imaging. Some image data compression techniques.

Masters students register in EE 583; Ph.D. students register in EE 683. Additional projects required for EE 683. (Lecture–problems 3 hours) Letter grade only (A-F).

585./685. Advanced Digital Signal Processing (3)

Prerequisite: EE 486 with a grade of "C" or better or consent of the instructor.

Advanced topics in digital signal processing and applications to communication and power line systems, including adaptive filters, FFT-based OFDM transceivers. IEEE standards for green energy communication and optimization.

Masters students register in EE 585; Ph.D. students register in EE685. Additional projects for EE 685. (Lecture-problems 3 hours). Letter grade only (A-F).

586. Real–Time Digital Signal Processing (3)

Prerequisite: EE 486 or CECS 440 all with a grade of "C" or better or consent of instructor.

Digital signal processors architecture and language. Real–time DSP considerations and limitations. Digital filter and signal processing system implementations.

(Lecture–problems 3 hours) Letter grade only (A-F).

587. Fiber Optic Netwoks (3)

Prerequisite: EE 360 with a grade of "C" or better, or consent of instructor

Introduction to optical networks. Operation of optical fiber, semiconductor lasers, photo detectors, and fiber optic components. Modulation and demodulation techniques for fiber optic communication systems. Design of optical transmission systems

(Lecture-problems 3 hours). Letter grade only (A-F).

588. DSP for MMO Communication Systems (3)

Prerequisite: EE 508 or consent of instructor

Advanced topics in DSP and Communication systems with applications to space-time coded OFDM transceivers, MIMO wireless systems, LTE/LTE-advanced in physical layer, and next generation for mobile communications.

Letter grade only (A-F). (Lecture-problems 3 hours)

590. Selected Topics in Electrical Engineering (3)

Prerequisites: Graduate standing in electrical engineering and consent of instructor.

Selected topics from recent advances in electrical engineering.

Letter grade only (A-F). May be repeated to a maximum of 6 units. Topics announced in the *Schedule of Classes*. (Lecture-problems 3 hours)

591. Adaptive Systems (3)

Prerequisite: EE 508 with a grade of "C" or better.

Adaptive systems and their applications to communication, control, and signal processing systems.

(Lecture-problems 3 hours) Letter grade only (A-F).

606./506. Theory and Practice of Biomedical Instrumentation (3)

Prerequisites: Graduate standing in engineering or natural sciences; and either EE 406 with a grade of "C" or better or consent of instructor.

Advanced design concepts and practical utilization of biomedical instrumentation. Transduction of physiological parameters. Theory and practice.

Master's students register in EE 506; Ph.D. students register in EE 606. Additional projects required for EE 606. (Lecture-problems 3 hours) Letter grade only (A-F).

607./507. Advanced Biomedical Systems (3)

Prerequisites: Graduate standing in engineering or natural sciences; and either EE 406 with a grade of "C" or better or consent of instructor.

Novel trends in biotechnology, design and organization of modern hospital systems and utilization of advanced technologies. Modeling an simulation of physiological and medical systems.

Master's students register in EE 507; Ph.D. students register in EE 607. Additional projects required for EE 607. (Lecture-problems 3 hours) Letter grade only (A-F).

632./532. Analog Signal Processing (3)

Prerequisite: EE 430 with a grade of "C" or better or consent of instructor.

Basic CMOS circuit techniques. Low-voltage and current-mode signal processing. Switched-capacitor (SC)and switched-current (SI) circuits such as amplifiers, integrators, S/H circuits, filters, oscillators, D/A and A/D converters, etc. Advanced techniques for corrections of nonideal behavior. Analysis and simulation projects.

Master's students register in EE 532; Ph.D. students register in EE 632. Additional projects required for EE 632. Letter grade only (A-F). (Lecture-problems 3 hours).

675./575. Non-Linear Control Systems (3)

Prerequisite: EE 511 with a grade of "C" or better or consent of instructor.

Methodologies and results dealing with stability and robust stabilization of non-linear systems applied to robotics, aerospace, artificial neural networks, etc. Phase plane analysis, limit cycles, Lyapunov stability theory and its extension, Positive real transfer matrix and passivity, feedback linearization and stabilization, tracking, robust control.

Ph.D. students register in EE 675. Advanced projects for EE 675 students. (Lecture-problems 3 hours) Not open for credit to students with credit in EE 775. Letter grade only (A-F).

683./583. Digital Image Processing (3)

Prerequisite: EE 505 with a grade of "C" or better or consent of instructor.

Acquiring Images. Correcting Imaging defects. Image enhancement. Segmentation and threshholding. Processing Binary images. Tomography. Three dimensional Imaging. Some image data compression techniques.

Masters students register in EE 583; Ph.D. students register in EE 683. Additional projects required for EE 683. (Lecture–problems 3 hours) Letter grade only (A-F).

685./585. Advanced Digital Signal Processing (3)

Prerequisite: EE 486 with a grade of "C" or better or consent of the instructor.

Advanced topics in digital signal processing and applications to communication and power line systems, including adaptive filters, FFT-based OFDM transceivers. IEEE standards for green energy communication and optimization.

Masters students register in EE 585; Ph.D. students register in EE 685. Additional projects for EE 685. (Lecture-problems 3 hours) Letter grade only (A-F).

697. Directed Research (3)

Prerequisite: Graduate Standing. Advancement to Candidacy is strongly recommended.

Theoretical, experimental, or industrial problems in Electrical Engineering requiring intensive analysis culminating in a substantial report.

Credit/No Credit grading only. May be repeated to a maximum of 6 units with same topic in different semesters.

698. Thesis or Industrial Project (3-6)

Prerequisite: Advancement to Candidacy.

Planning, preparation and completion of a thesis (total 6 units), or industrial project (3 units), in electrical engineering.

Credit/No Credit grading only. May be repeated to a maximum of 6 units with same topic in different semesters.

ENGINEERING TECHNOLOGY PROGRAMS

College of Engineering

Introduction

The Engineering Technology (ET) Programs at CSULB serve society by graduating well-prepared professionals, who are provided with an excellent education in the fundamentals of Engineering Technology through a combination of theory and laboratory practice, and who are able to apply their knowledge and transform their ideas into working systems.

Career Possibilities

Computer Option: Hardware and software Computer Applications Engineers • Test Equipment Engineers • Manufacturing Engineers or Technical Sales Engineers in industry and organizations where a combination of hardware and software background is required
Electronics Option: Electronic Technician • Calibration Engineer • Construction Inspector • Computer Applications Engineer • Time Study Engineer • Facilities Planner • Field Engineer • Manufacturing Engineering • Operations Research Analyst • Sales Representative • Project Engineer • Associate Electronics Engineer • Product Design Engineer • Process Engineer • Instructor

General Requirements

All students in the BSET, BSEET, or BSCET programs must receive a minimum grade of "C" in each of the prerequisite courses before enrolling in any Engineering Technology course. In addition to any other all-university requirements regarding grade point averages for graduation, student must achieve a minimum of 2.0 average in all Engineering Technology courses.

Bachelor of Science in Computer Engineering Technology (120 units)

Administered by the Electrical Engineering Department.
Faculty Advisor - I-Hung Khoo
EE Department Office - ECS 561
Faculty Advisor's Office - ECS 517
Faculty Advisor's Telephone - (562) 985-5082

This program is available to students interested in the manufacturing of computers and the applications and operations aspects of computer hardware and software.

Emphasis is placed on specific job skills required of entry level professionals in computer industry, including systems analysis and design, data administration, networking, data communications, data acquisition, oral and written communication, and management principles.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Computer Engineering Technology). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Computer Engineering Technology must also meet similar major specific requirements. To become fully admitted into the Computer Engineering Technology major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower Division Major Requirements:
MATH 122 (Calculus I), PHYS 100A (General Physics)

General Education Foundations Courses:
Written and Oral Communication

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 111, MATH 113, and PHYS 100A within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 122 and PHYS 100A and B within one calendar year.

Requirements

Lower Division:

Take all the following courses:

MAE 172 Engineering Design Graphics (2)
Prerequisites: None.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113.

PHYS 100A General Physics (4)
Prerequisite: MATH 109 or MATH 113 or MATH 119A or MATH 122.

PHYS 100B General Physics (4)
Prerequisites: PHYS 100A.

ENGR 101 Introduction to Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122.

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

ENGR 203 Engineering Problem Solving & Analysis (3)
Prerequisite: MATH 122 all with a grade of "C" or better.
Corequisite: ENGR 203L.

ENGR 203L Engr Problem Solving & Analysis Lab (1)
Prerequisite: MATH 122 all with a grade of "C" or better.
Corequisite: ENGR 203.

ET 101 Introduction to Engineering Technology (1)
Prerequisites: None.

ET 202 Probability and Statistics for Technology (3)
Prerequisite: High school algebra.
Corequisite: ET 202L.

ET 202L Probability & Statistics for Technology Lab (1)
Prerequisites: 2 yrs high school algebra, geometry, and intermediate algebra (or MATH 010) or equivalent.
Corequisite: ET 202.

ET 205 Computer Systems and Programming (1)
Corequisite: ET 205L.

ET 205L Computer Systems and Programming Lab (1)
Corequisite: ET 205.

ET 250 Circuit Analysis I (2)
Prerequisite: PHYS 100B with a grade of "C" or better.
Corequisite: ET 250L.

ET 250L Circuit Analysis I Laboratory (1)
Prerequisite: PHYS 100B with a grade of "C" or better.
Corequisite: ET 250.

ET 252 Circuit Analysis II (2)
Prerequisites: MATH 122; ET 250, ET 250L all with a grade of "C" or better. Corequisite: ET 252L.

ET 252L Circuit Analysis II Lab (1)
Prerequisites: MATH 122; ET 250, ET 250L all with a grade of "C" or better. Corequisite: ET 252.

ET 255 Introduction to Digital Electronics (2)
Prerequisites: ET 250, ET 250L all with a grade of "C" or better.
Corequisite: ET 255L.

ET 255L Introduction to Digital Electronics Lab (1)
Prerequisites: ET 250, ET 250L all with a grade of "C" or better.
Corequisite: ET 255.

ET 260 Solid State Electronic I (2)
Prerequisites: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 260L.

ET 260L Solid State Electronic I Lab (1)
Prerequisites: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 260.

ET 286 Intro to Object-Oriented Programming (2)
Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 286L.

ET 286L Intro to Object-Oriented Programming Lab (1)
Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 286.

Upper Division:

Take all the following courses:

ET 309 Industrial Communications and Leadership (3)
Prerequisites: ET 101 with a grade of "C" or better.

ET 311 Quality Engineering Technology (3)
Prerequisites: ET 202, ET 202L all with a grade of "C" or better.

ET 360 Control Instrumention (2)
Prerequisites: ET 260, ET 260L all with a grade of "C" or better.

Corequisite: ET 360L.

ET 360L Control Instrumention Lab (1)
Prerequisites: ET 260, ET 260L all with a grade of "C" or better.
Corequisite: ET 360.

ET 386 Introduction to Microprocessors (2)
Prerequisite: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 386L.

ET 386L Introduction to Microprocessors Lab (1)
Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 386.

ET 387 Robot Programming and Mechatronics (2)
Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 387L.

ET 387L Robot Programming & Mechatronics Lab (1)
Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 387.

ET 388 Technical Applications Using Programming Languages (2)
Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 388L.

ET 388L Technical Applications Using Programming Languages Lab (1)
Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 388.

ET 442 Computer Circuits (2)
Prerequisites: ET 255, ET 255L all with a grade of "C" or better.
Corequisite ET 442L.

ET 442L Computer Circuits Lab (1)
Prerequisites: ET 255, ET 255L all with a grade of "C" or better.
Corequisite ET 442.

ET 486 Data Structures (2)
Prerequisites: ET 388, ET 388L all with a grade of "C" or better.
Corequisite: ET 486L.

ET 486L Data Structures Lab (1)
Prerequisites: ET 388, ET 388L all with a grade of "C" or better.
Corequisite: ET 486.

ET 487 Introduction to Data Communications and Networking (2)
Prerequisites: ET 286, ET 286L, ET 386, ET 386L or equivalents all with a grade of "C" or better.
Corequisite: ET 487L.

ET 487L Introduction to Data Communications and Networking Lab (1)
Prerequisites: ET 286, ET 286L, ET 386, ET 386L or equivalents all with a grade of "C" or better.
Corequisite: ET 487.

ET 488 Microcomputer Systems (2)
Prerequisites: ET 386, ET 386L all with a grade of "C" or better.
Corequisite: ET 488L.

ET 488L Microcomputer Systems Lab (1)
Prerequisites: ET 386, ET 386L all with a grade of "C" or better.
Corequisite: ET 488.

ET 489 Computer Interfacing (2)
Prerequisites: ET 442, ET 442L, ET 488, ET 488L all with a grade of "C" or better.
Corequisite: ET 489L.

ET 489L Computer Interfacing Lab (1)
Prerequisites: ET 442, ET 442L, ET 488, ET 488L all with a grade of "C" or better.
Corequisite: ET 489.

ET 492 Computer Controlled Industrial Systems (2)
Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 492L.

ET 492L Computer Controlled Industrial Systems Laboratory (1)
Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 492.

ET 494 Applied Systems Development Project (2)
Prerequisites: ET 386, ET 386L, ET 487, ET 487L all with a grade of "C" or better.
Corequisite: ET 494L.

ET 494L Applied Systems Development Project Lab (1)
Prerequisites: ET 386, ET 386L, ET 487, ET 487L all with

a grade of "C" or better.
Corequisite: ET 494.

CE 406 Project Cost-Benefit Analysis (3)
Prerequisites: GE Foundation requirements.

Take 3 units of either:

ET 312 Statistical Quality Control
Prerequisite: ET 311 all with a grade of "C" or better.

or

ET 461 Management of Manufacturing Operations.
Prerequisite: ET 410 with a grade of "C" or better.

Take at least 3 units from the following, in consultation with an advisor:

ET 409E or (ET 491, ET 491L) or (ET 497, ET 497L).

To meet prerequisite standards for courses in this program's requirements, a "C" or better is necessary in the following: ENGR 101, ET 101, ET 202, ET 202L, ET 205, ET 205L, ET 250, ET 250L, ET 252, ET 252L, ET 255, ET 255L, ET 260, ET 260L, ET 286, ET 286L, ET 311, ET 386, ET 386L, ET 388, ET 388L, ET 442, ET 442L, ET 487, ET 487L, ET 488, ET 488L, MATH 122, PHYS 100B.

Fieldwork Requirements

Fieldwork experience is required for the BS in Computer Engineering Technology, consisting of no less than three months full-time (40 hours/week) (or equivalent part-time) of employment in an approved industry or governmental agency. The student must hold a position equivalent to a technician or higher which affords the opportunity to exercise responsibility usually given to those who have completed two years of college. The fieldwork must be completed prior to graduation, be certified and approved by the faculty of the Department.

Concurrent and/or Enrollment in Another Institution

Students who wish to take, or have already taken, coursework in a community college or another institution to meet curricular requirements must petition the ET Undergraduate Advisor for approval.

Bachelor of Science in Electronics Engineering Technology (120 units)

Administered by the Electrical Engineering Department.
Faculty Advisor - I-Hung Khoo
EE Department Office - ECS 561
Faculty Advisor's Office - ECS 517
Faculty Advisor's Telephone - (562) 985-5082

The Electronics Engineering Technology program, prepares the student for a position as a technologist, in such industries as aerospace, computers, communications, biomedical, chemical, power, etc. Students are offered a wide range of training in topics such as instrumentation, controls, microprocessors, microelectronics, biomedical electronics, communications, motors and generators, robotics, computer applications, programming and interfacing. Moreover the program emphasizes written and oral communications skills as well as modern methods of industrial administration and supervision.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Electrical Engineering Technology). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Electrical Engineering Technology must also meet similar major specific requirements. To become fully admitted into the Electrical Engineering Technology major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower Division Major Requirements:
MATH 122 (Calculus I), PHYS 100A (General Physics)

General Education Foundations Courses:
Written and Oral Communication

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 111 and 113, and PHYS 100A within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 122 and PHYS 100A and B within one calendar year.

