Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700, which accredits U.S. engineering programs. The engineering curricula are based on a thorough foundation in communication skills, humanities, mathematics, and natural and engineering sciences.

High School Preparation For an Engineering Degree

In addition to the mathematics, English, and science courses required for admission to the university, high school students should consider taking introductory courses in computing and pre-calculus. If these high school courses are not completed, additional time may be required to complete an engineering degree.

EIT/FE Examination

Senior engineering students are encouraged to take the Engineer-In-Training (Fundamentals of Engineering) exam which is the first of two exams required to become a licensed professional engineer by the California State Board of Registration.

Student Organizations

Several professional societies have student chapters on campus that help students by offering tutoring and peer advising. Student organizations conduct meetings with professional engineers, sponsor social events, and organize teams to compete at regional competitions with other universities. The American Society of Civil Engineers, the Structural Engineers Association of California, the Institute of Transportation Engineers, the Society of Plastics Engineers, the Association for Computing Engineers, the Institute of Electrical and Electronics Engineers, the American Society of Mechanical Engineers, the Society of Manufacturing Engineers, the Structural Engineers Association, the National Society of Black Engineers, and the Society of Women Engineers have active chapters. The national honor societies Tau Beta Pi andEta Kappa Nu are also available to qualified students.

MESA Engineering Programs (MEP)

The Mathematics • Engineering • Science Achievement (MESA) Engineering Programs, known collectively as MEP, are a comprehensive recruitment, retention, and graduation effort which assists underrepresented and disadvantaged students pursuing degrees in engineering and computer science. The program offers tutoring, advising, and counseling, and includes a study center and an MEP Theme House on campus. Please visit or call us.

Career Outlook

Opportunities for civil engineers will expand due to the need to maintain and enhance the nation’s infrastructure of transportation, water resources, structural, and environmental systems.

Computer engineers are some of the most highly recruited graduates on the campus. Recent surveys indicate that the demand for engineers with hardware and software design experience will continue to increase in both private and government sectors.

Electrical/electronics engineers are in high demand by industry and government. This demand is predicted to continue as electronic equipment and embedded systems becomes more vital to business, industry, and the home.

Mechatronic engineers are expected to be in high demand as the number of “intelligent” products on the market increases. The need for graduates who can design products with “embedded” intelligence and control is growing rapidly as microprocessors are integral to virtually every new consumer product.

Highlighted text indicates a change from the original publication.
High School Preparation For an Engineering Degree
High school graduates planning to study Engineering should complete three years of high school mathematics, including geometry, algebra, and trigonometry. In addition, courses in biology, English, computers, physics, chemistry, and mechanical drawing should be taken to assist the student in moving smoothly into an Engineering program. If these high school courses are not completed, additional time may be required to complete the requirements for an Engineering degree.

CIVIL ENGINEERING

Civil engineering graduates qualify for graduate school or professional work in a broad spectrum of engineering activities. The program is well balanced, stressing environmental engineering; engineering mechanics; soil mechanics and foundations; structural analysis and design; surveying and mapping; transportation and traffic engineering; water resources and hydraulics; and construction engineering and management, city planning, and administration.

Civil Engineering Program Mission

The civil engineering program has two comprehensive objectives: to prepare graduates for immediate entry into a variety of professional careers and to provide a solid undergraduate foundation in general principles enabling continued education at advanced levels.

Civil Engineering Educational Objectives

The CSU, Chico Civil Engineering program educational objectives are best framed in terms of the following goals for its graduates:
1. Civil Engineering graduates will be prepared to be effective engineers and problem solvers.
2. They will be well educated in engineering sciences and proficient in at least four recognized civil engineering areas.
3. They will be able to effectively use engineering technology that will enhance their productivity.
4. They will be familiar with applicable regulatory and professional issues.
5. They will be effective written, technical, and oral communicators, and be able to function effectively as members of multi-disciplinary teams.
6. They will have an appreciation for the individual, society, good citizenship, community service, ethical conduct, and human heritage, and they will be aware of the impact of their designs on humankind and the environment.

Civil Engineering Design Experience

The civil engineering program is a traditional balance of engineering science and design. The design sequence follows a logical and progressive path culminating during the senior year with advanced civil engineering design experience in environmental (C E 288), structural (C E 255), and transportation and traffic engineering and design (C E 270). Students progress to these advanced design classes after completion of the foundation courses in mathematics and basic science during the first three years of study. Also, during the first three years of the program there is a comprehensive group of engineering courses on surveying and mapping, engineering computer applications, engineering mechanics, fluid mechanics and hydraulics, structural mechanics, soil mechanics and foundations, thermodynamics and electrical circuits which provide depth of knowledge in the engineering sciences and introduce concepts of basic to mid-level engineering design. During the senior year, there is a group of classes—C E 119 Contracts, Specifications and Technical Report Writing, C E 121 Engineering Economy and Statistics, and ENGR 195 Lifelong Development—which address issues of ethics and professionalism that are essential components of the design projects required in the advanced design classes.

Civil engineering students are initially introduced to CE design concepts during their first year of study in C E 011. This class introduces students to design basics, process and creativity with little or no emphasis from engineering science. Subsequent classes build on the design experience, culminating in the senior design courses. The table below follows the progression of courses including elements of engineering science and design which qualifies students to take the advanced design classes in environmental, structural and transportation engineering.

1. Introduction to civil engineering design: C E 011*
3. Breadth subjects: C E 119*, C E 121, and ENGR 195* *Indicates classes with some design.

THE BACHELOR OF SCIENCE IN CIVIL ENGINEERING

Total Course Requirements for the Bachelor’s Degree: 132 units

See “Requirements for the Bachelor’s Degree” in The University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

The department has prepared a suggested Four Year Advising Plan to help students meet all graduation requirements within four years. Please request a plan from your major adviser or view it and other current advising information on the CSU, Chico Web.

General Education Requirements: 48 units

Civil engineering major requirements have modifications to the university’s General Education Requirements. The following courses, together with the approved General Education courses required for the civil engineering major, fulfill the General Education Requirement:
1. Select one course from each of the following Breadth areas: A1, A2, A3, B1, B2, B3, C1, C2, C3, D1, D2, D3, and E.
2. Select two courses from the same Upper-Division Theme. Consult with an adviser to determine which two courses in the selected theme meet the Upper-Division Theme Requirement for civil engineering majors.

Accreditation Requirement

Courses must be selected in such a manner as to satisfy the humanities, social science, mathematics, base science, and engineering topics requirements of the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700. Consult your academic adviser for additional information.

Cultural Diversity Course Requirements: 6 units

See “Cultural Diversity” in The University Catalog. Most courses used to satisfy these requirements may also apply to General Education.

American Institutions Requirement: 6 units

See the “American Institutions Requirement” under “Bachelor’s Degree Requirements.” For this major, this requirement is normally fulfilled by completing HIST 050 and POLS 055. For this major, HIST 050 may also be applied to General Education Breadth Area C1, C2, or C3, and POLS 055 may also be applied to General Education Breadth Area D1, D2, or D3.

Literacy Requirement:

See “Mathematics and Writing Requirements” in The University Catalog. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfactory completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn a C- are required to repeat the course and earn a C- or better to receive WP credit. See The Class Schedule for the designated WP courses for each semester. You must pass ENGL 001 (or its equivalent) with a C- or better before you may register for a WP course.

Course Requirements for the Major: 107-109 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree.

