

ENGINEERING, COLLEGE OF

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Electrical Engineering: Anastassios Chassiakos, Chair
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Mechanical and Aerospace Engineering: Jalal Torabzadeh,
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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 integration 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 GEAR. Students who have failed the WPE at least once can take the course and submit a portfolio at the end for GEAR 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 B1b.

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 GEAR Placement Examination or successfully completed the necessary portfolio course that is a prerequisite for a GEAR 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).