Requirements

Lower Division:

Take all the following courses:

MAE 172 Engineering Design Graphics (2)
Prerequisites: None.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and 113.

PHYS 100A General Physics (4)
Prerequisite: MATH 109 or MATH 113 or MATH 119A or MATH 122.

PHYS 100B General Physics (4)
Prerequisites: PHYS 100A.

ENGR 101 Introduction to Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122.

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

ENGR 203 Engineering Problem Solving & Analysis (3)
Prerequisite: MATH 122 all with a grade of "C" or better.
Corequisite: ENGR 203L.

ENGR 203L Engr Problem Solving & Analysis Lab (1)
Prerequisite: MATH 122 all with a grade of "C" or better.
Corequisite: ENGR 203.

ET 101 Introduction to Engineering Technology (1)
Prerequisites: None.

ET 202 Probability and Statistics for Technology (3)
Prerequisite: High school algebra.
Corequisite: ET 202L.

ET 202L Probability & Statistics for Technology Lab (1)
Prerequisites: 2 yrs high school algebra, geometry, and intermediate algebra (or MATH 010) or equivalent.
Corequisite: ET 202.

ET 205 Computer Systems and Programming (1)
Corequisite: ET 205L.

ET 205L Computer Systems and Programming Lab (1)
Corequisite: ET 205.

ET 250 Circuit Analysis I (2)
Prerequisite: PHYS 100B with a grade of "C" or better.
Corequisite: ET 250L.

ET 250L Circuit Analysis I Laboratory (1)
Prerequisite: PHYS 100B with a grade of "C" or better.
Corequisite: ET 250.

ET 252 Circuit Analysis II (2)
Prerequisites: MATH 122; ET 250, ET 250L all with a grade of "C" or better. Corequisite: ET 252L.

ET 252L Circuit Analysis II Lab (1)
Prerequisites: MATH 122; ET 250, ET 250L all with a grade of "C" or better. Corequisite: ET 252.

ET 255 Introduction to Digital Electronics (2)
Prerequisites: ET 250, ET 250L all with a grade of "C" or better.
Corequisite: ET 255L.

ET 255L Introduction to Digital Electronics Lab (1)
Prerequisites: ET 250, ET 250L all with a grade of "C" or better.
Corequisite: ET 255.

ET 260 Solid State Electronic I (2)
Prerequisites: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 260L.

ET 260L Solid State Electronic I Lab (1)
Prerequisites: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 260.

ET 286 Intro to Object-Oriented Programming (2)
Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 286L.

ET 286L Intro to Object-Oriented Programming Lab (1)
Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 286.

Upper Division:

Take all the following courses:

ET 309 Industrial Communications and Leadership (3)
Prerequisites: ET 101 with a grade of "C" or better.

ET 311 Quality Engineering Technology (3)
Prerequisites: ET 202, ET 202L all with a grade of "C" or better.

ET 341 Solid State Electronic II (2)
Prerequisites: ENGR 203,ENGR 203L, ET 260, ET 260L all with a grade of "C" or better.
Corequisite: ET 341L.

ET 341L Solid State Electronic II Lab (1)
Prerequisites: ENGR 203, 203L, ET 260, ET 260L all with a grade of "C" or better .
Corequisite: ET 341.

ET 350 Motors and Generators (2)
Prerequisites: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 350L.

ET 350L Motors and Generators Lab (1)
Prerequisite: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 350.

ET 360 Control Instrumention (2)
Prerequisites: ET 260, ET 260L all with a grade of "C" or better.
Corequisite: ET 360L.

ET 360L Control Instrumention Lab (1)
Prerequisites: ET 260, ET 260L all with a grade of "C" or better.
Corequisite: ET 360.

ET 386 Introduction to Microprocessors (2)
Prerequisite: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 386L.

ET 386L Introduction to Microprocessors Lab (1)
Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 386.

ET 387 Robot Programming and Mechatronics (2)
Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 387L.

ET 387L Robot Programming & Mechatronics Lab (1)
Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 387.

ET 388 Technical Applications Using Programming Languages (2)
Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 388L.

ET 388L Technical Applications Using Programming Languages Lab (1)
Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 388.

ET 442 Computer Circuits (2)
Prerequisites: ET 255, ET 255L all with a grade of "C" or better.
Corequisite ET 442L.

ET 442L Computer Circuits Lab (1)
Prerequisites: ET 255, ET 255L all with a grade of "C" or better.
Corequisite ET 442.

ET 444 Telecommunications (3)
Prerequisites: ET 360, ET 360L all with a grade of "C" or better.

ET 447 Industrial Applications of Electronic Circuits (2)
Prerequisites: ET 341, ET 341L all with a grade of "C" or better.
Corequisite: ET 447L.

ET 447L Industrial Appl of Electronic Circuits Lab (1)
Prerequisites: ET 341, ET 341L all with a grade of "C" or better.
Corequisite: ET 447.

ET 460 Electronic Packaging and Design (2)
Prerequisites: ET 341, ET 341L all with a grade of "C" or better and senior standing.
Corequisite: ET 460L.

ET 460L Electronic Packaging and Design Lab (1)
Prerequisites: ET 341, ET 341L all with a grade of "C" or better and senior standing.
Corequisite: ET 460.

ET 488 Microcomputer Systems (2)
Prerequisites: ET 386, ET 386L all with a grade of "C" or better.
Corequisite: ET 488L.

ET 488L Microcomputer Systems Lab (1)
Prerequisites: ET 386, ET 386L all with a grade of "C" or better.
Corequisite: ET 488.

CE 406 Project Cost-Benefit Analysis (3)
Prerequisites: GE Foundation requirements.

Take 3 units of either:

ET 312 Statistical Quality Control
Prerequisite: ET 311 all with a grade of "C" or better.

or

ET 461 Management of Manufacturing Operations.
Prerequisite: ET 410 with a grade of "C" or better.

Take at least 3 units from the following courses, in consultation with an advisor: ET 409B or ET 441 or (ET 445, ET 445L).

To meet prerequisite standards for courses in this program's requirements, a "C" or better is necessary in the following: MATH 122, PHYS 100B, ENGR 101, ENGR 203, ENGR 203L, ET 101, ET 202, ET 202L, ET 205, ET 205L, ET 250, ET 250L, ET 252, ET 252L, ET 255, ET 255L, ET 260, ET 260L, ET 286, ET 286L, ET 311, ET 341, ET 341L, ET 360, ET 360L, ET 386, ET 386L.

Fieldwork Requirements

Fieldwork experience is required for the BS in Electronics Engineering Technology, consisting of no less than three months full-time (40 hours/week) (or equivalent part-time) of employment in an approved industry or governmental agency. The student must hold a position equivalent to a technician or higher which affords the opportunity to exercise responsibility usually given to those who have completed two years of college.

The fieldwork must be completed prior to graduation, be certified and approved by the faculty of the Department.

Concurrent and/or Enrollment in Another Institution

Students who wish to take, or have already taken, coursework in a community college or another institution to meet curricular requirements must petition the ET Undergraduate Advisor for approval.

Engineering Technology Courses (E T)

LOWER DIVISION

101. Introduction to Engineering Technology (1)

Survey of professional activities and environment of engineering technologist. Covers role of technologist in American industry, the history of technology and the growth and future of those professionals who hold the Bachelor of Science degree in Engineering Technology.

(Lecture-Discussion 1 hour) Credit/No Credit grading only.

202. Probability and Statistics for Technology (3)

Prerequisite: High school algebra. Corequisite: ET 202L.

Statistics and probability theory, sampling, correlation, regression as applied to Engineering Technology.

(Lecture-problems 3 hours) Letter grade only (A-F).

202L. Probability and Statistics for Technology Laboratory (1)

Prerequisites: 2 yrs high school algebra, geometry, and intermediate algebra (or MATH 010) or equivalent.
Corequisite: ET 202.

Laboratory exercises in statistics and probability theory, sampling, correlation, regression as applied to Engineering Technology. Simulation using statistical packages.

(Laboratory 3 hours) Letter grade only (A-F).

204. Applied Mechanics-Statics (3)

Prerequisites: MATH 122, PHYS 100A all with a grade of "C" or better.

Force systems acting on structures, moments, equilibrium, centroids, trusses, beams, cables, frames, machines, friction, section properties, masses, both U.S. and S.I. units of measurements.

(Lecture 2 hrs, activity 2 hrs) Letter grade only (A-F).

205. Computer Systems and Programming (1)

Corequisite: ET 205L.

Overview of computer systems, hardware, and software development. Hardware topics include central processing unit and memory, input/output devices, storage mechanism, and communication. Software topics include programming languages, operating systems, and systems analysis and design.

(Lecture – discussion, exercise, 1 unit) Letter grade only (A-F).

205L. Computer Systems and Programming Lab (1)

Corequisite: ET 205.

Laboratory exercises in computer programming to solve problems in business, manufacturing, research and simulation. An object-oriented programming language will be used for these activities.

(Laboratory 3 hours) Letter grade only (A-F). Same as CEM 205L

244. Machine Tools (1)

Corequisite: ET 244L.

Operations and use of the conventional and non-conventional machine tools.

Not open for credit to students with previous machine tools credit. (Lecture-Discussion 1 hour) Letter grade only (A-F).

244L. Machine Tools Laboratory (1)

Corequisite: ET 244.

Laboratory exercises using conventional and non-conventional machine tools.

Not open for credit to students with previous machine tools experience. (Laboratory 3 hours) Letter grade only (A-F).

250. Circuit Analysis I (2)

Prerequisite: PHYS 100B with a grade of "C" or better.
Corequisite: ET 250L.

Fundamentals of DC theory, units of measurements, systems of units. Current, voltage, resistance, Ohm's law, power, energy. Series and parallel circuits. Methods of analysis and selected topics. Network theorems such as superposition, Thevenin's, Norton's and Millman's theorems.

(Lecture-Discussion 2 hours) Letter grade only (A-F).

250L. Circuit Analysis I Laboratory (1)

Prerequisite: PHYS 100B with a grade of "C" or better.
Corequisite: ET 250.

Laboratory exercises will be conducted on AC and DC circuits using proto boards and power supplies, multi-meters, function generators, oscilloscopes and frequency counters.

(Laboratory 3 hours) Letter grade only (A-F).

252. Circuit Analysis II (2)

Prerequisites: MATH 122, ET 250, ET 250L; all with a grade of "C" or better.
Corequisite: ET 252L.

Study of circuit analysis techniques in AC, including network theorems, mesh and nodal analysis, transients, time domain and phasors, magnetic circuits, sinusoidal and non-sinusoidal wave forms, resonance circuits (series and parallel), filters (low-pass, high-pass, passband and bandstop).

(Lecture-Discussion 2 hours) Letter grade only (A-F).

252L. Circuit Analysis II Laboratory (1)

Prerequisites: MATH 122, ET 250, ET 250L; all with a grade of "C" or better.
Corequisite: ET 252.

Laboratory exercises will be conducted on AC circuits using proto boards and AC power supplies, function generators, oscilloscopes, and frequency counters.

(Laboratory 3 hours) Letter grade only (A-F).

255. Introduction To Digital Electronics (2)

Prerequisites: ET 250, ET 250L all with a grade of "C" or better.
Corequisite: ET 255L.

Combinational logic utilizing Boolean algebra and the binary numbering system. Includes Karnaugh maps, truth tables, coding, switching circuits, converters and logic circuit elements.

(Lecture-problems 2 hours) Letter grade only (A-F).

255L. Introduction to Digital Electronics Laboratory (1)

Prerequisites: ET 250, ET 250L all with a grade of "C" or better.

Corequisite: ET 255.

Laboratory exercises in basic logic circuits. Topics included are breadboarding, basic gates, and combinational circuits.

(Laboratory 3 hours) Letter grade only (A-F).

260. Solid-State Electronics I (2)

Prerequisites: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 260L.

Analysis and design of solid-state electronic circuits using diodes, bipolar, unijunction and field-effect devices.

(Lecture-Discussion 2 hours) Letter grade only (A-F).

260L. Solid State Electronics I Laboratory (1)

Prerequisites: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 260.

Laboratory exercises in breadboarding and measurements of solid-state circuits utilizing all types of electronic measuring equipment.

(Laboratory 3 hours) Letter grade only (A-F).

264. Industrial Tooling (1)

Corequisite: ET 264L.

Design of tools for production. Typical tooling problems include working drawings and hardware.

(Lecture-Discussion 1 hour) Letter grade only (A-F).

264L. Industrial Tooling Laboratory (1)

Corequisite: ET 264.

Laboratory experiments in tool design in relation to mass part production.

(Laboratory 3 hours) Letter grade only (A-F).

286. Introduction to Object–Oriented Programming (2)

Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 286L.

Introduction to an object–oriented programming language (C++). Problem analysis and software development methodology. Emphasis on applications to technology

(Lec–Discussion 2 hrs) Letter grade only (A-F).

286L. Introduction to Object–Oriented Programming Laboratory (1)

Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 286.

Introduction to an object–oriented programming language (C++). Problem analysis and software development methodology. Emphasis on applications to technology.

Letter grade only (A-F). (Laboratory 3 hours)

UPPER DIVISION

301. Engineering Materials (2)

Prerequisites: CHEM 111A with a grade of "C" or better.
Corequisite: ET 301L.

Study of physical and mechanical properties and applications of engineering materials.

Letter grade only (A-F). (Lecture–Discussion 2 hours)

301L. Engineering Materials Laboratory (1)

Prerequisites: CHEM 111A with a grade of "C" or better.
Corequisite: ET 301.

Laboratory investigation and experiments in the application of engineering materials. Field trips.

Letter grade only (A-F). (Lab 3 hrs)

304. Applied Mechanics Strength of Materials (2)

Prerequisite: ET 204 with a grade of "C" or better.

Analysis of strength and ridigity of structural members in resisting applied forces, stress, strain, shear, moment, deflections, combined stresses, connections, and moment distribution.

Letter grade only (A-F). (Lecture-Discussion 1 hour, Activity 2 hours)

307. Industrial Safety (2)

Prerequisite: Junior Standing.

Survey of industrial safety administration, engineering and management. Emphasis is placed on the role of the first line supervisor in establishing and maintaining a safe, healthful work environment for employees. Introduction to supporting computer resources used in the safety field.

Letter grade only (A-F). (Lecture–Discussion 2 hours)

309. Industrial Communications and Leadership (3)

Prerequisites: ET 101 with a grade of "C" or better.

English Composition. Principles, theories of industrial communications and management for engineering technology. Management functions of planning, organizing, motivating, leading, controlling and staffing in technical environment. Intro decision support models. Written/oral technical information; communication forms and procedures of industry, with computer applications.

(Lecture-Discussion, 3 hours) Letter grade only (A-F).

311. Quality Engineering Technology (3)

Prerequisites: ET 202, ET 202L all with a grade of "C" or better.

Junior standing. Quality engineering technology principles and practices in industry, including management concepts, inspection practices, costs of quality and testing.

(Lecture–Discussion 3 hours) Letter grade only (A-F).

312. Statistical Quality Control (3)

Prerequisite: ET 311 all with a grade of "C" or better.

Statistical process control; including use of statistical methods for analysis and improvement of product quality, control charts, linear correlation; sampling procedures, stratification, cause and effect analysis, process capability and introduction to design of experiments.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

313. Quality Assurance, Inspection Measurement and Testing (2)

Prerequisite: ET 311 with a grade of "C" or better.
Corequisite: ET 313L.

Theory and application of inspection procedures, instrument calibration, precision measurements including theory and application of non-destructive testing of materials for quality control.

Letter grade only (A-F).

313L. Quality Assurance, Inspection Measurement and Testing Laboratory (1)

Prerequisite: ET 311 with a grade of "C" or better.
Corequisite: ET 313.

Laboratory experiments; instrument calibration including standards and precision measurements including the use of non destructive test equipment for quality control.

(Laboratory 3 hours) Letter grade only (A-F)

335. Engineering Materials and Processes I (3)

Corequisite: ET 335L.

Examination of engineering materials and manufacturing processes including the study of: Phase diagrams; heat treatment; metal casting processes; welding and soldering; corrosion, powder metallurgy, electronic fabrication; tribology, friction, wear, lubrication; surface treatment, coating and cleaning.

(Lecture - Discussion 3 hours) Letter grade only (A-F).