Lower-Division Requirements: 53-55 units

14 courses required:

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<tr>
<th>Course</th>
<th>Units</th>
<th>Requirements</th>
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<tbody>
<tr>
<td>C E 010</td>
<td>3.0</td>
<td>Surveying</td>
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<tr>
<td>C E 011</td>
<td>3.0</td>
<td>Intro to Civil Engineering Design</td>
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<tr>
<td>C E 020</td>
<td>2.0</td>
<td>Computer Applications in Engr</td>
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<td>C E 035</td>
<td>3.0</td>
<td>Statics</td>
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<td>M E 025</td>
<td>4.0</td>
<td>MATH 004A, MATH 007C (may be taken concurrently)</td>
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<tr>
<td>M E 025</td>
<td>4.0</td>
<td>MATH 004A, MATH 007C (may be taken concurrently)</td>
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Highlighted text indicates a change from the original publication.
C E 020 Materials Engineering 4.0 FS
Prerequisites: CHEM 037, PHYS 004A.

PHYS 004A Mechanics 4.0 FS *
Prerequisites: High school physics or faculty permission. Concurrent enrollment in or prior completion of MATH 007B (second semester of calculus) or equivalent.

PHYS 004B Electricity and Magnetism 4.0 FS
Prerequisites: MATH 007B, PHYS 004A.

1 course selected from:
MATH 007C Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007B with a grade of C- or higher.

MATHT 010 Intro to Probability/Statistics 3.0 FA
Prerequisites: MATH 007B.

MATH 135 Elementary Linear Algebra 3.0 FS
Prerequisites: MATH 007B.

1 course selected from:
BIOL 001 Concepts of Biology 3.0 FS *
BIOL 008 Principles of Biology 3.0 FS *
Prerequisites: High school biology and chemistry.

1 course selected from:
CHEM 038 General Chemistry 4.0 FS
Prerequisites: CHEM 037.

GEOS 002 Physical Geology 3.0 FS *
Prerequisites: High school chemistry or physics is recommended; students with no previous science courses are advised to enroll in GEOS 001. No college credit for those who have passed GEOS 001.

PHYS 004C Heat/Wave Motion/Sound/Light 4.0 FS
Prerequisites: MATH 007B, PHYS 004A.

Upper-Division Requirements: 54 units
13 courses required:
C E 101 Strength of Materials 4.0 FS
Prerequisites: C E 035, MATH 007C. Recommended: M E 045.

C E 102 Materials Testing Laboratory 1.0 FS
Prerequisites: C E 020, C E 101.

C E 119 Contracts/Specs/Tech Reports 4.0 FS
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher; junior standing (completion of 60 college units).

C E 121 Engineering Economy & Statistics 3.0 FS
Prerequisites: Either C E 020 or CS CI 065 or ECE 090 or M E 038; CMST 011 (may be taken concurrently); junior standing (completion of 60 college units).

C E 150 Fluid Mechanics 4.0 FS
Prerequisites: C E 035, MATH 007C; either C E 020 or ECE 090 or M E 038 (may be taken concurrently). Recommended: M E 135 (may be taken concurrently).

C E 153 Structural Mechanics 4.0 FS

C E 250 Soil Mechanics and Foundations 4.0 SP
Prerequisites: C E 020; C E 102 (may be taken concurrently); C E 150; ENGL 001.

C E 255 Reinforced Concrete Design 4.0 FA
Prerequisites: C E 022; C E 153; C E 250.

C E 270 Transportation Engineering 4.0 FA
Prerequisites: C E 011; C E 102; C E 121 (may be taken concurrently); C E 250.

C E 288 Environmental Engineering I 4.0 SP
Prerequisites: CHEM 037; C E 150.

ENGR 195 Lifelong Development Engineers 3.0 FS
Prerequisites: ENGL 001; graduation in engineering expected within 12 months.

M E 135 Dynamics 3.0 FS
Prerequisites: C E 035, MATH 007D (may be taken concurrently).

M E 152 Thermodynamics 3.0 FS
Prerequisites: PHYS 004A. Recommended: PHYS 004C.

C E 121 and ENGR 195 are approved General Education Courses for the Civil Engineering major.

6 units selected from:
Any 200-level Engineering courses (C E, ECE, or M E).

3 units selected from:
Other technical courses to be chosen from a list approved by the department.

Patterns of Specialization:
CONSTRUCTION, ENVIRONMENTAL, STRUCTURAL, TRANSPORTATION, and WATER RESOURCE ENGINEERING patterns are available to civil engineering students who choose to select the four major electives from a restricted group of classes which emphasize study in the selected pattern. Graduates who satisfy an elective pattern will receive Civil Engineering Department recognition for the specialty area of their degree. Additional information is available from the CE office or faculty adviser.

Grading Requirement:
All courses taken to fulfill major course requirements must be taken for a letter grade, except those courses specified by the department as Credit/No Credit grading only.

All students must attain a 2.0 Grade Point Average (GPA) in all college courses attempted and for all courses attempted at Chico. Civil Engineering majors must also attain a 2.0 GPA in:
(a) All courses required for the major, and
(b) All Civil Engineering (C E) courses taken at CSU, Chico to meet major requirements.

By policy, a student receiving a grade of D+ or lower in C E 035, C E 101, or C E 150 (or their transfer equivalents) may not progress in the Civil Engineering program until the course is repeated with a grade of C- or higher. The student may petition the Department of Civil Engineering to review the application of the policy in his/her situation if serious and compelling conditions contributed to the poor grade.

Advising Requirement:
Advising is mandatory for all majors in this degree program. Consult your undergraduate adviser for specific information.

A sample program for students who wish to complete their major in four years is available upon written request to the department, CSU, Chico, CA 95929-0930.

Honors in the Major
Honors in the Major is a program of independent work in your major. It involves 6 units of honors course work over two semesters.

Your Honors work will be recognized at your graduation, on your permanent transcripts, and on your diploma. It is often accompanied by letters of commendation from your mentor in the department or the department chair. Most importantly, however, the Honors in the Major program allows you to work closely with a faculty mentor in your area of interest on an original performance or research project. This year-long collaboration allows you to work in your field at a professional level and culminates in a public presentation of your work. Students sometimes take their projects beyond the university for submission in professional journals, presentation at conferences, or completion in a thesis. Such experience is valuable for graduate school and later professional life.

Some common features of Honors in the Major are:
1. You must take 6 units of Honors in the Major course work. You must complete the 6 units with a minimum grade of B.
2. You must have completed 9 units of upper-division course work or 21 units overall in your major before you can be admitted to Honors in the Major. Check the requirements carefully, as there may be specific courses that must be included in these units.
3. Your cumulative GPA should be at least 3.5 or within the top 5 percent of majors in your department.
4. Your GPA in your major should be at least 3.5 or within the top 5 percent of majors in your department.
5. Most students apply for or are invited to participate in Honors in the Major during the second semester of their junior year. Then they complete the 6 units of course work over the two semesters of their senior year.
6. Your honors work culminates with a public presentation of your Honors project.

While Honors in the Major is part of the Honors Program, each department administers its own program. Please contact your department chair to apply.

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Honors in Civil Engineering
The common elements of the Honors in the Major program listed above apply to Honors in Civil Engineering. Specific information for this program includes:
1. In addition to meeting the GPA requirements, you must be recommended by a faculty member.
2. Students who are admitted into the department’s Honors in the Major program may elect to take any two upper-division civil engineering electives eligible for honors credit. The honors section will be identified on your transcript. The courses are usually spread over two semesters. You must complete them with a minimum grade of B and maintain a minimum GPA of 3.0 overall.
3. Each Honors in the Major class will require completion of the course plus an additional honors project and culminates with a public presentation of your honors project.

The Faculty
Civil Engineering
Joel F. Arthur, 1986, Professor, PE, PhD, UC Davis.
Kenneth N. Derucher, 1994, Dean, Administrator, PE, PhD, VA Tech.
Tonya Emerson, 2001, Assist Professor, PE, PhD, UC Davis.
Thomas C. Ferrara, 1971, Professor Emeritus, PE, PhD, UC Davis.
A. Reed Gibby, 1984, Professor Emeritus, PE, PhD, UC Davis.
Kenneth V. R. Henkel, 1979, Professor, PE, PhD, U WI.
Elliott B. Johnson, 1956, Professor Emeritus, MSCE, Iowa St U.
Russell S. Mills, 1982, Professor, PE, PhD, Stanford U.
Maurice Mow, 1978, Chair, Professor, PE, PhD, Rensselaer.
Charles C. Mueller, 1973, Professor Emeritus, PE, PhD, Mich St U.
Stewart M. Oakley, 1986, Professor, PhD, Oregon State Univ.
John D. Teasdale, 1966, Professor Emeritus, PE, MS, U Iowa.
Gary Z. Walters, 1980, Professor Emeritus, PE, PhD, Stanford U.
PE designates Registered Professional Engineer
LS designates Licensed Land Surveyor

Civil Engineering Course Offerings
Please see the section on “Course Description Symbols and Terms” in The University Catalog for an explanation of course description terminology and symbols, the course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web.

C E 010 Surveying 3.0 Fall
Theory and practice in measurement and computation of distances, angles, and areas on the earth’s surface. Equipment and surveying techniques. Use of scientific calculators required. 2.0 hours discussion, 3.0 hours laboratory. Formerly C E 001A.

C E 011 Introduction to Civil Engineering Design 3.0 Spring
Provides an introduction to civil engineering facilities and systems (environmental, structural, transportation and water resources), environmental impacts of those systems, historical development of design, introduction to design concepts and procedures, examples of the design of civil engineering systems, creativity in design, and applications in civil engineering design, horizontal curves, vertical curves, earthwork, state plane coordinates, geographic information systems and global positioning systems.

C E 020 Computer Applications in Engineering 2.0 Spring
Use of the computer in a variety of applications from the fields of engineering. Topics include computer hardware, operating systems, the Internet, technical word processing, spreadsheets, computer charting and drawing, computer programming, CAD, and ethics.

C E 035 Statics 3.0 Fa/Spr
Prerequisites: M E 025, PHYS 004A; MATH 007C (may be taken concurrently).
Force systems, moments, equilibrium, centroids, and moments of inertia. Not open to students who have completed M E 192. 2.0 hours discussion, 2.0 hours activity. CMST 011.

C E 101 Strength of Materials 4.0 Fa/Spr
Prerequisites: C E 035, MATH 007C. Recommended: M E 045.
Strength and elastic properties of materials of construction; tension, compression, shear, and torsion stresses; deflection and deformation; stress analysis of beams and columns.

C E 102 Materials Testing Laboratory 1.0 Fa/Spr
Methods and instruments used in the determination of the strength and elastic properties of materials of engineering. Experiments verifying the theoretical principles of C E 101. 3.0 hours laboratory.

C E 119 Contracts, Specifications, and Technical Reports 4.0 Fa/Spr
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher; junior standing (completion of 60 college units). Introduction to law as it relates to the practice of civil engineering. Operation of a successful civil engineering business. Writing various technical reports and specifications. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors.

C E 121 Engineering Economy and Statistics 3.0 Fa/Spr
Prerequisites: Either C E 020 or CSC 065 or ECE 090 or M E 038 (may be taken concurrently); junior standing (completion of 60 college units). Analysis of alternatives by basic engineering economic methods and applications of statistics including probability, sampling theory and data analysis, and tests of hypotheses.

C E 150 Fluid Mechanics 4.0 Fa/Spr
Prerequisites: C E 035, MATH 007C; either C E 020 or ECE 090 or M E 038 (may be taken concurrently). Recommended: M E 135 (may be taken concurrently). Hydrostatics, principles of continuity, work-energy and momentum, viscous effects, dimensional analysis and similarity, flow in closed conduits, drag on objects. 3.0 hours discussion, 3.0 hours laboratory.

C E 153 Structural Mechanics 4.0 Fa/Spr
Prerequisites: C E 035, MATH 007C, MATH 007E; either C E 020 or ECE 090 or M E 038 (may be taken concurrently). Fundamentals of structural analysis for beams, trusses, and frames. Topics include influence lines, approximate analysis methods, deflection analysis, and statically indeterminate structures. Methods applicable to computer analysis are introduced.

C E 178 Ethics, Technology, and Society 3.0 Fa/Spr
Prerequisites: PHIL 108 and General Education Areas B1 and D3. A scholarly treatment of the technological impacts on developed and less developed societies in an ethical context. Assessment techniques will be introduced and applied. Historical, current, emerging, and future technologies (communication, transportation, agriculture, cloning, robotics, etc.) to be assessed. (This course cannot be taken as an engineering elective.) This is an approved General Education course.

C E 198 Special Topics 1.0-3.0 Fa/Spr
This course is for special topics offered as 198A-C for 1.0 to 3.0 units respectively. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered. Credit/no credit grading only.

C E 199 Special Problems 1.0-3.0 Fa/Spr
This course is an independent study of special problems and is offered as 199A-C for 1.0 to 3.0 units respectively. You must register directly with a supervising faculty member. Credit/no credit grading only.

C E 210 Alternative Housing Seminar 1.0 Inquire
C E 101 Seminar investigates alternative low-cost single-family dwellings, to include site considerations, loads, building codes, building types, and miscellaneous features. Credit/no credit grading only.

C E 220 Advanced Surveying 3.0 Inquire
Prerequisites: C E 011 or faculty permission.
Laws, practices, and historical background on land surveying. Includes property surveys and legal descriptions. Use of personal computers required. 2.0 hours discussion, 3.0 hours laboratory.

C E 231 Construction Management I 3.0 Inquire
Prerequisites: Junior standing in engineering; C E 020; concurrent enrollment in or prior completion of two of the following courses: C E 101, C E 150, or M E 135. Introduction to construction engineering and management. Cost estimation for both contract construction and engineering, including labor, material, equipment, and overhead costs. Planning, scheduling, and progress control of construction operations. One or two 3-hour field trips required.

C E 232 Construction Management II 3.0 Inquire
Prerequisites: Junior standing in engineering; C E 020; C E 121; concurrent enrollment in or prior completion of two of the following courses: C E 101, C E 150, or M E 135. Construction procedures, equipment and methods; efficient use of excavation and hauling equipment operations. Application of crew balance, process chart and operations research techniques to construction operations. Quality control and inspection technique for construction safety. One or two 3-hour field trips required. 2.0 hours discussion, 2.0 hours activity.
C E 250 Soil Mechanics and Foundations 4.0 Spring
Prerequisites: C E 020; C E 102 (may be taken concurrently); C E 150; ENGR 001.
Soil properties, tests, classification. Analysis of soil stresses, consolidation, shear strength, lateral pressures, and ground water movement. Related design consideration involving spread footings, piles, retaining walls, and slopes. Use of programmable scientific calculator required. 3.0 hours discussion, 3.0 hours laboratory.

C E 251 Foundations Engineering 3.0 Inquire
Prerequisites: C E 020; C E 250. C E 255 is recommended.
The application of soil mechanics principles to the design of foundations for buildings and earth structures. Integration of structural design and soil response.

C E 252 Engineering Hydrology 3.0 Inquire
Prerequisites: MATH 007A. Completion of C E 150 is recommended.
A concise treatment of modern hydrology, emphasizing a quantitative approach to surface-water runoff, ground-water runoff, precipitation, evapotranspiration, climate, infiltration, drainage-basin characteristics.

C E 254 Steel Design 3.0 Inquire
Prerequisites: C E 153.
Theory, analysis, and design of steel structural elements and systems using allowable stress design and load resistance factor design methods.

C E 255 Reinforced Concrete Design 4.0 Fall
Prerequisites: C E 102; C E 153; C E 250.
The analysis and design of reinforced concrete structures and its elements by the strength design method. Laboratory includes experiments on concrete, concrete structural elements, and a design project. 3.0 hours discussion, 3.0 hours laboratory.