335L. Engineering Materials Processes I Laboratory (1)

Corequisite: ET 335.

Laboratory exercises in engineering materials and manufacturing processes including the study of: Phase diagram; heat treatment; casting; metallography and electronic manufacturing processes.

(Laboratory 3 hours) Letter grade only (A-F).

341. Solid State Electronics II (2)

Prerequisites: ENGR 203, ENGR 203L, ET 260, ET 260L all with a grade of "C" or better.
Corequisite: ET 341L.

Miller's Theorem, integrated circuits, feedback, operational amplifiers, Fourier series, distortion, modulation, phase-locked loops, linear and non-linear circuits, and breadboarding.

(Lec-Discussion 2 hrs) Letter grade only (A-F).

341L. Solid State Electronics II Laboratory (1)

Prerequisites: ENGR 203, ENGR 203L, ET 260, ET 260L all with a grade of "C" or better.
Corequisite: ET 341.

Laboratory exercises in design and measurement of various circuits using operational amplifiers, comparators, regulators, silicon controlled rectifiers, frequency mixers and phase-locked loops.

(Lab 3 hours) Letter grade only (A-F).

350. Motors and Generators (2)

Prerequisites: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 350L.

Study of electric rotating machinery, its theories, principles, design and applications in automation industries.

(Lecture-Problems 1 hour) Letter grade only (A-F).

350L. Motors and Generators Laboratory (1)

Prerequisite: ET 252, ET 252L all with a grade of "C" or better.
Corequisite: ET 350.

Laboratory exercises in applications and design of rotating machines. Topics covered are DC machines, synchronous machines, servomotor, step motor, and control circuits.

(Laboratory 3 hours) Letter grade only (A-F).

360. Control Instrumentation (2)

Prerequisites: ET 260, ET 260L all with a grade of "C" or better.
Corequisite: ET 360L.

Application and basic design of analog and digital control instrumentation for industrial processes. Physical and electrical properties of thermal, mechanical and optical transducers with associated signal conditioning.

(Lecture-Problems 2 hours) Letter grade only (A-F).

360L. Control Instrumentation Laboratory (1)

Prerequisites: ET 260, ET 260L all with a grade of "C" or better.
Corequisite: ET 360.

Laboratory exercises in developing and measuring various control systems utilizing operational amplifiers, transducers, thermocouples, bridges, and various pressure devices.

(Laboratory 3 hours) Letter grade only (A-F).

363. Kinematics of Mechanisms (3)

Prerequisites: ET 204 with a grade of "C" or better.

Mathematical and graphical approaches to analyze the motion of mechanisms, for further machine development, through studies of displacement, velocity and acceleration of mechanical elements.

(Lecture-Discussion 2 hours, Activity 2 hours) Letter grade only (A-F).

365. Fluid Power and Control (2)

Prerequisite: ET 204 with a grade of "C" or better.
Corequisite: ET 365L.

Fundamentals and application of hydraulic, pneumatic and vacuum power as used in current manufacturing plants.

(Lecture–Discussion 2 hours) Letter grade only (A-F).

365L. Fluid Power and Control Laboratory (1)

Prerequisite: ET 204 with a grade of "C" or better.

Corequisite: ET 365.

Demonstration and operation of fluid power systems. Design and selection of components for specific applications. Computer data acquisition and analysis.

(Laboratory 3 hours) Letter grade only (A-F).

386. Introduction to Microprocessors (2)

Prerequisite: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 386L.

Theory and concepts of programming, hardware configuration, and functional capabilities of microcomputer systems including peripheral devices.

(Lecture-Problems 2 hours) Letter grade only (A-F).

386L. Introduction to Microprocessors Laboratory (1)

Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 386.

Laboratory exercises in programming microcomputers. Topics included are number systems, microcomputer structure, mnemonic, binary code, peripheral devices operations, stand alone operations, and system operations.

(Laboratory 3 hours) Letter grade only (A-F).

387. Robot Programming and Mechatronics (2)

Prerequisites: ET 205, ET 205L all with a grade of "C" or better.
Corequisite: ET 387L.

Basic concepts of robot manipulators, robot kinematics, robot programming languages. Applications of industrial robots, machine vision systems. Basic concepts of mechatronic systems: combine hardware, software, interface, and system integration to make an intelligent system. Sensors and actuators for robotics and mechatronic systems.

(Lecture-Problems 2 hours) Letter grade only (A-F).

387L. Robot Programming and Mechatronics Laboratory (1)

Prerequisites: ET 205, ET 205L all with a grade of "C" or better. Corequisite: ET 387.

Laboratory exercises in industrial and educational robot operation and applications. Laboratory exercises on mechatronic systems. Robot systems and their computer language instructions will be used. The experiments include teach pendant programming, high level language programming, workcell applications, continuous path programming.

Letter grade only (A-F).

388. Technical Applications Using Programming Languages (2)

Prerequisites: ET 286, ET 286L all with a grade of "C" or better. Corequisite: ET 388L.

Techniques for design and development of industrial programs that includes composite program design, module coupling/strength, program testing, top-down structured programming concepts and tools, object oriented programming, and memory management. Concepts are investigated and examined for use in solving complex problems.

(Lecture-problems 2 hours)

388L. Technical Applications Using Programming Languages Laboratory (1)

Prerequisites: ET 286, ET 286L all with a grade of "C" or better. Corequisite: ET 388.

Techniques for design and development of industrial programs that includes composite program design, module coupling/strength, program testing, top-down structured programming concepts and tools, object oriented programming, and memory management. Concepts are investigated and examined for use in solving complex problems.

(Lab 3 hours)

390. Applied Computer-Aided Design and Manufacturing (2)

Prerequisites: ET 205, ET 205L all with a grade of "C" or better. Corequisite: ET 390L.

Roll of the computers in the manufacturing process, application of CAD/CAM systems, hardware and software components for automation, part programming for manufacturing, computer controlled manufacturing equipment, simulation, programming the factory.

(Lecture - Discussion 2 hours) Letter grade only (A-F).

390L. Applied Computer-Aided Design and Manufacturing Laboratory (1)

Prerequisites: ET 205, ET 205L all with a grade of "C" or better. Corequisite: ET 390.

Use of microcomputer based hardware and software to solve 2D and 3D modeling problems. Computer automation software packages. Also includes part programming and CAD/CAM data exchange exercises.

(Laboratory 3 hours) Letter grade only (A-F).

409. Selected Topics in Engineering Technology (1-3)

Prerequisites: Senior standing in ET, consent of instructor.

Advanced work of a technical nature within an area of specialization on an experimental or research basis.

Letter grade only (A-F). Topics announced in the *Schedule of Classes*.

B. Electronics Technology
C. Manufacturing Technology
D. Quality Assurance
E. Computer Technology
F. Environmental Technology

410. Cost Engineering and Analysis (3)

Prerequisites: Economics course, Junior standing.

Introduction to the concepts of capital and operations budgets, capital acquisitions, economic evaluations of capital alternatives and factors of the time–value of money in industrial operations and construction industries.

(Lecture–Discussion 3 hours) Letter grade only (A-F).

418. Production Methods and Process Improvement (3)

Prerequisite: ET 410 with a grade of "C" or better.

Simplification and improvement of manufacturing operations through the use of production analysis tools for optimum production economy. Also included is the investigation of production automation applications for improving manufacturing process, quality and productivity.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

419. Design of Experiments (3)

Prerequisite: ET 312 with a grade of "C" or better.

Advanced statistical analysis applied to quality functions. Comparative and single factor experiments. Factorial designs and multiple regression.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

435. Engineering Materials and Processes II (3)

Prerequisites: ET 335, ET 335L all with a grade of "C" or better. Corequisite: ET 435L.

Application of engineering materials and manufacturing processes including: rolling; forging; extrusion and drawing; sheet-metal forming; manufacturing of plastics and composites; material removal processes and rapid prototyping.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

435L. Engineering Materials and Processes II Laboratory (1)

Prerequisites: ET 335, ET 335L all with a grade of "C" or better. Corequisite: ET 435.

Continuation of ET 335L. Laboratory exercises in: welding processes; machining processes; metal forming; manufacturing of composite materials.

(Laboratory 3 hours) Letter grade only (A-F).

441. Theory of Electronic Control (3)

Prerequisites: ET 360, ET 360L all with a grade of "C" or better.

Procedures for the design, preparation, and evaluation of electronic systems that control manufacturing and production processes, simulation analysis for sensing, programming, and actuating operations.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

442. Computer Circuits (2)

Prerequisites: ET 255, ET 255L all with a grade of "C" or better. Corequisite ET 442L.

Introduction to digital hardware design. Combinational/sequential logic circuits and systems and application of integrated circuits to logic controls. Programmable logic devices, Field-programmable gate array, Circuit synthesis, and analysis.

(Lecture-Problems 2 hours) Letter grade only (A-F).

442L. Computer Circuits Laboratory (1)

Prerequisites: ET 255, ET 255L all with a grade of "C" or better. Corequisite ET 442.

Laboratory study of digital computer circuits design and implementation. Standard designing and trouble-shooting procedures will be discussed. Topics covered are multivibrator, register, counter, decoder, arithmetic circuits, and memory.

(Laboratory 3 hours) Letter grade only (A-F).

444. Telecommunications (3)

Prerequisites: ET 360, ET 360L all with a grade of "C" or better.

National Communication Network, decibels, transmission units, transmission lines, characteristic impedance, loading systems, lattice networks, PCM, Nyquist Criterion, Bessel functions, coaxial cable, fiber optics, microwave, impedance matching, and Smith chart.

(Lecture-Discussion 3 hours) Letter grade only (A-F).

445. Microelectronics (2)

Prerequisites: ET 350, ET 350L all with a grade of "C" or better.
Corequisite: ET 445L.

Design, processing and applications of monolithic and hybrid microcircuits for analog and digital systems.

(Lecture 2 hours) Letter grade only (A-F).

445L. Microelectronics Laboratory (1)

Prerequisites: ET 350, ET 350L all with a grade of "C" or better.
Corequisite: ET 445.

Laboratory exercises in the processing of thick-film and thin-film materials, ultrasonic and thermocompression wire bonding and laser resistive trimming. Practical application and equipment utilization is emphasized.

(Laboratory 3 hours) Letter grade only (A-F).

447. Industrial Applications of Electronic Circuits (2)

Prerequisites: ET 341, ET 341L all with a grade of "C" or better.

Corequisite: ET 447L.

An in-depth study of the applications of important electronic circuit concepts in industry. Analysis of circuits and how they work in industrial applications. Techniques for troubleshooting of design circuits. Biomedical electronic circuits which have industrial applications are emphasized.

(Lecture-Discussion 2 hours) Letter grade only (A-F).

447L. Industrial Applications of Electronic Circuits Laboratory (1)

Prerequisites: ET 341, ET 341L all with a grade of "C" or better.
Corequisite: ET 447.

Laboratory exercises include constructing circuits which have important applications in industry. Troubleshooting methodology emphaiszed throughout. Assignments focus on biomedical electronic circuits which have industrial applications.

(Laboratory 3 hours) Letter grade only (A-F).

460. Electronics Project Design and Development (2)

Prerequisites: ET 341, ET 341L all with a grade of "C" or better and senior standing.
Corequisite: ET 460L.

Integrative learning capstone course, focusing on electronics project design and development. Product planning, implementation planning, proposal and approvals, implementation, system integration, packaging and testing. Written communication, teamwork, demonstration, and oral presentation on finished product.

This capstone course is open to Electronics Technology majors only. Letter grade only (A-F). (Lecture-Discussion 2 hours)

460L. Electronics Project Design and Development Laboratory (1)

Prerequisites: ET 341, ET 341L all with a grade of "C" or better and senior standing.
Corequisite: ET 460.

Laboratory on Electronics Project Design and Development. Product planning, implementation planning, proposal and approvals, implementation, system integration, packaging and testing. Written communication, teamwork, demonstration, and oral presentation on finished product.

Letter grade only (A-F). (Laboratory 3 hours)

461. Management of Manufacturing Operations (3)

Prerequisite: ET 410 with a grade of "C" or better.

Application of analytical planning and control techniques to the resources of industry including the physical plant, equipment, personnel, inventories and supplies use in the production of products and services.

(Lecture-Discussion 3 hrs) Letter grade only (A-F).

486. Data Structures (2)

Prerequisites: ET 388, ET 388L all with a grade of "C" or better.
Corequisite: ET 486L.

Data structures and applications. Choice and implementation of appropriate data structures for applications. Treatment of arrays, lists, stacks, queues, lined lists, trees, and assorted algorithms. Introduction to search and sorting. File organization techniques.

(Lecture-Problems 2 hours) Letter grade only (A-F).

486L. Data Structures Laboratory (1)

Prerequisites: ET 388, ET 388L all with a grade of "C" or better.
Corequisite: ET 486.

Laboratory exercises in data structures and applications. A recursive programming language will be used.

(Laboratory 3 hours) Letter grade only (A-F).

487. Introduction to Data Communications and Networking (2)

Prerequisites: ET 286, ET 286L, ET 386, ET 386L or equivalents all with a grade of "C" or better.
Corequisite: ET 487L.

Introduction to data communications fundamentals, peer-to-peer and client/server network models. Hardware and software technology, Protocols, networks, relational database technology, and security. Example applications, tools and development environments, Groupware, middleware. A design project and class presentation is required.

(Lecture-discussion 2 hours) Letter grade only (A-F).

487L. Introduction to Data Communications and Networking Laboratory (1)

Prerequisites: ET 286, ET 286L, ET 386, ET 386L or equivalents all with a grade of "C" or better.
Corequisite: ET 487.

Laboratory and programming exercises introducing the students to data communications and Networking technology. Protocols, networks, relational database technology, and security. Applications using software/hardware tools and development environments.

(Laboratory 3 hours) Letter grade only (A-F).

488. Microcomputer Systems (2)

Prerequisites: ET 386, ET 386L all with a grade of "C" or better.
Corequisite: ET 488L.

Study of available microprocessors and microcomputer systems. Topics cover microcomputer architecture, software structure, assembly language, central processing unit, input/output, memory manipulation, and interfacing applications in Engineering Technology.

(Lecture-problems 2 hours) Letter grade only (A-F).

488L. Microcomputer Systems Laboratory (1)

Prerequisites: ET 386, ET 386L all with a grade of "C" or better.
Corequisite: ET 488.

Laboratory experience in microcomputer architecture, assembly language programming, and interfacing applications in Engineering Technology. Topics covered are central processing unit function, memory organization, and input/output operation. Available microcomputer systems will be used. Applications in Engineering Technology.

(Laboratory 3 hours) Letter grade only (A-F).

489. Computer Interfacing (2)

Prerequisites: ET 442, ET 442L, ET 488, ET 488L all with a grade of "C" or better.

Corequisite: ET 489L.

Study of theories and techniques that are used in peripheral control and interfacing. Topics covered are serial interfacing, Parallel interfacing, timing, handshaking, A/D converters, buffering, and UARTs.

(Lecture-Discussion 2 hours) Letter grade only (A-F).

489L. Computer Interfacing Laboratory (1)

Prerequisites: ET 442, ET 442L, ET 488, ET 488L all with a grade of "C" or better.

Corequisite: ET 489.

Laboratory exercises in computer interfacing applications and design. Available computer system and its assembly language instructions will be used.

(Laboratory 3 hours) Letter grade only (A-F).

491. Embedded Processors and Systems (2)

Prerequisites: ET 489, ET 489L all with a grade of "C" or better.
Corequisite: ET 491L.

Embedded microprocessors, embedded systems, development concepts, principles, and applications. Hardware/software tradeoffs, interfacing issues, memory sizing, timing, code and power optimization issues. Application requirements, platform selection, RISC vs. CISC issues, co-processors vs. ASIC's.

(Lecture-discussion 2 hours) Letter grade only (A-F).

491L. Embedded Processors and Systems Laboratory (1)

Prerequisites: ET 489, ET 489L all with a grade of "C" or better.

Corequisite: ET 491.

Laboratory exercises on embedded system development. Emphasis will be on application requirements, platform selection, interfacing, memory sizing, timing, code and power optimization. Use of development environments and evaluation boards.