C E 256 Timber Design 3.0 Inquire
Prerequisites: C E 150.
Theory and design procedures for timber structures to resist gravity and lateral loads and their connections. Basic element design by the Allowable Stress Design (ASD) and Load and Resistance Factored Design (LRFD) methods will be detailed. Also covered are design of horizontal (floor and roof systems) and vertical (shear wall) diaphragms. One or two 3-hour field trips required.

C E 257 Prestressed Concrete and Reinforced Masonry Design 3.0 Inquire
Prerequisites: C E 020; C E 253.
Theory, analysis, design, and construction of prestressed concrete and masonry structural elements and systems using working stress and ultimate strength design methods.

C E 258 Earthquake and Wind Engineering 3.0 Inquire
Prerequisites: M E 135; C E 153. Concurrent enrollment in or prior completion of C E 254, C E 255, or C E 257 is recommended.
Earthquake and wind hazard related to the structural design of buildings. Topics include engineering seismology, wind environment and climatology, structural dynamics, structural loading, and design methodologies. Use of computer software for the static and dynamic analysis of three-dimensional building systems. 2.0 hours discussion, 2.0 hours workshop.

C E 270 Transportation Engineering 4.0 Fall
Prerequisites: C E 011; C E 102; C E 121 (may be taken concurrently); C E 250. Transportation systems and facility planning, design, construction, operation, and maintenance. Pavement design and traffic engineering fundamentals. Laboratory includes field studies, design exercises, and modeling/forecasting tasks. 3.0 hours discussion, 3.0 hours laboratory.

C E 271 Transportation Pavements 3.0 Inquire
Prerequisites: C E 270 or faculty permission.
Characteristics and manufacture of bituminous materials; engineering properties, design, and production of bituminous mixes; analysis, design, and construction of flexible and rigid pavement cross-sections; stabilization of sub-grades; analysis of pavement distress; development and operation of pavement management systems; and application of computer software. 2.0 hours discussion, 2.0 hours activity.

C E 273 Urban Transportation Systems Planning 3.0 Inquire
Prerequisites: C E 270 or faculty permission.
Introduction to systems approach, urban transportation technology, urban problems and transportation, forecasting methods, urban transportation models, and calibration of traffic impact studies and USDOT computer requirements. Not open to students who have completed C E 373.

C E 275 Traffic Engineering 3.0 Inquire
Prerequisites: C E 270 or faculty permission.
Traffic engineering fundamentals, traffic control — signs, markings, and signals; intersection and highway capacity. Highway safety and accident investigations. Design of streets and parking facilities. Assessment of the environmental impact of traffic.

C E 286 Open Channel Hydraulics 3.0 Inquire
Prerequisites: C E 020; C E 150.
Principles and applications of steady, gradually varying, and unsteady open channel hydraulics.

C E 287 Pipeline Hydraulics and Design 3.0 Inquire
Prerequisites: C E 020; C E 121; C E 150; C E 250 may be taken concurrently.
Design of pumped pipelines. Analysis of transients in pipe systems caused by valve movement, pump power failure, etc. Design of transient controls through operational procedures and devices such as surge relief valves, air chambers, and surge tanks.

C E 288 Environmental Engineering I 4.0 Spring
Prerequisites: CHEM 037; C E 150.
Rainfall and runoff; development, purification, distribution, and analysis of water; collection, treatment, disposal of sewage; analysis, design, construction, and maintenance of plants and systems. 3.0 hours discussion, 3.0 hours laboratory.

C E 290 Advanced Structural Analysis 3.0 Inquire
Prerequisites: C E 153.
Analysis of statically determinate and indeterminate structures under the action of external effects, including gravity and lateral loading. Emphasis on computer analysis of trusses, continuous beams, and rigid frames, using both flexibility and stiffness approaches.

C E 291 Environmental Engineering II 3.0 Inquire
Prerequisites: C E 150. Completion of C E 288 is recommended.
Water processes, non-point sources, and local pollution control. Ecosystem interaction in eutrophic and oligotrophic environments. Theory and design of pollution control systems.

C E 293 Water Quality Engineering 3.0 Inquire
Prerequisites: C E 150; Completion of C E 288 is recommended.
Water quality criteria and standards; engineering design; management and monitoring or water quality. 2.0 hours discussion, 2.0 hours activity.

C E 295 Hazardous Waste Management 3.0 Inquire
Prerequisites: CHEM 037; BIOL 008; C E 150.
An introduction to the handling and management of hazardous wastes. Emphasis on state-of-the-art engineering techniques and contemporary management issues based on social, economic, and legal considerations; risk assessment; case studies.

C E 298 Advanced Topics 1.0-3.0 Fa/Spr
Prerequisites: To be established when courses are formulated.
This course is for special topics offered as 298A-C for 1.0 to 3.0 units respectively. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered.

C E 299H Honors Project 3.0 Inquire
Prerequisites: Completion of 12 units of upper-division C E courses; faculty permission. This course may be taken twice for a maximum of 6 units. Prerequisite to the second semester is a B or higher in the first semester. Open by invitation to C E majors who have a GPA among the top 5% of C E students based upon courses taken at CSU, Chico. This is an “Honors in the Major” course; a grade of B or higher in 6 units of 299H certifies the designation of “Honors in the Major” to be printed on the transcript and the diploma. Each 3-unit course will require both formal written and oral presentations. You may take this course more than once for a maximum of 60 units.

C E 356 Advanced Timber Design 4.0 Inquire
Prerequisites: C E 153 or equivalent.
Theory and design procedures for the design of timber structures to resist gravity and lateral loads and the design of formwork for concrete. Design of horizontal (floor system) and vertical (shear wall) diaphragms. One or two 3-hour field trips required. Students having credit in C E 258 cannot receive credit for C E 356. 3.0 hours discussion, 2.0 hours activity.

C E 356A Advanced Timber Design Activity 1.0 Inquire
Prerequisites: C E 153 or equivalent; C E 256.
Advanced timber design activities including design projects for lateral loads (seismic or wind) in horizontal diaphragms and shear walls, seismic connections, flexible diaphragm deflections, and design methodologies. Use of computer software for the static and dynamic analysis of three-dimensional building systems. Investigations of current topics. Students having credit in C E 258 cannot receive credit for C E 356. 3.0 hours discussion, 2.0 hours activity.
**Engineering**

**C E 358A Advanced Earthquake and Ground Engineering Activity**
Prerequisites: M E 135 and C E 153 or equivalent; C E 258. Completion of or concurrent enrollment in an advanced structural design course or equivalent is recommended. Investigations of current topics in earthquake and wind hazard related to the structural design of buildings. 2.0 hours activity.

**C E 371 Advanced Transportation Pavements 4.0 Inquire**
Prerequisites: C E 270 or faculty permission. Characteristics and manufacture of bituminous materials; engineering properties, design and production of bituminous mixtures; analysis, design and construction of flexible and rigid pavement cross-sections; stabilization of subgrades; analysis of pavement distress; development and operation of pavement management systems, application and evaluation of computer software and critique of several pavement design methods. Two field trips required. Students having credit in C E 271 cannot receive credit for C E 371. 3.0 hours discussion, 2.0 hours activity.

**C E 371A Advanced Transportation Pavements Discussion**
Prerequisites: C E 270 and C E 271 or faculty permission. A comparative and critical analysis of the various pavement design techniques and the application and evaluation of pavement design software. 2.0 hours activity.

**C E 373 Advanced Urban Transportation Systems Planning**
Prerequisites: C E 270 or equivalent or faculty permission. Introduction to systems approach, urban transportation technology, urban problems and transportation, forecasting methods, traditional urban transportation models, calibration and sensitivity analysis, traffic impact studies, USDOT planning requirements, and newer modeling technique, i.e., discrete choice models. Students having credit in C E 273 will receive only 1 unit of credit in C E 373. 3.0 hours discussion, 2.0 hours activity.

**C E 386 Advanced Open Channel Hydraulics 4.0 Inquire**
Prerequisites: C E 286. Principles and design procedures for the design of open channels. Applications in steady, gradually-varying and unsteady open channel hydraulics. Students having credit in C E 286 cannot receive credit for C E 386. 3.0 hours discussion, 2.0 hours activity.

**C E 386A Advanced Open Channel Hydraulics Design Activity**
Prerequisites: C E 286. Design procedures for the design of open channels. Applications in steady, gradually-varying and unsteady open channel hydraulics. 2.0 hours activity.

**C E 398 Independent Study 1.0-3.0 Fa/Spr**
This course is a graduate level independent study offered as 398A-C for 1.0 to 3.0 units respectively. You must register directly with a supervising faculty member.

**C E 399 Master's Study 1.0-6.0 Fa/Spr**
This course is a master's study offered as either a Master's Thesis, identified as 399A-F for 1.0 to 6.0 units respectively, or as a Master's Project, identified as 399P-L for 1.0 to 6.0 units respectively. You must register directly with a supervising faculty member.

**Engineering Course Offerings**
See the section on “Course Description Symbols and Terms” in The University Catalog for an explanation of course description terminology and symbols, the course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web.

**ENGR 001 MESA Orientation Class 2.0 Fall**
Prerequisites: MESA eligibility. A comprehensive introduction that provides incoming Math, Engineering, Science Achievement (MESA) students with an overview of the fields of engineering and computer science, along with information on degree requirements, technical skills needed, working in industry, professional organizations, and professional development. In addition, there is an introduction to campus resources and university life for first-year MESA students. ABC/no credit grading only.

**ENGR 002 Surveying for Non-Engineers 3.0 Fa/Spr**
Prerequisites: One semester of high school trigonometry or MATH 004. Theory and practice in the use of surveying equipment, with particular emphasis on mapping as applied to such disciplines as construction, geology, architecture, agriculture, and anthropology. 2.0 hours discussion, 3.0 hours laboratory.

**ENGR 100 Planning of Public Works Projects 3.0 Inquire**
Prerequisites: Junior standing (completion of 60 college units). Not intended for engineering majors. A non-mathematical approach to the decisions made in the planning of public works projects, with particular emphasis on public participation. Current projects being planned on the local, state, and national level will be studied.

**ENGR 195 Lifelong Development for Engineers 3.0 Fa/Spr**
Prerequisites: ENGL 001; graduation in engineering expected within 12 months. Professional practices in engineering: ethics, opportunities for continuing development, design practices, proper use of computer software, professional relationships. A substantial written project will be required. 2.0 hours discussion, 2.0 hours activity.

**COMPUTER ENGINEERING**

The computer engineering program at CSU, Chico bridges the curriculum gap between electrical/electronic engineering and computer science. The program is designed to provide a broad background in both the theory and practice of computer hardware and software design and the integration of both into usable computer systems. The curriculum includes courses in logic design, microprocessor system design, computer interfacing, programming and data structures, computer architecture and assembly language programming, embedded system design, and system requirements and design. The program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700.

**Computer Engineering Program Mission**
The Electrical and Computer Engineering Department educates each student to be a responsible and productive computer engineer who can effectively respond to future challenges.

**Computer Engineering Program Objective**
The objective of the Computer Engineering Program is to produce graduates able to:
1. Apply knowledge of mathematics, science, and engineering to identify, formulate, and solve computer engineering problems.
2. Use industry standard tools to analyze, design, develop and test computer-based systems containing both hardware and software components.
3. Achieve success in graduate programs in computer engineering, electrical engineering or computer science.
4. Continue to develop their knowledge and skills after graduation in order to succeed personally and contribute to employer success.
5. Work effectively as a member of a multi-disciplinary development team and undertake leadership roles when appropriate.
6. Communicate their thoughts, in both written and oral forms, so that others can comprehend and build on their work.
7. Appreciate the importance of ethics in the profession and the need to act in society's best interest.

**Computer Engineering Design Experience**
Design is a fundamental aspect of the computer engineering curriculum and it is integrated into the curriculum beginning in the freshman year where students are introduced to both hardware and software design. As students expand their knowledge and analysis skills through the sophomore and junior years, the design problems they are assigned increase in complexity. Design problems are assigned in electronics, digital and microprocessor systems, embedded systems, and software systems. The design experience culminates in the senior year when all students are required to identify a design project, create testable requirements for the project, design the project, and construct the project to prove the design works. Projects chosen by students often include elements of both hardware and software design. In the past, students have designed computer-controlled robots, security systems, sophisticated Web applications, and peripheral interfaces.
THE BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

Total Course Requirements for the Bachelor's Degree: 132 units

See “Requirements for the Bachelor’s Degree” in The University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

The department has prepared a suggested Four Year Advising Plan to help students meet all graduation requirements within four years. Please request a plan from your major adviser or view it and other current advising information on the CSU, Chico Web.

General Education Requirements

Computer Engineering is a major with modifications to the university’s General Education Requirement. The following requirements fulfill the General Education Requirement.

Area A: 9 units
A1: CMST 011 or CMST 011H
A2: ENGL 001 or ENGL 011H
A3: Waived
A4: MATH 007A

Area B: 3 units (computer engineering); 6 units (electrical/electronic engineering)
B1: CHEM 037
B2: Additional physics courses satisfy requirement for computer engineering:
    BIOL 008 for electrical/electronic engineering

Area C: 6 units
HIST 050 plus one course selected from C1, C2, or C3 (a course that also fulfills the Ethnic or Non-Western requirement is recommended)

Area D: 9 units
POLS 055, C E 121, plus one course selected from D1, D2, or D3 (a course that also fulfills the Ethnic or Non-Western requirement is recommended)

Area E: 3 units
ENGR 195

Upper-Division Theme: 9 units
ECE 140 plus two courses from the same theme. Consult with an ECE adviser to determine which courses satisfy the requirements for the degree.

Please see the Cultural Diversity and U.S. History requirements under the BS in Civil Engineering.

Literacy Requirement:

See “Mathematics and Writing Requirements” in The University Catalog. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfactory completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn below a C- are required to repeat the course and earn a C- or better to receive WP credit. See The Class Schedule for the designated WP courses for each semester. You must pass ENGL 001 (or its equivalent) with a C- or better before you may register for a WP course.

Course Requirements for the Major: 105 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree.

Lower-Division Requirements: 51 units
16 courses required:

CHEM 037  General Chemistry  4.0  FS *
Prerequisites: Second-year high school algebra; one year high school chemistry or CHEM 016. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)
CSCI 015B  Programming and Algorithm II  3.0  FS
Prerequisites: Grade of C- or better in CSCI 015A (or ECE 090 for engineering majors).
ECE 084  Intro Elec/Computer Engineering  2.0  FS
ECE 085  Logic Design Fundamentals  3.0  FS
Prerequisites: Either ECE 084 or M E 025 or permission of instructor.
Corequisite: ECE 097.
ECE 086  Processor Architecture/Assembly Lang  3.0  FS
Prerequisites: Either CSCI 015A or ECE 090.
ECE 090  Algorithms & Programs for Engrs  3.0  FS
Prerequisites: MATH 007A is recommended.