(Laboratory 3 hours) Letter grade only (A-F).

492. Computer Controlled Industrial Systems (2)

Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 492L.

Concepts of computer-based control of industrial systems and data acquisition. Signals and measurements, noise, resolution, signal conditioning. Software and hardware for data acquisition and control.

(Lecture-discussion, 2 hours) Letter grade only (A-F).

492L. Computer Controlled Industrial Systems Laboratory (1)

Prerequisites: ET 286, ET 286L all with a grade of "C" or better.
Corequisite: ET 492.

Laboratory exercises on computer-based control of industrial systems and data acquisition. Software and hardware for data acquisition and control. Emphasis placed on object-oriented languages and creation of graphical user interfaces for data acquisition, display and control.

(Laboratory, 1 hour) Letter grade only (A-F).

494. Applied Systems Development Project (2)

Prerequisites: ET 386, ET 386L, ET 487, ET 487L all with a grade of "C" or better.
Corequisite: ET 494L.

Integrative learning capstone course, focusing on computer technology project design and development. Systems development concepts, principles, and practices. Project management techniques, interviewing, forms analysis, structured methods. Written communication, teamwork, demonstration, and oral presentation on finished product.

(Lecture-Discussion 2 hours) Letter grade only (A-F).

494L. Applied Systems Development Project Laboratory (1)

Prerequisites: ET 386, ET 386L, ET 487, ET 487L all with a grade of "C" or better.
Corequisite: ET 494.

Laboratory on Applied Systems Development Project. Systems development concepts, principles, and practices. Project management techniques, interviewing, forms analysis, structured methods. Written communication, teamwork, demonstration, and oral presentation on finished product.

(Laboratory 3 hours) Letter grade only (A-F).

497. Computer Network Technology (2)

Prerequisites: ET 487, ET 487L all with a grade of "C" or better.
Corequisite: ET 497L.

Hardware and software technology as it relates to computer networking. LAN, WAN environments and access methods, Ethernet, ATM, Bridges, routers, gateways and intelligent hubs. Networking protocols. Security, Load balancing, and the use of simulation tools in designing networks.

(Lecture-discussion 2 hours) Letter grade only (A-F).

497L. Computer Network Technology Laboratory (1)

Prerequisites: ET 487, ET 487L all with a grade of "C" or better.
Corequisite: ET 497.

Laboratory exercises using hardware and software technology related to computer networking. Internetworking laboratory, Ethernet, ATM, Bridges, routers, gateways, and intelligent hubs. Security, Load balancing, and the use of simulation tools.

(Laboratory 3 hours) Letter grade only (A-F).

498. Manufacturing Engineering Technology Capstone Project (3)

Prerequisite: Senior standing.

Group project involving analysis, design, tooling and production processes for product manufacture. Economic, market and capital requirements, manpower analysis. Written reports and oral presentations required.

(Lecture 2 hours, Activity 2 hours) Letter grade only (A-F).

MECHANICAL AND AEROSPACE ENGINEERING

College of Engineering

Department Chair: Jalal Torabzadeh

Department Office: ECS - 635
Telephone: (562) 985-1563
Website: http://www.csulb.edu/colleges/coe/mae

Faculty: Eric Besnard, Christiane Beyer, David Stout, Hsun-Hu Chen, Hsin-Piao Chen, Ramin Esfandiari, Joshua Hamel, Bei Lu, Yan Li, Panadda Marayong, Bob Minaie, Hamid Rahai, Praveen Shankar, Reza Toossi, Jalal Torabzadeh, Parviz Yavari, Mahdi Yoozbashizadeh

Undergraduate Advisors: Panadda Marayong (ME), Allen Teagle Hernandez (ME), Praveen Shankar (AE), Parviz Yavari (ET)

Extension Program Advisor/Coordinator for Mechanical Engineering: Praveen Shanka(ME)

Graduate Advisors: Bei Lu (ME), Hsin-Piao Chen (AE)

Administrative Support Coordinator: Leanne Hayes

Students desiring detailed information should contact the department for referral to one of the faculty advisors.

Career Possibilities

Mechanical Engineer • Aerospace Engineer • Facilities Engineer • Manufacturing Engineer • Design Engineer • Sales Engineer • Plant Engineer • Safety Engineer • Tool Engineer • Project Engineer • Utilization/Test Engineer • Automotive Engineer • Production Engineer • Manufacturing Engineer • Standards Engineer • Industrial Engineer • Factory Plant Layout Engineer • Material Schedule • Tool Planner • Safety Engineer • Product Safety Engineer • Production Planner • Statistician • Staff Assistant Specification Writer • Tooling Quality Assurance Worker • Quality Planning Analyst • Process Engineering • Estimator • Manufacturing Engineering • Quality Engineer • Supervisor Vendor Quality • Production Engineer • Material Schedule • Quality Control Technician • Configuration Analyst • Quality Manager • Production Manager • Industrial Engineering • Production Safety Engineer • Safety Engineer • Metrologist • Liaison Worker • Methods and Time-Study Engineer • Traffic Control Engineer • Technical Sales Representative • Process Engineer • Estimator • Associate Engineer • Field Engineer (Some of these, and other careers, require additional education or experience. For more information, see www.careers.csulb.edu.)

ABET Accreditation

The Bachelor of Science in Aerospace Engineering and the Bachelor of Science in Mechanical Engineering offered at the Long Beach campus are accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. The Mechanical Engineering Extension Program offered at Lancaster University Center, Lancaster, CA is undergoing accreditation Review in 2014- 2015.

Advisory Council

The Department of Mechanical and Aerospace Engineering is supported by a professional Advisory and Development Council (ADC) comprised of outstanding engineers and executives from industry and government agencies in Southern California. The role of the ADC is to form a liaison between the University and industry and to help the administration and faculty remain informed of modern engineering practices and help with Continuous Improvement Process (CIP).

Programs at a Glance

Undergraduate

- Bachelor of Science in Aerospace Engineering (BSAE);
- Bachelor of Science in Mechanical Engineering (BSME);
- Bachelor of Science in Mechanical Engineering - Undergraduate Extension (BSME)
- *Bachelor of Science in Manufacturing Engineering Technology.

Graduate

- Master of Science in Aerospace Engineering (MSAE);
- Master of Science in Mechanical Engineering (MSME);
- Master of Science in Engineering (MSE) with an emphasis in Management Engineering;
- Ph.D. in Engineering and Industrial Applied Mathematics (offered jointly with Claremont Graduate University).

Student Organizations

Students have the benefit of joining the student chapters of professional societies:

- AIAA (American Institute for Aeronautics and Astronautics)
- ASME (American Society for Mechanical Engineers)
- SAE (Society of Automotive Engineers)
- SPE (Society of Petroleum Engineers)
- ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers)
- SME (Society of Manufacturing Engineers)
- ASQ (American Society of Quality)
- SWE (Society of Women Engineers)
- Tau Beta Pi (Engineering Honor Society)
- Pi Tau Sigma (Mechanical Engineering Honor Society)
- Sigma Gamma Tau (Aerospace Engineering Honor Society)

As student members of professional societies, students can attend local, regional, national, and international meetings and conferences, participate in student contests, become eligible for sponsored scholarships, interact with professionals from industry, and many other benefits.

Undergraduate Programs

MECHANICAL ENGINEERING PROGRAM

The undergraduate program in mechanical engineering offered at the Long Beach campus accepts both freshmen and transfer students. Students are admitted to the program following the university admission guidelines for freshmen and major specific admission criteria for transfer students.

Extension Program

The undergraduate program in mechanical engineering is also offered as an extension program at Lancaster University Center, Lancaster, CA as part of the Antelope Valley Engineering Programs. This special program offered through the College of Continuing and Professional Education (CCPE) only accepts upper division transfer students with specific admission requirements. The extension program is a cohort-based model, allowing students to proceed as a group through the program placing greater emphasis on teamwork.

BSME Program Educational Objectives

The goal of the undergraduate program in mechanical engineering is to produce well-rounded engineers prepared for careers in mechanical engineering or related disciplines, utilizing an excellent education in the fundamentals of engineering mathematics, sciences, and design in order to:

- Create innovative solutions responsive to customer needs and meeting societal challenges;
- Apply their knowledge to communicating and translating ideas and plans into working engineering systems;
- Effectively function as a team member and/or leader in global, multi-disciplinary technical environments.

Student Learning Outcomes

The ME program Student Outcomes used to meet the Program Educational Objectives are the same as the ABET "A through K":

A. An ability to apply knowledge of mathematics, science, and engineering.
B. An ability to design and conduct experiments, as well as to analyze and interpret data.
C. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
D. An ability to function on a multidisciplinary team.
E. An ability to identify, formulate and solve engineering problems.
F. An understanding of professional and ethical responsibilities.
G. An ability to communicate effectively.
H. The broad education necessary to understand the impact of engineering solutions in a global and societal context.
I. A recognition of the need for, and an ability to engage in, lifelong learning.
J. A knowledge of contemporary issues.
K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Bachelor of Science in Mechanical Engineering (120 units)

The opportunity to explore a particular area of interest is provided by additional elective courses in the senior year. Several industry and professional society sponsored scholarships and internships are available to upper division mechanical engineering students. Further information is available in the department office.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Mechanical Engineering). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Mechanical Engineering at the Long Beach campus must also meet similar major specific requirements. To become fully admitted into the Mechanical Engineering major at the Long Beach campus, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses:

Core Lower Division Major Requirements (grade of "C" or better required):
MATH 122 (Calculus I), MATH 123 (Calculus II), PHYS 151 (Mechanics & Heat)
General Education Foundations Courses:
Written and Oral Communication

To be admitted to the Mechanical Engineering Extension Program offered at Lancaster University Center, all prospective students must have a minimum cumulative 2.5 GPA on all transferable course work attempted, and complete course work equivalent to the following:

Core Lower Division Major Requirements – 34 units (grade of C or better required):
- MATH 122 (Calculus I), MATH 123 (Calculus II), MATH 224 (Calculus III), PHYS 151 (Mechanics & Heat), PHYS 152 (Electricity & Magnetism), CHEM 111A (General Chemistry), MAE 205 (Computer Methods), MAE 172 (Engineering Design Graphics), and CE 205 (Statics)

General Education Courses: - 27 units:
- Category A – 6 units (Written and Oral Communication)
- Category C – 9 units (Humanities, Arts)
- Category D – 9 units (US history, Constitution & American Ideals, Social Science)
- Category E – 3 units (Self-Integration)

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 122 within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 123 and PHYS 151 within one calendar year.

Requirements

Minimum of 120 units including University General Education requirements. A grade of "C" or better must be achieved in all of the required courses listed below.

Lower Division:

Take all of the following courses:

CHEM 111A General Chemistry (5)
Prerequisites: A passing score on the Chemistry Placement Examination.
Corequisite: MATH 109 or higher.

CE 205 Analytical Mechanics I (Statics) (3)
Prerequisite: PHYS 151 all with a grade of "C" or better.
Prerequisite/Corequisite: MATH 123.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113.

MATH 123 Calculus II (4)
Prerequisite: A grade of "C" or better in MATH 122.

MATH 224 Calculus III (4)
Prerequisite: A grade of "C" or better in MATH 123 or MATH 222.

ENGR 101 Introduction to Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

MAE 101B Introduction to Mechanical Engineering (1)
Prerequisite: Freshman standing or consent of instructor and MATH 111 or MATH 113 or MATH 122 with a grade of "C" or better.

MAE 172 Engineering Design Graphics I (2)
Prerequisites: None.

MAE 205 Computer Methods in MAE (2)
Prerequisites: MATH 122 with a grade of "C" or better.

MAE 272 Introduction to Manufacturing Processes (2)
Prerequisite: MAE 172 with a grade of "C" or better.

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

Take one of the following choices:

PHYS 152 Electricity and Magnetism (4)
Prerequisite: PHYS 151 with a grade of "C" or better.
Prerequisite/Corequisite: MATH 123.

or both of the following:

EE 210 Electro-Magnetic Foundations in EE (3)
Prerequisite: PHYS 151 with a grade of "C" or better.
Corequisites: MATH 123, EE 210L.

EE 210L Electro-Magnetic Foundations in EE Lab (1)
Corequisite: EE 210.

Upper Division:

Take all of the following courses:

CE 335 Fluid Mechanics (3)
Prerequisites: MATH 224 and C E 205 all with a grade of "C" or better.

CE 336 Fluid Mechanics Laboratory (1)
Prerequisite: ENGL 100 or equivalent all with a grade of "C" or better.
Prerequisite/Corequisite: C E 335.

CE 406 Project Cost-Benefit Analysis (3)
Prerequisite: GE Foundation requirements.

MATH 370A Applied Mathematics I (3)
Prerequisites: A grade of "C" or better in MATH 123. Not open to Freshmen.

MAE 300 Engineering Instrumentation and Measurement (2)
Prerequisites: MATH 224, PHYS 151, PHYS 152 all with a grade of "C" or better.

MAE 305 Numerical Methods in MAE (3)
Prerequisites: MAE 205 and MATH 370A all with a grade of "C" or better.

MAE 322 Engineering Materials and Materials Processes (3)
Prerequisites: CHEM 111A, MATH 123, MAE 172 all with a grade of "C" or better.

MAE 330 Engineering Thermodynamics I (3)
Prerequisites: MATH 224, PHYS 151 or equivalent, and CHEM 111A all with a grade of "C" or better or consent of instructor.

MAE 336 Power Plant Design (3)
Prerequisite: MAE 330 with a grade of "C" or better.

MAE 337 Thermal Engineering Laboratory (2)
Prerequisite: MAE 336 with a grade of "C" or better.

MAE 361 Materials and Properties Laboratory (1)
Prerequisites: ENGL 100 or GE Composition (Area A1), MAE 300, MAE 322, MAE 373 all with a grade of "C" or better.

MAE 371 Analytical Mechanics Dynamics (3)
Prerequisites: CE 205, MAE 205, or CE 206 and 206L all with a grade of “C” or better.

MAE 373 Mechanics of Deformable Bodies (3)
Prerequisite: CE 205 all with a grade of "C" or better.

MAE 375 Kinematics & Dynamics of Mechanisms (3)
Prerequisites: MAE 272, MAE 371 all with a grade of "C" or better.

MAE 376 Modeling & Analysis of Dynamic Systems (3)
Prerequisite: MAE 371; MATH 370A all with a grade of "C" or better.

MAE 409A Modern Computational Aspects in Mechanical Engineering (3)
Prerequisites: Senior standing in engineering and consent of instructor.

MAE 431 Heat Transfer Systems Design (3)
Prerequisites: MAE 305, MAE 330; CE 335 all with a grade of "C" or better.

MAE 459 Professional Practice Seminar (1)
Prerequisite: Senior standing or consent of instructor.

MAE 471 Design and Analysis of Mechanical Engineering Systems I (3)
Prerequisites: MAE 373 and MAE 375 all with a grade of "C" or better.

MAE 472 Design and Analysis of Mechanical Engineering Systems II (3)
Prerequisites: MAE 330, MAE 471 all with a grade of "C" or better.

MAE 476 Mechanical Control Systems I (3)
Prerequisite: MAE 376 with a grade of "C" or better.

MAE 490 Special Topics (3)
Prerequisites: Senior standing in engineering and consent of instructor.

AEROSPACE ENGINEERING PROGRAM

BSAE Program Educational Objectives

The goal of the undergraduate program in aerospace engineering is to produce well-rounded engineers prepared for careers in aerospace engineering or related disciplines,

utilizing an excellent education in the fundamentals of engineering mathematics, sciences, and design in order to:

1. Create innovative solutions responsive to customer needs and meeting societal challenges;
2. Apply their knowledge to communicating and translating ideas and plans into working engineering systems;
3. Effectively function as a team member and/or leader in global, multi-disciplinary technical environments.

Student Learning Outcomes

The AE program Student Outcomes used to meet the Program Educational Objectives are listed below:

1. The students graduating in aerospace engineering will possess the skills in mathematics, physics and chemistry required to solve real-world problems.

2. The students will have a firm understanding of engineering science fundamentals that enables them to analyze real-world problems and propose an appropriate solution to these problems.