ECE 095  Electrical Circuits and Devices  3.0  FS
Prerequisites: PHYS 004B (may be taken concurrently), MATH 007C (may be taken concurrently).
Corequisites: ECE 095L.
ECE 095L  Circuits and Devices Activity  1.0  FS
Corequisite: ECE 095.
ECE 097  Simulation and Analysis Tools  1.0  FS
Prerequisites: Either ECE 084 or M E 025 or permission of instructor.
Corequisites: ECE 085.
MATH 007A  Analytic Geometry and Calculus  4.0  FS *
Prerequisites: Completion of ELM requirement; both MATH 004 and MATH 006 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.
MATH 007B  Analytic Geometry and Calculus  4.0  FS
Prerequisites: Completion of ELM requirement; MATH 007A with a grade of C- or higher.
MATH 007C  Analytic Geometry and Calculus  4.0  FS
Prerequisites: Completion of ELM requirement; MATH 007B with a grade of C- or higher.
MATH 007D  Elem Diff Equation/Vector Calc  4.0  FS
Prerequisites: Completion of ELM requirement; MATH 007C with a grade of C- or better.
PHYS 004A  Mechanics  4.0  FS *
Prerequisites: High school physics or faculty permission. Concurrent enrollment in or prior completion of MATH 007B (second semester of calculus) or equivalent.
PHYS 004B  Electricity and Magnetism  4.0  FS
Prerequisites: MATH 007B, PHYS 004A.
PHYS 004C  Heat/Wave Motion/Sound/Light  4.0  FS
Prerequisites: MATH 007B, PHYS 004A.

Upper-Division Requirements: 54 units
16 courses required:

C E 121  Engineering Economy & Statistics  3.0  FS
Prerequisites: Either C E 020 or CSCI 065 or ECE 090 or M E 038; CMST 011 (may be taken concurrently); junior standing (completion of 60 college units).
CSCI 153  Algorithms and Data Structures  3.0  FS
Prerequisites: Grade of C- or better in CSCI 015B.
ECE 140  Linear Circuits  3.0  FS
Prerequisites: ECE 095; ECE 097, MATH 007D (both may be taken concurrently).
ECE 141  Signals and Transforms  3.0  FS
Prerequisites: ECE 140.
ECE 145  Electronics I  3.0  FS
Prerequisites: ECE 095, ECE 095L; ECE 097, ECE 140 (both may be taken concurrently).
ECE 180  Project Requirements/Design/Test  3.0  FS
Prerequisites: ENGL 001; either CSCI 015B or ECE 085.
This course is the same as CSCI 180 which may be substituted.
ECE 186  Digital Systems Design  3.0  FS
Prerequisites: ECE 085, ECE 086; either CSCI 015I or ECE 095L.
ECE 187  System Architecture/Performance  3.0  FA
Prerequisites: Either CSCI 171 or ECE 186 (may be taken concurrently).
ECE 188  Computer Interface Circuits  3.0  FS
Prerequisites: ECE 085, ECE 145.
ECE 210  SW Engg/Requirements & Design  3.0  FA
Prerequisites: CSCI 015B.
ECE 236  State Machine Design  3.0  SP
Prerequisites: Either CSCI 171 or ECE 085.
ECE 252  Real-Time Embedded Systems  3.0  SP
Prerequisites: CSCI 015B; either CSCI 171 or ECE 085.
ECE 285  Microprocessor Systems Design  4.0  SP
Prerequisites: ECE 186.
ECE 290A  Senior Project Planning  1.0  FS
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher, faculty permission.
ECE 290B  Senior Project  1.0  FS
Prerequisites: ECE 290A.
ENGR 195  Lifelong Development Engineers  3.0  FS
Prerequisites: ENGL 001; graduation in engineering expected within 12 months.

Any approved upper-division ECE or CSCI courses not otherwise required for graduation.

Grading Requirement:

All courses taken to fulfill major course requirements must be taken i or a letter grade, except those courses specified by the department as Credit/No Credit grading only.

All students must attain a 2.0 Grade Point Average (GPA) in all college courses attempted and for all courses attempted at Chico. Computer Engineering majors must attain a 2.0 GPA in:

(a) All courses required for the major, and
(b) All Electrical and Computer Engineering (ECE) and Computer Science (CSCI) courses taken to meet major requirements at CSU, Chico.
Advising Requirement:
Advising is mandatory for all majors in this degree program. Consult your undergraduate adviser for specific information.
A sample program for students who wish to complete their major in four years is available upon written request to the department, CSU, Chico, CA 95929-0888, or on the department's website.

Honors in the Major
Honors in the Major is a program of independent work in your major. It involves 6 units of honors course work completed over two semesters. Your Honors work will be recognized at your graduation, on your permanent transcripts, and on your diploma. It is often accompanied by letters of commendation from your mentor in the department or the department chair. Most importantly, however, the Honors in the Major program allows you to work closely with a faculty mentor in your area of interest on an original performance or research project. This year-long collaboration allows you to work in your field at a professional level and culminates in a public presentation of your work. Students sometimes take their projects beyond the university for submission in professional journals, presentation at conferences, or competition in shows, such experience is valuable for graduate school and later professional life.

Some common features of Honors in the Major program are
1. You must take 6 units of Honors in the Major course work. At least 3 of these 6 units are independent study (299H) as specified by your department. You must complete each class with a minimum grade of B.
2. You must have completed 9 units of upper-division course work or 21 overall units in your major before you can be admitted to Honors in the Major. Check the requirements carefully, as there may be specific courses that must be included in these units.
3. Your cumulative GPA should be at least 3.5 or within the top 5 percent of majors in your department.
4. Your GPA in your major should be at least 3.5 or within the top 5 percent of majors in your department.
5. Most students apply for or are invited to participate in Honors in the Major during the second semester of their junior year. Then they complete the 6 units of course work over the two semesters of their senior year.
6. Your honors work culminates with a public presentation of your work. Students sometimes take their projects beyond the university for submission in professional journals, presentation at conferences, or competition in shows, such experience is valuable for graduate school and later professional life.

While Honors in the Major is part of the Honors Program, each department administers its own program. Please contact your major department or major adviser for further information.

The Faculty

Electrical and Computer Engineering

Richard A. Bednar, 1979, Professor, PE, PhD, Mich St U.
Roy E. Crosbie, 1983, Director of Academic Develop., Professor, PhD, UK: Univ of Livermore.
Ralph J. Gagnon, 1981, Professor Emeritus, PhD, U of WA.
Arthur Gee, 1977, Professor Emeritus, PE, MSEE, Poly U NY.
Louis R. Harrold, 1984, Professor Emeritus, MSEE, UC Davis.
Philip H. Hoff, 1970, Professor, PhD, UC Berkeley.
William G. Lane, 1960, Lecturer I, PE, PhD, UC Davis.
Hede Ma, 2000, Assoc Professor, PhD, SUNY Binghampton.
Lyle McBride, 1985, Professor Emeritus, PhD, Harvard U.
Harold E. Petersen, 1984, Professor Emeritus, PhD, Stanford U.
Albert O. Richardson, 1989, Professor, PhD, Penn St U.
Ben-Dau Tseng, 1982, Professor, PhD, U Windsor.
Larry J. Wear, 1972, Chair, Professor, PhD, Santa Clara Univ.
Dale Word, 2002, Assist Professor, MS, CSU Chico.
John J. Zenor, 1982, Professor, PhD, U Missouri.

PE designates Registered Professional Engineer

Electrical and Computer Engineering Course Offerings

Please see the section on “Course Description Symbols and Terms” in The University Catalog for an explanation of course description terminology and symbols, the course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available for the Chico Web.

ECE 030 Basic Electricity and Instruments
3.0 Fall
Prerequisites: Faculty permission. This course is not intended for engineering or manufacturing technology majors or minors. Fundamentals of DC and AC passive components. Instruments used in the study of Basic Electronics will be discussed and demonstrated; emphasis on interpretation of schematic diagrams, breadboarding, familiarization with electronic components. 2.0 hours discussion. 2.0 hours activity.

ECE 031 Electrical and Electronics Technology
3.0 Spring
Prerequisites: PHYS 002B. Not for engineering majors. An introduction to electrical and electronic technology: DC circuitry analysis, AC circuitry analysis, basic electronic components and circuits. Interpretation of schematic diagrams, breadboarding, familiarization with electronic components. 2.0 hours lecture. 2.0 hours activity.

ECE 084 Introduction to Electrical and Computer Engineering
2.0 Fa/Spr
Survey of topics from the fields of electrical and computer engineering. Applications of critical thinking to the solution of engineering problems. Using the computer and sensors to control mechanical devices.

ECE 085 Logic Design Fundamentals
3.0 Fa/Spr
Prerequisites: Either ECE 084 or M E 025 or permission of instructor. Corequisites: ECE 097. Boolean algebra and logic simplification techniques. Design of combinational logic networks for decoders, encoders, multiplexers, and demultiplexers. Design of sequential logic devices including flip-flops, registers, and counters. Analysis of devices used to build logic networks, including programmable logic devices. Use of tools for schematic capture and circuit simulations. 2.0 hours lecture, 2.0 hours activity. Formerly ECE 185.

ECE 086 Processor Architecture and Assembly Language Programming
3.0 Fa/Spr
Prerequisites: Either CSCI 015A or ECE 090. An introduction to the components that make up a processor and the organization of those components. The representation of numbers, data, and instructions within a processor along with the ways they are addressed. Assembly language programming using arithmetic, logical, test, and input/output instructions. 2.0 hours lecture, 2.0 hours activity.

ECE 090 Algorithms and Programs for Engineers
3.0 Fa/Spr
Prerequisites: MATH 007A is recommended. Introduces students to the software development life cycle and the elements of a computer system. Teaches the syntax common to both C and C++. Shows how to split large program into segments and explains the role of algorithms in programming. Programming assignments are taken from simple engineering and mathematics problems. 2.0 hours discussion, 2.0 hours activity.

ECE 090X Programming Problem Session
1.0 Fa/Spr
Prerequisites: Concurrent enrollment in ECE 090. Designed to supplement ECE 090 with additional applications and extended explanations of concepts encountered in programming. Provides the student with the opportunity for additional assistance in basic programming skills. 2.0 hours activity. Credit/no credit grading only.

ECE 095 Fundamentals of Electrical Circuits and Devices
3.0 Fa/Spr
Prerequisites: Either CSCI 015A or ECE 090. Corequisites: ECE 095L. DC and sinusoidal circuit analysis, including resistive, capacitive, and inductive circuit elements, independent sources, and the ideal transformer. Thévenin and Norton circuit theorems. Analog and digital electronics will be covered at an introductory level, including diodes, transistors, FETs, operational amplifiers, electronic switching, logic gates, flip-flops, registers, and counters. AC and DC motors and polyphase circuits will be discussed, including three-phase analysis, Y and delta connections, and complex power. CAN ENGR 12.

ECE 095L Circuits and Devices Activity
1.0 Fa/Spr
Corequisites: ECE 095. Experiments to reinforce the principles taught in ECE 095. The combination of ECE 095 and ECE 095L is equivalent to CAN ENGR 6. 2.0 hours activity.
ECE 236 State Machine Design 3.0 Spring
Prerequisites: Either ECE 171 or ECE 085.
State machine design concepts and procedures. Design and analysis of synchronous and asynchronous sequential machines, state table derivation and reduction, State assignment and flow table realization, application of PAL, PLA, PLA, and ROM logic will be stressed.

ECE 237 Introduction to VLSI Systems 3.0 Inquire
Prerequisites: ECE 085, ECE 145.
Design of VLSI circuits. Emphasis is on design methodologies, including the use of CAE tools for schematic capture, chip layout, circuit simulation, and fault/timing analysis.

ECE 242 Digital Signal Transmission 3.0 Inquire
Prerequisites: ECE 141.

ECE 244 Consumer Electronics 3.0 Inquire
Prerequisites: ECE 146; ECE 228.
Engineering analysis of consumer electronic equipment: radio receivers, audio and video tape recorders, and television. Other topics will be covered as time permits and student interest directs.

ECE 247 Radio Frequency Circuits 3.0 Fall
Prerequisites: ECE 145.
Characteristics of passive and active components at high frequencies, reflections and standing waves, matching networks, scattering parameters, high-frequency measurement equipment and techniques, sample high-frequency design and construction projects, Smith charts.

ECE 248 Solid State Electronics 3.0 Fall
Prerequisites: CHEM 037, ECE 145; either MATH 110 or ECE 224.
Crystalline structure of solids, introduction to quantum concepts, statistics of semiconductors in thermal equilibrium, carrier transport mechanisms, excess carrier statistics, p-n junction fundamentals, diodes, photonic devices, relationship of internal processes to terminal characteristics for bipolar transistors, junction field-effect transistors and MOS transistors.

ECE 250 Introduction to Random Signal Analysis 3.0 Inquire and Kalman Filtering
Prerequisites: ECE 141; ECE 224.

ECE 252 Real-Time Embedded Systems 3.0 Spring
Prerequisites: CSI 015B; either CSI 171 or ECE 085.
This course presents the special problems associated with developing, testing, and maintaining real-time systems containing embedded digital computers. Nature and uses of real-time systems, architecture of real-time systems, development and maintenance environments, and programming techniques are also discussed.

ECE 255 Introduction to Network Engineering 3.0 Fall
Prerequisites: Either CSI 171 or ECE 186.
Computer network architecture is reviewed. Network components such as hubs, routers, and bridges are discussed. Transmission media and protocols are discussed. Concepts of data communications are reviewed.

ECE 260 Engineering Intelligent Systems and Robotics 3.0 Inquire
Prerequisites: ECE 186.
Robotic and intelligent systems and their applications. Interdisciplinary technologies used in robotics: mechanics, electronics, kinematics, control, sensors, vision, speech, and programming. Robotic system analysis, design, synthesis, and application, in class and in the laboratory. Demonstration and student operation of robots, actuators, sensors, and vision equipment. Laboratory project and reports discussion. 3.0 hours laboratory.

ECE 263 Control System Elements 3.0 Inquire
Prerequisites: ECE 141, ECE 145.
Modeling and detailed analysis of components frequently encountered in the design of control systems, including different types of stepper, d-c and a-c servomotors, magnetic particle clutches, optical encoders, tachometers, and other transducers such as temperature and pressure. Investigation of various integrated circuits used to drive servomotors, and solid-state devices used as sensors.

ECE 265 Discrete-Time Control Systems 3.0 Inquire
Prerequisites: Either M E 201 or both ECE 141 and ECE 224.
Topics covered include linear difference equations, dynamic response of linear discrete-time systems, Z-transforms, system stability, discrete equivalents to continuous-time transfer functions. Sampled-data systems. Design of digital control systems: lead and lag transform and state-space techniques. Discrete regulators and observers.

ECE 285 Microprocessor Systems Design 4.0 Spring
Prerequisites: ECE 186.
Introduction to hardware/software design considerations for 16-bit microprocessor systems. A system will be designed and implemented using current technology and components, including universal peripheral interface and serial interface components. Automated development systems and procedures are used throughout design. 3.0 hours discussion, 2.0 hours activity. Special fee required; see The Class Schedule.

ECE 290A Senior Project Planning 1.0 Fa/Spr
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher, faculty permission.
Under faculty supervision, each student prepares a plan for his/her senior engineering project. This plan includes project definition, project requirements, preliminary design, and work schedule. Requirements and design should address human factors, safety, reliability, maintainability, and customer cost. Oral and written reports are required. 2.0 hours activity. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors.

ECE 290B Senior Project 1.0 Fa/Spr
Prerequisites: ECE 290A.
In a continuation of ECE 290A, the student constructs, tests, and demonstrates his/her senior design project. Formal oral and written reports documenting the project are required. 2.0 hours activity.

ECE 292 Electromagnetics II 3.0 Inquire
Prerequisites: ECE 142.
Advanced topics in electromagnetic wave propagation, including numerical methods. Applications to RF, microwaves and optics.