3. The students will have an ability to apply their knowledge in aerospace fundamental disciplines to the analysis and design of components. These aerospace fundamental disciplines include aerodynamics; aerospace materials and structures; propulsion; space environment and space systems; communications and avionics systems; orbital and flight mechanics; and stability & control.

4. The students will have the ability to work in teams and (1) carry out simplified design problems from the conceptual level to the realization of a manufacturing plan, or (2) design complex systems, such as aircraft or spacecraft, from a preliminary design point of view. Projects address economic and business aspects such as commercial viability.

5. The students will have the ability to design and conduct experiments, as well as to analyze and interpret data.

6. The students will have an understanding of professional and ethical responsibility.

7. The students will have the ability to build on their knowledge and will be trained to be lifelong learners, pursuing and interested in independent study, research and development.

8. The students will have good oral, written and graphical communication skills.

9. The students will be trained in the role of the engineer in society, and have an awareness of environmental concerns in the engineering profession.

10. The students will have knowledge of contemporary issues and current projects in aerospace engineering and of technical, design, and business challenges faced by the aerospace industry.

Bachelor of Science in Aerospace Engineering (120 units)

The curriculum is designed to supplement mathematics, science and basic engineering courses in order to give students the specialization needed in different areas of aerospace engineering. In addition to acquiring technical knowledge, graduates will have completed appropriate courses in communications and in humanistic social studies.

Major Declaration

Freshmen admission to engineering majors is to a 'pre-major' status (i.e., Pre-Aerospace Engineering). Continuation in the major will be subject to meeting specific lower division course and GPA requirements at CSULB that indicate the student's ability to succeed and complete the major. Transfer applicants and CSULB students seeking admission into Aerospace Engineering must also meet similar major specific requirements. To become fully admitted into the Aerospace Engineering major, all prospective students (i.e., pre-majors, undeclared, major changes) must have a minimum cumulative 2.5 GPA and complete the following lower-division courses with a minimum grade of "C" prior to earning 60 units:

Core Lower Division Major Requirements:
MATH 122 (Calculus I), MATH 123 (Calculus II), PHYS 151 (Mechanics & Heat)

General Education Foundations Courses:
Written and Oral Communication

Degree Progress

Students must complete the following requirements within one calendar year of declaring the major. Some students may need to take courses during Summer Session to meet these requirements. At the end of the year, students who have not met the requirements must either declare another major or meet with an Academic Advisor to determine if the student's performance in the courses merits an additional semester to complete.

First-Time Freshmen: A grade of "C" or better must be achieved in MATH 122 within one calendar year.

Transfer Students: A grade of "C" or better must be achieved in MATH 123 and PHYS 151 within one calendar year.

Requirements

A grade of "C" or better must be achieved in all of the required courses listed below. A minimum of 120 units is required.

There are two emphases in the BSAE Program: (1) Aeronautics, and (2) Astronautics. Aeronautics focuses on aerospace engineering as it relates to flight in the atmosphere, while Astronautics addresses space flight.

Core Requirements

Lower Division:

Take all of the following courses:

CE 205 Analytical Mechanics I (Statics) (3)
Prerequisite: PHYS 151 with a grade of "C" or better.
Prerequisite/Corequisite: MATH 123.

CHEM 111A General Chemistry (5)
Prerequisites: A passing score on the Chemistry Placement Examination.
Corequisite: MATH 109 or higher.

ENGR 101 Introduction to Engineering Profession (1)
Prerequisite/Corequisite: MATH 111 or MATH 113 or MATH 122

ENGR 102 Academic Success Skills (1)
Prerequisite: ENGR 101 with a grade of "C" or better.

MAE 101A Introduction to Aerospace Engineering (1)
Prerequisites: Freshman standing or consent of instructor and MATH 111 or MATH 113 or MATH 122 with a grade of "C" or better. .

MAE 172 Engineering Design Graphics (2)
Prerequisites: None.

MAE 205 Computer Methods in Mechanical/Aerospace Engineering (2)
Prerequisites: MATH 122 with a grade of "C" or better.

MATH 122 Calculus I (4)
Prerequisite: Appropriate MDPT placement or a grade of "C" or better in MATH 111 and MATH 113.

MATH 123 Calculus II (4)
Prerequisite: A grade of "C" or better in MATH 122.

MATH 224 Calculus III (4)
Prerequisite: A grade of "C" or better in MATH 123 or MATH 222.

PHYS 151 Mechanics and Heat (4)
Prerequisite/Corequisite: MATH 122.

Take one of the following choices:

PHYS 152 Electricity and Magnetism (4)
Prerequisite: PHYS 151; Prerequisite/Corequisite: MATH 123.

or both of the following:

EE 210 Electro-Magnetic Foundations in EE (3)
Prerequisite: PHYS 151 with a grade of "C" or better.
Corequisites: MATH 123, EE 210L.

EE 210L Electro-Magnetic Foundations in EE Lab (1)
Corequisite: EE 210.

Upper Division:

Take all of the following courses:

ECON 300 Fundamentals of Economics (3)
Prerequisites: GE Foundation requirements.

MATH 370A Applied Mathematics I (3)
Prerequisites: A grade of "C" or better in MATH 123. Not open to Freshmen.

MAE 300 Engineering Instrumentation and Measurement (2)
Prerequisites: MATH 224, PHYS 151, PHYS 152 all with a grade of "C" or better.

MAE 305 Numerical Methods in MAE (3)
Prerequisites: MAE 205 and MATH 370A all with a grade of "C" or better.

MAE 330 Engineering Thermodynamics I (3)
Prerequisites: MATH 224, PHYS 151 or equivalent, and CHEM 111A all with a grade of "C" or better or consent of instructor.

MAE 333 Engineering Fluid Dynamics (3)
Prerequisites: CE 205, MATH 370A all with a grade of "C" or better.

MAE 334 Aerodynamics I (3)
Prerequisite: MAE 333 with a grade of "C" or better.

MAE 350 Flight Mechanics (3)
Prerequisite: CE 205 with a grade of "C" or better.

MAE 365 Aerospace Structures I (3)
Prerequisite: MAE 373 with a grade of "C" or better.

MAE 371 Analytical Mechanics II (Dynamics) (3)
Prerequisites: CE 205, MAE 205, or CE 206 and 206L all with a grade of “C” or better.

MAE 373 Mechanics of Deformable Bodies (3)
Prerequisite: CE 205 with a grade of "C" or better.

MAE 374 Mechanical Properties of Materials Lab (1)
Prerequisites: ENGL 100 or equivalent, MAE 373, and MAE 300 all with a grade of "C" or better or consent of instructor.

MAE 381 Fundamentals of Space Dynamics (3)
Prerequisites: PHYS 152, MATH 370A, and MAE 371 all with a grade of "C" or better.

MAE 390 Aerospace Engineering Seminar (1)
Prerequisite: Upper division standing.

MAE 440 Aerodynamics Laboratory (1)
Prerequisites: MAE 300 and MAE 334 all with a grade of "C" or better.

MAE 452 Propulsion (3)
Prerequisites: MAE 330 and MAE 334 all with a grade of "C" or better.

MAE 465 Aerospace Structures II (3)
Prerequisite: MAE 365 with a grade of "C" or better.

MAE 478 Aerospace Systems Design I (3)
Prerequisites: MAE 334, MAE 365, and MAE 381 all with a grade of "C" or better .
Corequisite: MAE 434, MAE 465, or MAE 481.

MAE 479 Aerospace Systems Design II (3)
Prerequisite: MAE 478 with a grade of "C" or better.

Emphasis in Aeronautics:

Take all of the following courses:

MAE 434 Aerodynamics II (3)
Prerequisite: MAE 334 with a grade of "C" or better.

MAE 451 Aircraft Preliminary Design and Performance (3)
Prerequisite: MAE 334, MAE 350 all with a grade of "C" or better, or consent of instructor.

MAE 453 Stability and Control of Aerospace Vehicles (3)
Prerequisite: MAE 350 or equivalent all with a grade of "C" or better.
Corequisite: MAE 334.

Choose one of the following courses:

MAE 422, MAE 431, MAE 435, MAE 454, MAE 476, MAE 481, MAE 483

Emphasis in Astronautics:

Take all of the following courses:

MAE 481 Space Systems Engineering (3)
Prerequisite: MAE 381 with a grade of "C" or better.

MAE 483 Space Flight and Orbital Mechanics (3)
Prerequisites: MAE 381 with a grade of "C" or better.

Choose two of the following courses:

MAE 422, MAE 431, MAE 434, MAE 435, MAE 451, MAE 453, MAE 454, MAE 476

GRADUATE PROGRAMS

The goal of the Master’s programs in mechanical and aerospace engineering, the MSAE and MSAE degrees, is to provide students with the advanced engineering education needed to enhance their careers and pursue doctoral studies.

Admission to the MSAE or MSME degree programs requires a minimum GPA of 2.70 in the last 60 (semester) or 90 (quarter) upper-division major units attempted.

Master of Science in Mechanical Engineering

This program involves modern computational and experimental methods knowledge and skills which are of immediate practical importance. This knowledge is communicated in the advanced courses and used in the conduct of a thesis or project. The areas of study within the MSME program include:

- Dynamics, Vibration, Control, and Robotics
- Fluid and Thermal Sciences
- Materials
- Mechanics

• Design and Manufacturing

Further information may be obtained from the Department of Mechanical and Aerospace Engineering's website: http://www.csulb.edu/colleges/coe/mae.

To be considered for admission, the graduate applicant must have earned a bachelor's degree from an accredited institution, have been in good standing at the last institution attended, and have a grade point average (GPA) of at least 2.7 for the last 60 (semester) or 90 (quarter) upper-division major units attempted. The general Graduate Record Examination (GRE) is required.

Prerequisites

1. A bachelor's degree in an accredited curriculum in Mechanical Engineering, or other appropriate discipline, with a minimum grade point average of 2.70 in the last 60 (semester) or 90 (quarter) upper-division major units attempted.
2. Students must consult with the MSME graduate advisor prior to enrolling in any courses for their program.
3. Failure to attempt to fulfill the Graduation Writing Assessment Requirement (GWAR) during the first semester in the program will prevent registration in engineering courses in subsequent semesters.

Note: Before being admitted a qualified student without a mechanical engineering undergraduate degree MUST provide a written statement to the MSME graduate advisor that he/she understands that all deficiencies must be removed before attempting graduate-level courses.

Requirements

PLAN I

Completion of a minimum of 30 units beyond the bachelor's degree in graduate and 400-level courses approved by the student's Department Graduate Advisor, including:

1. Eighteen units of 500- and/or 600-level courses in mechanical and aerospace engineering;
2. Six units of electives selected from approved graduate or 400-level courses from appropriate areas;
3. Completion of six units of MAE 698-Thesis and submission of a written thesis.

PLAN II

Completion of a minimum of 30 units beyond the bachelor's degree in graduate and 400-level courses approved by the student's Department Graduate Advisor, including:

1. Twenty-four units of 500- and/or 600-level courses in mechanical and aerospace engineering;
2. Six units of electives selected from approved graduate or 400-level courses from approved areas;
3. Completion of a comprehensive written exam. (Note: In order to satisfy the culminating activity requirement (thesis, project, or comprehensive examination dependent upon the program), students must earn at least three (3) units and no more than six (6) units related to the completion of the culminating activity.

Advancement to Candidacy

Prior to formally starting their thesis or project (registering for MAE 697 or 698), students must apply for Advancement to Candidacy. Students applying for Advancement to Candidacy must:

1. Have completed ALL undergraduate deficiencies with grades of "C" or better;
2. Have attained an overall grade point average (GPA) of 3.0
3. Have completed at least 12 units applicable to the degree with a GPA of at least 3.0;
4. Have completed at least 12 units applicable to the degree with a GPA of at least 3.0;
5. Have fulfilled the Graduation Writing Assessment Requirement (GWAR). This requirement can also be met by presenting evidence that the student met the requirement while an undergraduate at CSULB or at certain CSU campuses.
6. Have their program of studies approved by the faculty coordinating their area of emphasis, the ME program graduate advisor, and department chair.

Master of Science in Aerospace Engineering

This program involves modern computational and experimental methods and provides the essential information which will permit students to acquire the knowledge and skills which are of immediate practical importance. This knowledge is communicated in the advanced courses listed in the MAE curriculum and used in the conduct of a thesis or project. The areas of study within the MSAE program include:

• Space Systems Engineering
• Aircraft Systems Engineering
• Aerodynamics and Computational Fluid Dynamics
• Aerospace Structures and Materials

Both graduate and undergraduate programs benefit from the advice of an advisory committee comprised of senior staff from aerospace companies, government agencies, and universities. Further information may be obtained from the Department of Mechanical and Aerospace Engineering's website: http://www.csulb.edu/colleges/coe/mae.

To be considered for admission, the graduate applicant must have earned a bachelor's degree from an accredited institution, have been in good standing at the last institution attended, and have a grade point average (GPA) of at least 2.7 for the last 60 (semester) or 90 (quarter) upper-division major units attempted. The general Graduate Record Examination (GRE) is required.

Prerequisites

1. A bachelor's degree in an accredited curriculum in Aerospace or Mechanical Engineering with a minimum grade point average of 2.70 in the last 60 (semester) or 90 (quarter) upper-division major units attempted. Applicants with a lower GPA may be admitted, subject to the successful completion of appropriate deficiencies assigned by the graduate advisor.
2. A bachelor's degree in engineering, mathematics, science or other appropriate discipline, with the requirement that essential undergraduate prerequisites in engineering be satisfied.

3. Graduate students must consult with the graduate advisor for information concerning procedures and requirements for appropriate approval of their courses of study prior to enrolling in their graduate programs.

Requirements

PLAN I

Completion of a minimum of 30 units beyond the bachelor's degree in graduate and 400-level courses approved by the student's Department Graduate Advisor, including:

1. Eighteen units of 500- and/or 600-level courses in mechanical and aerospace engineering;
2. Six units of electives selected from approved graduate or 400-level courses from appropriate areas;
3. Completion of six units of MAE 698-Thesis and submission of a written thesis.

PLAN II

Completion of a minimum of 30 units beyond the bachelor's degree in graduate and 400-level courses approved by the student's Department Graduate Advisor, including:

1. Twenty-four units of 500- and/or 600-level courses in mechanical and aerospace engineering;
2. Six units of electives selected from approved graduate or 400-level courses from approved areas;
3. Completion of a comprehensive written exam. (Note: In order to satisfy the culminating activity requirement (thesis, project, or comprehensive examination dependent upon the program), students must earn at least three (3) units and no more than six (6) units related to the completion of the culminating activity.

Advancement to Candidacy

Prior to formally starting their thesis or project (registering for MAE 697 or 698), students must apply for Advancement to Candidacy. Students applying for Advancement to Candidacy must:

1. Have completed ALL undergraduate deficiencies with grades of "C" or better;
2. Have attained an overall grade point average (GPA) of 3.0
3. Have completed at least 12 units applicable to the degree with a GPA of at least 3.0;
4. Have fulfilled the Graduation Writing Assessment Requirement (GWAR). This requirement can also be met by presenting evidence that the student met the requirement while an undergraduate at CSULB or at certain CSU campuses.
5. Have their program of studies approved by the faculty coordinating their area of emphasis, the AE program graduate advisor, and department chair.

Master of Science in Engineering

Admission to the MSE graduate program requires a minimum GPA of 2.7 in the last 60 upper-division units attempted. For requirements, see the description in the College of Engineering section of this catalog.

The Mechanical and Aerospace Engineering Department administers two emphases under the Master of Science in Engineering. The other prerequisites and requirements are the same as for the MSAE and MSME programs.

Management Engineering Emphasis

A special management perspective is required for the successful generation of technical products and services. In order to plan, design, direct and control technical projects, technical managers must be capable of inspiring and developing professional personnel. They must be able to integrate planning, manufacturing and budgetary concerns of the project and be able to easily communicate with general management.

This emphasis primarily admits students with a traditional engineering background. It emphasizes the management of engineering-based endeavors and does not require undergraduate business courses as prerequisites for graduate work. An individualized program is developed according to student's undergraduate degree, area of interest, or industrial application; interdisciplinary approaches are encouraged.

Ph.D. in Engineering and Industrial Applied Mathematics

For requirements, see the description in the College of Engineering section of this catalog.

Courses (MAE)

LOWER DIVISION

101A. Introduction to Aerospace Engineering (1)

Prerequisite: Freshman standing or consent of instructor and MATH 111 or MATH 113 or MATH 122 with a grade of "C" or better.

Role of various types of engineering specialties in the development of an actual aerospace vehicle product. Current social, ethical and environmental issues in Aerospace Engineering solutions. Life-long learning skills using resources from professional societies and Internet are also emphasized.

Letter grade only (A-F). (Lecture-problem 1 hour)

101B. Introduction to Mechanical Engineering (1)

Prerequisite: Freshman standing or consent of instructor and MATH 111 or MATH 113 or MATH 122 with a grade of "C" or better.

Introduction to mechanical engineering as a profession. Past, present, and future trends and related professional opportunities and challenges. Introduction to mechanical engineering curriculum studies. Social, economical, cultural, legal and ethical issues related to mechanical engineering and its applications.

Letter grade only (A-F)

172. Engineering Design Graphics (2)

Engineering design graphics and visualization skills using CAD software. Emphasis on industrial practice involving component and assembly modeling and drawings for actual products. Standards, tolerances, surface finishes, and other attributes of drawings addressed. Projects involving modeling of systems and subsystems.

Letter grade only (A-F). (Lecture-Problems 1 hour, Laboratory 3 hours)

205. Computer Methods in Mechanical and Aerospace Engineering (2)

Prerequisites: MATH 122 with a grade of "C" or better.

Application of computer programming to engineering problem solving. Structured approach to problems. Input-output concepts for both numerical and graphical results.

Letter grade only (A-F). (Lecture-problems 1 hour, laboratory 3 hours)

272. Introduction to Manufacturing Processes (2)

Prerequisite: MAE 172 with a grade of "C" or better.

Manufacturing processes, properties of materials; metals production; foundry, casting, heat treatment; welding, powder metallurgy, plastics, metrology; working metals, press work; machine tool elements, numerical control; metal cutting/turning; drilling, boring, milling; shaping planning, sawing broaching; grinding, sanding; gears, gear-cutting, threads, thread-cutting.

Letter grade only (A-F). (Lecture-problems 1 hour, laboratory 3 hours)

UPPER DIVISION

300. Engineering Instrumentation and Measurement (2)

Prerequisites: MATH 224, PHYS 151, PHYS 152 all with a grade of "C" or better.

Statistical analysis of experimental data, uncertainty analysis, various statistical distributions and test of goodness of fit, correlation coefficient and multivariable regression. Engineering instrumentation include types of passive/active transducers, electronics for instrumentation, computer-based data acquisition, and experiments on pressure, temperature, force measurements.

Letter grade only (A-F). (Lecture-problems 1 hour, Laboratory 3 hours)

305. Numerical Methods in Mechanical and Aerospace Engineering (3)

Prerequisites: MAE 205 and MATH 370A all with a grade of "C" or better.

Roots of linear and nonlinear algebraic equations. Solutions of simultaneous linear algebraic equations. Parametric notation of analytical curves and surfaces. Numerical interpolation and splines. Numerical integration and differentiation. Numerical solution of differential equations, initial-value and boundary-value problems. Individual and/or group projects.

Letter grade only (A-F). (Lecture-problems 3 hours). Same course as MAE 305H. Not open for credit to students with credit in MAE 305H.

305H. Numerical Methods in Mechanical and Aerospace Engineering (3)

Prerequisites: MAE 205 and MATH 370A all with a grade of "C" or better.

Roots of linear and nonlinear algebraic equations. Solutions of simultaneous linear algebraic equations. Parametric notation of analytical curves and surfaces. Numerical interpolation and splines. Numerical integration and differentiation. Numerical solution of differential equations, initial-value and boundary-value problems. Individual and/or group projects.

Letter grade only (A-F). MAE 305H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in MAE 305. (Lecture-problems 3 hours)

322. Engineering Materials and Materials Processes (3)

Prerequisites: CHEM 111A, MATH 123, MAE 172 all with a grade of "C" or better.

Structure and properties of engineering materials. Phase and transformation diagrams. Heat treatments and mechanical processing. Manufacturing methods of metals. alloys, polymers, composites, ceramics, and semiconductors.

Letter grade only (A-F). (Lecture-problems 3 hours)

330. Engineering Thermodynamics I (3)

Prerequisites: MATH 224, PHYS 151 or equivalent, and CHEM 111A all with a grade of "C" or better or consent of instructor.

Laws of thermodynamics. Properties of liquids, gases and vapors. Sources of energy and conversion to work. Introduction to heat transfer and psychrometry.

Letter grade only (A-F). (Lecture-problems 3 hours). Same course as MAE 330H. Not open for credit to students with credit in MAE 330H.

330H. Engineering Thermodynamics I (3)

Prerequisites: MATH 224, PHYS 151 or equivalent, and CHEM 111A all with a grade of "C" or better or consent of instructor.

Laws of thermodynamics. Properties of liquids, gases and vapors. Sources of energy and conversion to work. Introduction to heat transfer and psychrometry.

Letter grade only (A-F). MAE 330H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in MAE 330. (Lecture-problems 3 hours)

333. Engineering Fluid Dynamics (3)

Prerequisites: CE 205, MATH 370A all with a grade of "C" or better.

Fluid statics. Formulation of the conservation of mass, momentum and energy using finite control volume analysis and differential analysis. Dimensional analysis. Viscous flow in pipes.

Letter grade only (A-F). (Lecture-problems 3 hours)

334. Aerodynamics I (3)

Prerequisite: MAE 333 with a grade of "C" or better.

The Bernoulli equation. Incompressible inviscid flow. Flow around circular cylinder, flow around thin airfoils. Panel method. Incompressible flow about wings of finite span. Vortex lattice method.

Letter grade only (A-F). (Lecture-problems 3 hours).

336. Power Plant Design (3)

Prerequisite: MAE 330 with a grade of "C" or better.

Design of power production systems, including steam power plants, gas turbines and auxiliary power units. Survey of alternate power sources including wind, solar, geothermal, ocean thermal and biomass. Group and/or individual design projects.

(Lecture-problems 3 hours) Letter grade only (A-F).

337. Thermal Engineering Laboratory (2)

Prerequisite: MAE 336 with a grade of "C" or better.

Thermodynamics, heat transfer and fluid flow property measurements, measurement of heating value of fuels, energy and performance analysis of thermal systems, including internal combustion engines, power and heat generating systems, refrigeration and air-conditioning systems, and heat exchangers.

(Lecture-problems 1 hour, Laboratory 3 hours) Letter grade only (A-F).

350. Flight Mechanics (3)

Prerequisite: CE 205 with a grade of "C" or better.

Turbojets: level and other flights in the vertical plane, turning flight in the horizontal plane. Piston props: level and other flights in the vertical plane, turning flight in the horizontal plane. Performance analysis and design examples.

(Lecture-problems 3 hours). Letter grade only (A-F).

361. Materials and Properties Laboratory (1)

Prerequisites: ENGL 100 or GE Composition (Area A1), MAE 300, 322, 373 all with a grade of "C" or better.

Study of the effects of thermal processing and mechanical processing on the properties and microstructures of metals, alloys, and other materials. Determination of material properties using tensile test, torsion test, and beam test. Study of the statistical nature and reliability of test results.

(Laboratory 3 hours) Letter grade only (A-F).

365. Aerospace Structures I (3)

Prerequisite: MAE 373 with a grade of "C" or better.

Mechanical behavior of aerospace materials. Torsion of thin walled section beams. Bending and torsion of advanced beams. Analysis of stiffened box beams. Load transfer in stiffened panel structures. Failure criteria of aerospace materials.

(Lecture-problems 3 hours) Letter grade only (A-F).

371. Analytical Mechanics II (Dynamics) (3)

Prerequisites: CE 205, MAE 205 or CE 206 all with a grade of "C" or better.

Newton's Laws and the principles of work and energy and impulse and momentum applied to the study of particle and rigid body motion. Engineering application with emphasis on plane motion problems. Individual and/or group projects involving in-depth numerical analysis.

(Lecture-problems 3 hours) Letter grade only (A-F). Same course as MAE 371H. Not open for credit to students with credit in MAE 371H.

371H. Analytical Mechanics II (Dynamics) (3)

Prerequisites: CE 205, MAE 205 or CE 206 and 206L all with a grade of "C" or better.

Newton's Laws and the principles of work and energy and impulse and momentum applied to the study of particle and rigid body motion. Engineering application with emphasis on plane motion problems. Individual and/or group projects involving in-depth numerical analysis.

Letter grade only (A-F). MAE 371H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in MAE 371. (Lecture-problems 3 hours)

373. Mechanics of Deformable Bodies (3)

Prerequisite: CE 205 with a grade of "C" or better.

Application of the principles of mechanics to the design of structural and machine members and connections; stress analysis of beams and columns. Properties and strength of engineering materials. Design projects.

(Lecture-problems 3 hours) Letter grade only (A-F). Same course as MAE 373H. Not open for credit to students with credit in MAE 373H.

373H. Mechanics of Deformable Bodies (3)

Prerequisite: CE 205 with a grade of "C" or better.

Application of the principles of mechanics to the design of structural and machine members and connections; stress analysis of beams and columns. Properties and strength of engineering materials. Design projects.

Letter grade only (A-F). MAE 373H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in MAE 373. (Lecture-problems 3 hours)

374. Mechanical Properties of Materials Laboratory (1)

Prerequisites: ENGL 100 or equivalent, MAE 373, and MAE 300 all with a grade of "C" or better or consent of instructor

Physical and mechanical properties of engineering materials and their relationship to structural elements; accuracy of measurements; statistical analysis of experimental data; professional laboratory reports.

(Laboratory 3 hours) Letter grade only (A-F).

375. Kinematics and Dynamics of Mechanisms (3)

Prerequisites: MAE 272, MAE 371 all with a grade of "C" or better.

Fundamentals of kinematics and dynamics of mechanisms, including structural and mobility considerations; graphical and analytical methods for linkage synthesis and position, velocity and acceleration analysis; cams and gears; analysis of combined static and dynamic forces in mechanisms.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F).

376. Modeling and Analysis of Dynamic Systems (3)

Prerequisite: MAE 371; MATH 370A all with a grade of "C" or better.

Modeling and analysis of dynamic systems including mechanical, electrical, electro–mechanical, and hydraulic systems. Use of complex algebra and Laplace transforms. Mathematical modeling of dynamic systems in state–space. Linear systems analysis in time and frequency domains. Introduction to feedback control systems.

(Lecture–problems 3 hours) Letter grade only (A-F).

381. Fundamentals of Spacecraft Dynamics (3)

Prerequisites: PHYS 152 or EE 210 and EE 210L, MATH 370A, and MAE 371, all with a grade of "C" or better.

Space environments and their impact on spacecraft design. Space mission engineering. Spacecraft propulsion. Attitude dynamics and kinematics. Controls. Spacecraft attitude determination and control.

(Lecture-problems 3 hours). Letter grade only (A-F).

390. Aerospace Engineering Seminar (1)

Prerequisite: Upper-division standing.

Advanced skills capstone course introducing effective oral and written communication techniques. Speakers from industry present professional practice, social responsibilities, ethical issues and latest developments in aerospace engineering. Student teams write reports and make oral presentations on topics in aerospace engineering.

(Seminar 1 hour) Letter grade only (A-F).

408./508. Systems Engineering and Integration (3)

Prerequisite: Senior standing or consent of instructor.

Introduction to tools and methods employed by systems engineers in aerospace industry. Development of system functions, requirements, verification and validation, and interfaces in the context of integrated product teams and the product life cycle. Trade studies and risk management.

(Lecture-Problems 3 hours) Letter grade only (A-F).

409A. Finite Element Methods I **(3)**

Prerequisites: Senior standing in engineering and consent of instructor.

A. Finite Element Methods I
Finite element methods for beam and truss elements. Systems of ordinary differential equations in a finite element formulation. Static and dynamic analysis of complex structures. Rigid elements in an elastic environment. Solid modeling for 1D, 2D, 3D structures using IDEAS.

B. Introduction to Computational Fluid Dynamics and Heat Transfer
Classification of partial differential equations and boundary conditions, finite difference and finite volume formulations, grid generation, stability analysis, numerical methods for inviscid flows, viscous laminar flows, compressible flows, conduction and convection heat transfer.

May be repeated to a maximum of 6 units with consent of department. (Lecture-problems 3 hours.) Letter grade only (A-F).

422./522. Composite Materials (3)

Prerequisite: MAE 373 with a grade of "C" or better.

Stress-strain relations for anisotropic materials. Classical lamination theory. Strength and failure theories for laminae and laminates. Micromechanics. Applications of composite structures. Additional projects will be required for MAE 522.

(Lecture-problems 3 hours) Letter grade only (A-F).

431. Heat Transfer Systems Design (3)

Prerequisites: MAE 305, MAE 330; CE 335 all with a grade of "C" or better.

Analysis of heat transfer by conduction, convection and radiation. Investigation of steady state and transient heat transfer systems. Computer methods. Individual-group design projects problems in heat transfer such as electronic packaging, heat exchangers, heat engines, refrigerators, and thermal systems analysis.

(Lecture-problems 3 hours) Letter grade only (A-F).

434. Aerodynamics II (3)

Prerequisite: MAE 334 with a grade of "C" or better.

Compressible flows. Subsonic and supersonic flows around airfoils and wings. Two-dimensional, incompressible boundary layers. Introduction to computational fluid dynamics (CFD). Aerodynamic design considerations. Projects are assigned and written reports are required.

(Lecture-problems 3 hours). Letter grade only (A-F).

435./535. Computational Fluid Dynamics I (3)

Prerequisites: MATH 370A, MAE 333 all with a grade of "C" or better.

Numerical methods for elliptic, parabolic, and hyperbolic equations, finite difference and volume methods, analysis of consistency, stability, and convergence, panel method, modeling and computation of boundary layer flows, full potential equation, grid generation, application to inviscid and viscous subsonic, transonic/supersonic flows.

(Lecture-Problems 3 hours) Letter grade only (A-F).

438. Heating, Ventilating, Air Conditioning, and Refrigeration (3)

Prerequisites: MAE 330, CE 335 all with a grade of "C" or better.

Basic HVAC system calculations. Thermodynamics and psychometrics, design conditions and load estimating, residential and non-residential heating and cooling load calculations, energy estimating methods, duct and pipe siding, and life cycle costs.

(Lecture-Problems 3 hours) Letter grade only (A-F).

440. Aerodynamics Laboratory (1)

Prerequisites: MAE 300 and MAE 334 all with a grade of "C" or better.

Experimental techniques in aerodynamics, wind tunnel measurements, use of Pitot tube, hot wire and Laser Doppler Velocimetry systems, flow visualization techniques, calbration of transducers. Computer controlled data acquisition and analysis. Projects are assigned and written reports and oral presentations are required.

Letter grade only (A-F). (Laboratory 3 hours)

451./551. Aircraft Preliminary Design and Performance (3)

Prerequisite: MAE 334, MAE 350 all with a grade of "C" or better, or consent of instructor.

Complete aircraft preliminary design, including mission definition, specifications, and regulations. Preliminary takeoff weight and weight empty for a mission. Aircraft geometric characteristics are developed. Detailed aerodynamic data are estimated and used to calculate aircraft performance. Individual projects required for MAE 551.

The design project is conducted in teams for MAE 451 and individually for MAE 551. (Lecture-Design Project 3 hours) Letter grade only (A-F).

452. Propulsion (3)

Prerequisites: MAE 330 and MAE 334 all with a grade of "C" or better.

Simple gas turbine cycle. Heat exchange and reheat gas turbine cycles. Gas turbine components. Ideal and actual thrust development in gas turbines. Principles of rocket engines. Solid, liquid and hybrid fuel rockets. Thrust and control in rockets.

(Lecture-problems 3 hours) Letter grade only (A-F).

453. Stability and Control of Aerospace Vehicles (3)

Prerequisite: MAE 350 or equivalent all with a grade of "C" or better.
Corequisite: MAE 334.

Physical dependence of airplane stability/control characteristics on airplane configuration and flight condition. Equations for static longitudinal, lateral and directional stability of airplanes. Neutral points, control effectiveness, trim in maneuvering flight. Configuration determinants. Transient modes. Additional Projects for MAE 553.

(Lecture-problems 3 hours) Letter grade only (A-F). Same course as MAE 453H. Not open for credit to students with credit in MAE 453H.

453H. Stability and Control of Aerospace Vehicles (3)

Prerequisite: MAE 350 or equivalent all with a grade of "C" or better.

Corequisite: MAE 334.

Physical dependence of airplane stability/control characteristics on airplane configuration and flight condition. Equations for static longitudinal, lateral and directional stability of airplanes. Neutral points, control effectiveness, trim in maneuvering flight. Configuration determinants. Transient modes.

Letter grade only (A-F). MAE 453H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in MAE 453. (Lecture-problems 3 hours)

454. Avionics Systems (3)

Prerequisite: MAE 453 with a grade of "C" or better.

Avionics systems requirements definition and design. Systems used for guidance and navigation. Components of avionics systems (software, integrated circuits, devices, etc.). Integration of optics and electronics. Testing and certification.

(Lecture-Problems 3 hours) Letter grade only (A-F).

459. Professional Practice Seminar (1)

Prerequisite: Senior standing or consent of instructor.

Professional, social and moral responsibilities of engineers. Examination of ethical and legal issues, including intellectual property rights and regulatory codes and practices. Students are encouraged to participate in professional societies and attend professional seminars. Licensure is emphasized.

(Lecture-Problems 1 hour) Letter grade only (A-F).

465. Aerospace Structures II (3)

Prerequisite: MAE 365 with a grade of "C" or better.

Fracture mechanics. Fatigue failure. Structural stability. Elementary aeroelasticity. Energy principles. Finite element methods of aerospace structural analysis. Application of finite element computer programs. Projects are assigned and written reports are required.

(Lecture-problems 3 hours). Letter grade only (A-F).

471. Design and Analysis of Mechanical Engineering Systems I (3)

Prerequisites: MAE 373 and MAE 375 all with a grade of "C" or better.

First course in a two-course integrative learning capstone design sequence. Topics include: the design process; design and selection of mechanical components; and written/oral communication. Students begin design projects in teams and progress through the preliminary stages of the design process.

(Lecture-problems 2 hours, Laboratory 3 hours) Letter grade only (A-F).

472. Design and Analysis of Mechanical Engineering Systems II (3)

Prerequisites: MAE 330, MAE 471 all with a grade of "C" or better.

Second course in a two-course integrative learning capstone design sequence. Topics include detailed engineering analysis, design decisions, fabrication of prototypes, and written/oral communication. Student teams complete design project started in MAE 471, culminating in a final design solution. Teamwork Required.

(Lecture-problems 2 hours, Laboratory 3 hours). Letter grade only (A-F).

474./574. Computer–Aided Manufacturing (3)

Prerequisites: MAE 322, MAE 490A all with a grade of "C" or better.

Fundamental concepts in automation. High volume discrete parts production systems. Numerical control manufacturing systems. Computer process monitoring. Direct digital control. Group techniques. Flexible manufacturing systems.

Letter grade only (A-F). (Lecture-Problems 2 hours, Laboratory 3 hours)

476. Mechanical Control Systems I (3)

Prerequisite: MAE 376 with a grade of "C" or better.

Feedback control systems in mechanical engineering. Modeling, analysis, and design. System performance and design criteria: stability, transient response, frequency response and compensation, root locus. Introduction to nonlinear control systems, state space analysis and design.

(Lecture-problems 2 hours, laboratory 3 hours) Letter grade only (A-F). Same course as MAE 476H. Not open for credit to students with credit in MAE 476H.

476H. Mechanical Control Systems I (3)

Prerequisite: MAE 376 with a grade of "C" or better.

Feedback control systems in mechanical engineering. Modeling, analysis, and design. System performance and design criteria: stability, transient response, frequency response and compensation, root locus. Introduction to nonlinear control systems, state space analysis and design.

Letter grade only (A-F). MAE 476H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in MAE 476. (Lecture-problems 2 hours, laboratory 3 hours)

478. Aerospace System Design I (3)

Prerequisites: MAE 334, MAE 365, and MAE 381 all with a grade of "C" or better.
Corequisite: MAE 434, MAE 465, or MAE 481.

First course in a two-course integrative learning capstone design sequence. Customer specifications are articulated in a proposal. Student teams define system requirements and work through preliminary design. Extensive design reviews (oral presentations) and written reports required.

Letter grade only (A-F). (Lecture-Design Project 2 hours, Laboratory 3 hours)

479. Aerospace Systems Design II (2)

Prerequisite: MAE 478 with a grade of "C" or better.

Second course in a two-course integrative learning capstone design sequence. Team projects started in MAE 478 are completed. Design for manufacturing. System evaluation verification and validation. Aerospace engineering ethics. Extensive design reviews (oral presentations) and written reports are required.

(Lecture-Design Project 1 hour, Laboratory 3 hours) Letter grade only (A-F).

481. Spacecraft Systems (3)

Prerequisite: MAE 381 with a grade of "C" or better.

Systems engineering approach to spacecraft design. Spacecraft systems engineering and spacecraft and power subsystem. Radiative and conductive heat transfer. Thermal control subsystem. Telecommunications. Command and data handling. Team projects including spacecraft subsystem design are assigned. Written reports and oral presentations are required.

(Lecture-Problems 3 hours) Letter grade only (A-F).

483. Space Flight and Orbital Mechanics (3)

Prerequisites: MAE 381 with a grade of "C" or better.

Two-body problem. Predicting orbital positions. Kepler's equation. Orbital elements. Lambert's problem. Rocket dynamics. Rocket payloads and staging. Impulsive orbital transfer. Interplanetary mission analysis. Projects are assigned and written reports are required.

(Lecture-problems 3 hours). Letter grade only (A-F). Same course as MAE 483H. Not open for credit to students with credit in MAE 483H.

483H. Space Flight and Orbital Mechanics (3)

Prerequisites: MAE 381 with a grade of "C" or better.

Two-body problem. Predicting orbital positions. Kepler's equation. Orbital elements. Lambert's problem. Rocket dynamics. Rocket payloads and staging. Impulsive orbital transfer. Interplanetary mission analysis. Projects are assigned and written reports are required.

Letter grade only (A-F). MAE 483H is open only to students in the Engineering Honors Program. Additional assignments/projects adding depth to the course materials required for Engineering Honors students. Not open for credit to students with credit in MAE 483. (Lecture-problems 3 hours)

490. Selected Topics in Mechanical and Aerospace Engineering (3)

Prerequisites: Senior standing in engineering and consent of instructor.

Selected topics from recent advances in mechanical and aerospace engineering. Content may vary from semester to semester.

May be repeated to a maximum of 6 units with different topics. (Lecture-problems 3 hours) Letter grade only (A-F).

A. CAD/CAM

Prerequisites: MAE 172; MAE 272 or MAE 350; MAE 322 or MAE 365; and MAE 373; upper-division standing or consent of instructor.

Not open for credit to students with credit in ME 405A.

B. Robotics Principles

Prerequisites: MAE 371, MAE 376; upper-division standing or consent of instructor.

Not open for credit to students with credit in ME 405B.

C. Energy and Resource Management (3)

Prerequisites: MAE 330 and MAE 431 all with a grade of "C" or better.

F. Petroleum Engineering

Prerequisites: Senior standing in engineering or science.

G. Mechatronics Systems Design

Prerequisites: (EE 202 and EE 346) or (MAE 300 and MAE 376) all with a grade of "C" or better or consent of instructor.

Same course as EE 442. Not open for credit to students with credit in: EE 442.

491. Special Problems (1-3)

Prerequisite: Senior standing.

Assigned topics in technical literature or laboratory projects and reports on same.

Requires consultation with the respective program's undergraduate advisor and submission of an Agreement for Independent Study form as a contract for the project and submission of a Special Problems Permission form each semester of enrollment. Instructor permission is required. May be repeated to a maximum of 3 units in different semesters. Letter grade only (A-F).

GRADUATE LEVEL

501. Engineering Analysis I (3)

Prerequisite: MATH 370A with a grade of "C" or better.

Differential equations, series solutions of differential equations (special functions), boundary-value problems and characteristic function representation, Laplace transforms, Fourier analysis, partial differential equations, formulating and solving problems in engineering for systems of differential equations and partial differential equations, complex analysis.

(Lecture-problems 3 hours) Letter grade only (A-F).

502. Engineering Analysis II (3)

Prerequisite: MAE 501 with a grade of "C" or better.

Linear algebra, matrix computations, systems of differential equations, eigenvalue problems, iterative solution of systems of algebraic equations, numerical methods for ordinary and partial differential equations, systems of nonlinear equations, optimization.

(Lecture-problems 3 hours) Letter grade only (A-F).

505. Quantitative Methods for Engineering Managers (3)

Prerequisite: MAE 501 or MAE 502 or equivalents all with a grade of "C" or better.

Concepts and methods using quantitative approaches in engineering management decision-making. Computer-based tools used in management decision-making for subjective approaches. Probabilistic methods, forms of linear program model, network analysis, dynamic programming, Monte Carlo simulation and queuing models. Methods formulating problems are emphasized.

(Lecture-problems 3 hours) Letter grade only (A-F).

506. Management of Engineering Technology and Innovation (3)

Prerequisite: Graduate engineering standing.

Analysis of the principles and theory of engineering administrative organizations, information systems, management functions, decision making tools, strategies and administrative policy formulations.

(Lecture-problems 3 hours) Letter grade only (A-F).

507. Engineering Project Management (3)

Prerequisite: Graduate engineering standing.

Theory and philosophies of project management, principles of internal and industrial organization planning and control systems, motion in time study, industrial statistics, industrial research as aid to decision making.

(Lecture-problems 3 hours) Letter grade only (A-F).

508./408. Systems Engineering and Integration (3)

Prerequisite: Senior standing or consent of instructor.

Tools and methods employed by systems engineers in aerospace industry. Development of system functions, requirements, verification and validation, and interfaces in context of integrated product teams and the product life cycle. Trade studies and risk management. Projects assigned, written reports and oral presentations are required.

Additional projects required for MAE 508. (Lecture-Problems 3 hours) Letter grade only (A-F).

512./612. Computer Aided Design in Mechanical Engineering (3)

Prerequisites: MAE 490A, MAE 501, MAE 502. (Master's students register in MAE 512 or MAE 612; Ph.D. students register in MAE 612) all with a grade of "C" or better.

Computer graphics in CAD/CAM. Includes geometrical transformations, viewing in three dimensions, modeling and object hierarchy, represenation of 3D shapes, shading models and imaging databases and data transfer.

(Lecture-problems 3 hours) Letter grade only (A-F).

521. Engineering Metallurgy II (3)

Prerequisite: MAE 322 with a grade of "C" or better.

Properties and uses of structural steels: heat treatable steels; titanium alloys; nickel and cobalt base alloys; refractory metals; ultra high-strength steels; stainless steels; and metal matrix composite materials. Designing for fracture resistance.

(Lecture-Problems 3 hours) Letter grade only (A-F).

522./422. Composite Materials (3)

Prerequisite: MAE 373 with a grade of "C" or better.

Stress-strain relations for anisotropic materials. Classical lamination theory. Strength and failure theories for laminae and laminates. Micromechanics. Applications of composite structures. Additional projects will be required for MAE 522.

(Lecture-problems 3 hours) Letter grade only (A-F).

523. Nanomaterial Properties and Applications (3)

Prerequisite: MAE 322 or equivalent, graduate student standing, or consent of instructor.

Mechanical and material characteristics of hierarchical materials with nanoscale features. Overview of synthesis, characterization techniques and applications of nanomaterials.

Lecture-problems 3 hours. Letter grade only (A-F).

524. Design of Experiments (3)

Prerequisite: MAE 300 or Consent of Instructor

This course aims to develop skills necessary to plan experimental procedures for data collection of physical systems, derive empirical models of the collected data, analyze and validate the developed empirical models, and perform optimization techniques from the empirical models.

Letter grade only (A-F). (Lecture-Problems 3 hours)

527. Metals and Plastics Manufacturing Processes (3)

Prerequisite: MAE 322 with a grade of "C" or better.

Theory of metal forming and plastics processing. Includes metal forging and rolling, metal and plastics extrusion, plastics injection molding, casting. Discussion of appropriate manufacturing methods.

(Lecture-problems 3 hours) Letter grade only (A-F).

528. Advanced Composites Manufacturing (3)

Prerequisite: Graduate standing in ME/AE or consent of instructor.

Characteristics of advanced polymer composites manufacturing processes, their capabilities, and limitations. Curing, repair, green manufacturing, and process modeling of advanced composites. Manufacturing of nanocomposites.

(Lecture-problems 3 hours.) Letter grade only (A-F).

529. Structural Analysis of Composite Laminates (3)

Prerequisite: MAE 522 with a grade of "C" or better or consent of instructor.

Beams, columns and rods of composite materials. Bending, vibration and buckling analysis of composite laminates. Shells of composite materials. Joining of composite material structures.

(Lecture-Problems 3 hours) Letter grade only (A-F).

531. Advanced Heat Transfer (3)

Prerequisites: MAE 431, MAE 501 all with a grade of "C" or better.

Advanced topics in conduction and convection heat transfer, analytical and numerical solutions to multidimensional heat conduction equations in various geometries. Solutions to laminar and turbulent convective heat transfer problems. External and internal flows, free and forced convection, and mass transfer from external surfaces. Applications in thermal systems design.

(Lecture-problems 3 hours) Letter grade only (A-F).

533. Gas Dynamics (3)

Prerequisite: MAE 333 or equivalent all with a grade of "C" or better.

Isentropic flow, normal and oblique shocks, Prandtl-Meyer flow, shock expansion theory, method of characteristics, nozzle flow, flow in ducts with friction and heat transfer, solutions of linearized potential equation with applications, slender body theory, similarity rules, transonic flow, shock wave/boundary layer interactions.

(Lecture-Problems 3 hours) Letter grade only (A-F).

535./435. Computational Fluid Dynamics I (3)

Prerequisites: MATH 370A, MAE 333 all with a grade of "C" or better.

Numerical methods for elliptic, parabolic, and hyperbolic equations, finite difference and finite volume methods, analysis of consistency, stability, and convergence, panel method, modeling and computation of boundary layer flows, etc.

Additional projects will be required for MAE 535. (Lecture-Problems 3 hours) Letter grade only (A-F).

537. Advanced Fluid Dynamics I (3)

Prerequisites: CE 335, MAE 431 all with a grade of "C" or better.

Dynamics of ideal, real and compressible flows, potential flow, vortex flow, the Navier Stokes equations, integral and differential equations for laminar flow, exact solutions for laminar flow, steady and unsteady compressible flows.

(Lecture-problems 3 hours) Letter grade only (A-F).

538. HVAC Systems, Energy Ratings and LEEDS (3)

Prerequisites: MAE 330 and CE 335, with a grade of "C" or better.

Building envelope and environment. HVAC equipment and systems. Lighting, green design and energy rating systems, and LEEDS.

Lecture-Problems 3 hours. Letter grade only (A-F)

551./451. Aircraft Preliminary Design and Performance (3)

Prerequisites: MAE 334, MAE 350 all with a grade of "C" or better, or consent of instructor.

Complete aircraft preliminary design, including mission definition, specifications and regulations. Preliminary takeoff weight and weight empty for a specific mission. Aircraft geometric characteristics are developed. Detailed aerodynamic data are estimated and used to calculate aircraft performance. The design project is conducted in teams for MAE 451 and individually for MAE 551.

(Lecture-Design Project 3 hours) Letter grade only (A-F).

553. Advanced Flight Dynamics and Control (3)

Prerequisites: MAE 502 or equivalent all with a grade of "C" or better.

Introduces the design and analysis of flight control systems. Topics include linear and nonlinear flight dynamics, state space modeling, stability analysis, modern control system design and simulation.

(Lecture-problems 3 hours) Letter grade only (A-F).

561. Fundamentals of Fracture Mechanics (3)

Prerequisite: MAE 373 or consent of instructor

The primary learning objective of the course is to thoroughly understand the basic concepts of linear-elastic fracture mechanics (LEFM) and elastic-plastic fracture mechanics (EPFM) for predicting fracture and crack growth in structural components that contain cracks or crack-like defects.

Letter grade only (A-F). (Lecture-Problems 3 hours)

563. Linear Finite Element Analysis (3)

Prerequisite: MAE 409A with a grade of "C" or better.

Finite element(FE) forms of differential equations. Isoparametric concepts. Dynamic response of damped elastic structures, modal and direct integration analysis. Automatic mesh generation via solid modeling using IDEAS, automatic adaptation to popular software such as: STRUDL, NASTRAN, ANSYS, and ABAQUS. FE fluid flow and heat transfer analysis.

(Lecture-problems 3 hours) Letter grade only (A-F).

567. Advanced Mechanics of Deformable Bodies (3)

Prerequisites: MAE 373, MAE 374, MAE 471 all with a grade of "C" or better or consent of instructor.

Analysis of stress and deflection in unsymmetrical bending, shear center for beams, curved beams. Stress concentration, deformation beyond the elastic limit. Energy method; Castigliano's Theorem; Rayleigh-Ritz technique.

(Lecture-problems 3 hours) Letter grade only (A-F).

568. Creep and Fatigue (3)

Prerequisites: MAE 322, MAE 373 all with a grade of "C" or better, or consent of instructor.

Phenomena of creep and fatigue; effect on stress distribution in structural elements; buckling caused by creep; effects of space environment on fatigue; cumulative fatigue damage at normal and elevated temperatures.

(Lecture-problems 3 hours) Letter grade only (A-F).

572. Structural Design Optimization (3)

Prerequisite: MAE 373 with a grade of "C" or better or consent of instructor.

Structural optimization using calculus of variations. Method of Lagrange multipliers, unconstrained and constrained optimization, fast reanalysis techniques, sequential approximate optimization, sensitivity calculations of structural response, variational sensitivity analysis, approximation techniques, optimal design of laminated composite materials etc.

(Lecture-Problems 3 hours) Letter grade only (A-F).

573. Modern Control of Dynamic Systems (3)

Prerequisite: MAE 476 with a grade of "C" or better.

Advanced topics in analysis and design of modern control systems in mechanical engineering. Topics include state space, Riccati and Liapunov equations, Linear Quadratic Regulator (LQR), Kalman filter, etc. Optimization via calculus of variations, Pontryagin's minimum principle. Control of distributed-parameter systems with applications to structural dynamics.

Letter grade only (A-F). (Lecture-problems 3 hours)

574./474. Computer-Aided Manufacturing (3)

Prerequisites: MAE 322, MAE 490A all with a grade of "C" or better.

Fundamental concepts in automation. High volume discrete parts production systems. Numerical control manufacturing systems. Computer process monitoring. Direct digital control. Group techniques. Flexible manufacturing systems. Additional projects will be required from M.S. students in a wide–range of Engineering applications.

Letter grade only (A-F). (Lecture-Problems 2 hours, Laboratory 3 hours).

575. Robot Modeling and Control (3)

Prerequisites: MAE 371, MATH 370A all with a grade of "C" or better.

Detailed study of rigid body dynamics with emphasis on robot arm analysis. Three–dimensional kinematic analysis. Rotational and homogeneous transformations. Eulerian angles. Denavit Hartenberg representation. Kinematic chains. Recursive formulas. Euler's moment equations and gyrodynamics. Multi–body analysis. Lagrange's equations. Special topics.

(Lecture–problems 3 hours) Letter grade only (A-F).

576. Engineering Vibrations (3)

Prerequisite: MAE 376 with a grade of "C" or better.

Fundamentals of mechanical vibrations, types of oscillatory motions. Single-Degree-of-Freedom (SDOF) and Multiple-Degree-of-Freedom (MDOF) systems. Free and forced vibrations, damping, vibration isolation, vibration measuring instruments, Modal analysis. Lagrange's equations. Introduction to Finite Element Method and modal testing.

(Lecture-problems 3 hours) Letter grade only (A-F).

577. Biomechanics of Human Movement (3)

Prerequisites: MAE 371 and MATH 370A or Consent of Instructor

The course will include a review of experimental techniques used to study human movement, an introduction to advanced modeling, simulation and motion analysis techniques. Projects and demonstrations emphasize applications of mechanics in robotics, sports, orthopedics, and rehabilitation.

Letter grade only (A-F). (Lecture-Problems 3 hours)

578. Haptic Systems for Virtual Reality and Teleoperation (3)

Prerequisites: MAE 501; MAE 376 or MAE 490B and MAE 476 or equivalent all with a grade of "C" or better.

The course introduces haptic systems, which involve virtual and teleoperated environments that are displayed through force and/or tactile feedback. Topics covered include: human haptic sensing and control, design of haptic interfaces, teleoperation, modeling of virtual environments, control and stability issues.

(Lecture-Problems 3 hours) Letter grade only (A-F).

581. Space Vehicle Design (3)

Prerequisite: Graduate engineering standing or consent of instructor.

Space environments and their impact on spacecraft design. Space mission design. Payloads and communications. Integration of attitude determination and control, thermal, propulsion, configuration, telemetry, power, structures, and data handling subsystems.

(Lecture-Problems 3 hours) Letter grade only (A-F).

582. Rocket and Spacecraft Propulsion (3)

Prerequisite: Graduate engineering standing or consent of instructor.

Thrust and specific impulse. Compressible flows. Detailed analysis of liquid, solid and hybrid propulsion systems. Includes propellants, injection systems, combustion and chemical equilibrium, thrust chambers, nozzles and plumes. Electro-thermal thrusters. Plasmas and electromagnetic thrusters.

(Lecture-Problems 3 hours) Letter grade only (A-F).

583. Astrodynamics (3)

Prerequisite: MAE 502 or equivalent all with a grade of "C" or better, or consent of instructor.

Physical principles. Two-body and central force motion. Coordinate and time systems. Trajectory correction maneuvers. Position and velocity in conic orbits. Lambert's Problem. Celestial mechanics. Orbital perturbations. Numerical methods in orbital mechanics and mission analysis.

(Lecture-problems 3 hours) Letter grade only (A-F).

585. Spacecraft Attitude Determination and Control (3)

Prerequisite: MAE 501 or equivalent all with a grade of "C" or better, or consent of instructor.

Control systems. Spacecraft attitude dynamics and control. Stabilization methods and maneuvers. Impact of flexible structures.

(Lecture-Problems 3 hours) Letter grading only (A-F).

590. Selected Topics in Mechanical and Aerospace Engineering (1-3)

Prerequisites: MAE 501, MAE 502 all with a grade of "C" or better, and other prerequisites as related to the topics offered, or consent of instructor.

Selected topics from recent advances in mechanical or aerospace engineering.

Letter grade only (A-F). May be repeated to a maximum of 6 units with different topics in different semesters. Topics announced in the *Schedule of Classes*. (Lecture-problems 3 hours).

612./512. Computer Aided Design in Mechanical Engineering (3)

Prerequisites: MAE 490A, MAE 501, MAE 502. (Master's students register in MAE 512 or MAE 612; Ph.D. students register in MAE 612) all with a grade of "C" or better.

Computer graphics in CAD/CAM. Includes geometrical transformations, viewing in three dimensions, modeling and object hierarchy, represenation of 3D shapes, shading models and imaging databases and data transfer. Additional projects required for MAE 612.

(Lecture-problems 3 hours) Letter grade only (A-F).

631. Thermal Radiation (3)

Prerequisite: Consent of instructor.

Fundamentals of thermal radiation, properties of matter, radiative exchange in enclosures, equation of transfer for radiative transfer in absorbing, emitting, scattering media, gas radiation, and solutions for gas flows.

(Lecture-problems 3 hours) Letter grade only (A-F).

633. Hypersonic Flow (3)

Prerequisite: MAE 533 with a grade of "C" or better.

Hypersonic shock and expansion-wave relations, similarity concepts, Newtonian theory and modified Newtonian theory, nonlinear small-disturbance theory, blunt body flows, hypersonic viscous/inviscid interactions, aerodynamic heating, real gas effects, waveriders, atmospheric reentry.

(Lecture-Problems 3 hours) Letter grade only (A-F).

635./735. Computational Fluid Dynamics II (3)

Prerequisite: MAE 535 with a grade of "C" or better.

Computational methods for solving Euler and Navier-Stokes equations, implicit and explicit schemes, upwind differencing and artificial diffusion, multi-grid techniques and convergence acceleration, unstructured grid techniques, turbulence modeling, application to inviscid and viscous subsonic, transonic, and supersonic flows, inverse problems and aerodynamic shape optimization.

(Lecture-Problems 3 hours) Letter grade only (A-F).

637. Advanced Fluid Dynamics II (3)

Prerequisites: MAE 431, MAE 501, MAE 537 all with a grade of "C" or better.

Transition to turbulent flow, wall bounded and free turbulent shear flows, numerical methods for turbulent flow, turbulence modeling.

(Lecture-problems 3 hours) Letter grade only (A-F).

663./763. Nonlinear Optimized Structures (3)

Prerequisite: MAE 563, or consent of instructor. (Master's students register in MAE 663, Ph.D. students register in MAE 763) all with a grade of "C" or better.

Analysis, optimization of frame with automatic mesh generation using I-DEAS, with popular software such as: STRUDL, NASTRAN etc. Generation, idealization of complex structures. Sensitivity, Buckling analysis etc. Required topics for Ph.D. students: advanced numerical methods for flutter and random analysis.

(Lecture-problems 3 hours) Letter grade only (A-F).

669. Design of Composite Structures (3)

Prerequisite: MAE 522 all with a grade of "C" or better or consent of instructor.

Design concepts and guidelines of composite structures. Strength and stiffness design of composite laminates. Optimum design. Fatigue and creep of composite structures. Design of bolted and bonded joints.

(Lecture-Problems 3 hours) Letter grade only (A-F).

672. Stress Analysis in Design (3)

Prerequisite: MAE 567 with a grade of "C" or better or consent of instructor.

Modes of failure and failure criteria. Stability of mechanical models, elastic bars and frames by kinetic and energy approaches; design of columns, beam columns and framed columns. Plastic collapse and limit analysis. Experimental methods of stress analysis.

(Lecture-problems 3 hours) Letter grade only (A-F).

673. Theory of Elasticity and Plasticity (3)

Prerequisite: MAE 567 with a grade of "C" or better.

Equations of the mechanics of elastic bodies. Plane problem. Bending, torsion, and extension of Prismatic Bodies. Three-dimensional problem. Propagation of waves in elastic media. Approximate methods. Theory of plasticity.

(Lecture-problems 3 hours) Letter grade only (A-F).

678. Robust Control (3)

Prerequisites: MAE 476 (or an equivalent undergraduate course in classical control systems and state-space design methods), MAE 502 (or an equivalent course in linear algebra and matrix theory) all with a grade of "C" or better. Experience in basic programming and MATLAB are highly recommended.

Introduces robust analysis and design for multivariable feedback control systems with uncertain dynamics or unknown parameters. Topics include: uncertainty modeling; robust stability; robust performance; mu synthesis; H infinity control; and applications of linear matrix inequalities.

Letter grade only (A-F). (Lecture-Problems 3 hours)

690. Selected Topics in Mechanical and Aerospace Engineering (1-3)

Prerequisites: MAE 501, MAE 502 all with a grade of "C" or better, and other prerequisites as related to the topics offered, or consent of instructor.

Selected topics from recent advances in mechanical or aerospace engineering.

Letter grade only (A-F). May be repeated to a maximum of 6 units with different topics in different semesters. Topics announced in the *Schedule of Classes*. (Lecture-problems 3 hours).

691. Directed Studies (1-3)

Prerequisite: Graduate Standing in a Mechanical and Aerospace Engineering graduate program.

The study of information in the engineering and scientific literature on a current topic in mechanical or aerospace engineering under the direction of a faculty member. Submission of a final written report based on the literature surveyed.

Requires consultation with the respective program's graduate advisor and submission of an Agreement for Independent Study form as a contract for the project and submission of a Directed Studies permission form each semester of enrollment. Instructor permission is required. May be repeated to a maximum of 3 units in different semesters. Letter grade only (A-F).

697. Directed Research (1-3)

Prerequisite: Graduate standing. Advancement to Candidacy strongly recommended.

Theoretical and experimental problems in MAE requiring extensive research and analysis. MAE 697 permission form required in each semester of enrollment. Agreement for Independent Study form required once per project topic.

May be repeated to a maximum of 3 units in different semesters. Not open for credit to students enrolled in MAE 698. Letter grade only (A-F).

698. Thesis (1-6)

Prerequisites: Graduate standing in a Mechanical and Aerospace Engineering graduate program and Advancement to Candidacy for the degree.

Planning, preparation, and completion of a thesis on a suitable topic in mechanical and aerospace engineering, following the library's prescribed format. The graduate advisor for the respective program and the thesis supervisor must be consulted prior to registration.

Submission of an Agreement for Independent Study form as a contract for the project and submission of a Thesis permission form are required for each semester of enrollment. Instructor permission is required. May be repeated to a maximum of 6 units in different semesters. Not open for credit to students who are enrolled in MAE 697. Letter grade only (A-F).

735./635. Computational Fluid Dynamics II (3)

Prerequisite: MAE 535 with a grade of "C" or better.

Methods for solving Euler and Navier-Stokes equations, implicit and explicit schemes, upwind differencing and artificial diffusion, multi-grid techniques and convergence acceleration, unstructured grid techniques, turbulence modeling, application to inviscid and viscous subsonic, transonic, and supersonic flows,etc.

Additional projects required for MAE 735.(Lecture-Problems 3 hours) Letter grade only (A-F).

763./663. Nonlinear Optimized Structures (3)

Prerequisite: MAE 563, or consent of instructor. (Master's students register in MAE 663, Ph.D. students register in MAE 763) all with a grade of "C" or better

Analysis, optimization of frame with automatic mesh generation using I-DEAS, with popular software such as: STRUDL, NASTRAN etc. Generation, idealization of complex structures. Sensitivity, Buckling analysis etc. Required topics for Ph.D. students: advanced numerical methods for flutter and random analysis.

(Lecture-problems 3 hours) Letter grade only (A-F).

795. Advanced Directed Studies (4)

Prerequisites: Master of Science degree or equivalent and formally admitted to the Ph.D. program in Engineering and Industrial Applied Mathematics.

Exploration of theoretical and experimental (if applicable) engineering problems in great depth with an emphasis on mathematical modeling and analysis. Students must present the findings in a formal report. Consultation with the respective program's graduate advisor and permission of faculty supervisor are required.

Submission of an Agreement for Independent Study form as a contract for the project and an Advanced Directed Studies permission form are required each semester of enrollment. May be repeated to a maximum of 8 units in different semesters. Letter grade only (A-F).

797. Advanced Directed Research (4)

Prerequisites: Master of Science degree or equivalent and formally admitted to the Ph.D. program in Engineering and Industrial Applied Mathematics. Exploration of theoretical and experimental (if applicable) engineering problems in great depth, with emphasis on mathematical modeling and analysis. Students must present the findings in a formal report and a seminar. Consultation with the respective program's graduate advisor and permission of faculty supervisor are required.

Submission of an Agreement for Independent Study form as a contract for the project and an Advanced Directed Research permission form are required each semester of enrollment. May be repeated to a maximum of 8 units in different semesters. Letter grade only (A-F).

798. Doctoral Dissertation (4-12)

Prerequisite: Enrollment is limited to students formally admitted to the Ph.D. program in Engineering and Industrial Applied Mathematics who have passed the preliminary examinations and research tool tests on completion of at least 48 units of course work. A written dissertation proposal containing an outline of the research to be undertaken must be submitted with references to relevant source material. Consultation with the respective program's graduate advisor and permission of faculty supervisor are required. Student may only embark upon the doctoral dissertation after having received a positive recommendation.

Submission of an Agreement for Independent Study form as a contract for the project and an Advanced Directed Research permission form are required each semester of enrollment. Students must enroll in a minimum of 4 units per semester. May be repeated to a maximum of 12 units in different semesters. Letter grade only (A-F).