ECE 295 Control Systems I 4.0 Fall
Prerequisites: ECE 141; either M E 135 or M E 192; ECE 224 (may be taken concurrently).

ECE 296 Control Systems II 3.0 Inquire
Prerequisites: Either ECE 295 or M E 201.
Lead, lag compensator design. State variable analysis of continuous and discrete time systems; stability, controllability, and observability. Observers and pole placement techniques. Signal sampling and Z-transform. Introduction to non-linear system analysis.

ECE 297 Digital Signal Processing 3.0 Spring
Prerequisites: MATH 007D; ECE 141 (may be taken concurrently).
Introduction to non-linear system analysis. Properties of continuous and discrete signals. Z-transform and Fast-Fourier transforms. Digital filtering techniques. Finite word length effects on digital signal processing elements. 2.0 hours discussion, 2.0 hours activity.

ECE 298 Advanced Topics 1.0-5.0 Inquire
Prerequisites: To be established when courses are formulated.
This course is an independent study of special problems and is offered as 299A-5 for 1.0 to 5.0 units respectively. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered.

ECE 299 Independent Study 1.0-3.0 Fa/Spr
This course is an independent study of special problems and is offered as 299A-5 for 1.0 to 5.0 units respectively. You must register directly with a supervising faculty member. 1.0 hour discussion, 6.0 hours laboratory. Credit/no credit grading only.

ECE 299H Honors Project 3.0 Inquire
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher, completion of all junior-level ECE courses required in the major.
This course may be taken twice for a maximum of 6 units. Prerequisite to the final semester is a “B” or higher in the first semester. Open by invitation to E and CMPE majors who have a GPA among the top 5% of ECE students based upon courses taken at CSU, Chico. This is an “Honors in the Major” course; a grade of “B” or higher in 5 units of ECE 299H certifies the designation of “Honors in the Major” to be printed on the transcript and the diploma. Each 3-unit course will require both formal written and oral presentations. You may take this course more than once for a maximum of 6.0 units. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors.
ECE 310  Software Engineering— Process Improvement  3.0 Spring
Prerequisites: CSCI 151 or ECE 210.
This course analyzes software development processes. It uses the Carnegie-Mellon Capability Maturity Model (CMM) as the guide for measuring process capability. The CMM method is compared with ISO 9001 certification. The class covers key process areas such as require- ment management, software estimation, configuration management, peer reviews, root cause analysis, and risk assessment and management. Ways of accelerat- ing change within an organization are discussed. Application of process improvement techniques to individual developers is discussed.

ECE 312  Software Engineering— Software Quality Assurance and Testing  3.0 Fall
Prerequisites: Either ECE 210 or CSCI 151.
This course gives students the opportunity to investigate verifications and validation, proving program correctness, test data selection, static vs. dynamic testing, coverage analysis, reliability, white box vs. black box testing, bounded testing, and automated testing. Testing tools are also discussed. Testing and performance analysis of real-time systems is emphasized.

ECE 324  Communication System Coding  3.0 Inquire
Prerequisites: Either ECE 121 or MATH 105A.
Practical aspects of digital data detection and correction in noisy communciation systems. Emphasis on overall link evaluation of coding systems in terms of signal to noise ratio improvement and real time system performance monitoring.

ECE 330  Advanced Topics in Digital Signal Processing  3.0 Inquire
Prerequisites: ECE 297.
Computer-aided design of FIR and IIR filters, Multi-rate signal processing, Power spectral estimation, Adaptive filters, Homomorphic signal processing, cepstrum, and two-dimensional signal processing.

ECE 333  Electronic Circuits for Digital Signal Processing  3.0 Fall
Prerequisites: ECE 186; ECE 297 (may be taken concurrently).
The use of digital signal processing (DSP) chips and microprocessors in various multi-processor hardware configurations to implement digital signal processing functions. Application areas in electronic engineering which will be studied are speech synthesis and recognition, audio processing, image processing, and control systems. Both general purpose DSP and application specific DSP chips (for example, digital filters) will be discussed.

ECE 342  Optical Signal Processing  3.0 Inquire
Prerequisites: ECE 142.

ECE 343  Light Transmission Optics  3.0 Inquire
Prerequisites: ECE 142. Recommended: ECE 230.

ECE 345  High-Frequency Design Techniques  3.0 Fall
Prerequisites: PHYS 004C, ECE 145.
Study of the problems associated with passive components at high frequencies, high-frequency measurement techniques, transmission lines, line reflections, matching and terminations, scattering parameters, ground and power planes, and printed circuit board design considerations.

ECE 355  Advanced Topics in Computer Networking  3.0 Spring
Prerequisites: ECE 186, ECE 255.

ECE 356  High-Frequency Analog Design  3.0 Spring
Prerequisites: ECE 247, ECE 345.
Design, analysis and construction of high-frequency amplifiers, oscillators and mixers are covered in this course.

ECE 357  Electromagnetic Compatibility  3.0 Spring
Prerequisites: ECE 345.
Analysis of cabling and grounding problems in high-frequency systems. Circuit layout for high-frequency applications. Electromagnetic discharge problems. Radio-frequency emissions from electronic devices. Shielding techniques to prevent ESD and EMI.

ECE 370  Non-linear Control Systems  3.0 Inquire
Prerequisites: Either ECE 295 or ME 201.
Analysis of non-linear systems using state space and frequency domain techniques. Quasilinearization, stability, Lyapunov’s methods, describing functions, and Popov’s Criterion.

ECE 375  Optimal Control Systems  3.0 Inquire
Prerequisites: ECE 296 or ME 201.
Static optimization, calculus of variations, necessary conditions for optimal control, Pontryagin’s Maximum Principle, dynamic programming, and numerical techniques. Engineering applications.

ECE 388  Computer-Aided Circuit Engineering  3.0 Spring
Prerequisites: ECE 345.
The use of computer-aided design tools to analyze, design, and test both analog and digital circuits and devices.

ECE 397  Seminar in Advanced Topics  1.0-3.0 Fa/Spr
This course is offered as 397A-C for 1.0-3.0 units respectively. Typical subjects that will be taught include embedded systems design, high-speed networking, program management, and fault-tolerant system design. Consult The Class Schedule for listings. You may take this course more than once for a maximum of 12.0 units.

ECE 398  Independent Study  1.0-6.0 Fa/Spr
This course is a graduate level independent study offered as 398A-F for 1.0 to 6.0 units respectively. You must register directly with a supervising faculty member. Independent study and investigation of special problems in the student’s area of concentration. Both registration and study plan must have approval of the instructor and the student’s graduate advisory committee chair.

ECE 399  Master’s Study  1.0-6.0 Fa/Spr
This course is a master’s study offered as either a Master’s Thesis identified as 399A-F, for 1.0 to 6.0 units respectively, or as a Master’s Project, identified as 399G-I, for 1.0 to 3.0 units respectively. Independent study and investigation of special problems in student’s area of concentration. Both registration and study plan must have approval of the instructor and the student’s graduate advisory committee chair.

ELECTRICAL/ELECTRONIC ENGINEERING

Electrical/electronic engineering graduates are qualified for professional practice or graduate work in several areas of specialization. In addition to fundamentals of science and mathematics, the program provides a solid background in circuits, analog and digital electronics, microprocessors, and electromagnetics. The senior-level classes offered for electrical/electronic engineers include control systems, communication systems, digital signal processing, electro-optics, and digital system design. The program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700.

Electrical/Electronic Engineering Program Mission
The Electrical and Computer Engineering Department educates each student to be a responsible and productive electrical/electronic engineer who can effectively respond to future challenges.

Electrical/Electronic Engineering Program Objective
The objective of the Electrical/Electronic Engineering Program is to produce graduates able to:
1. Apply knowledge of mathematics, science, and engineering to identify, formulate, and solve electrical/electronic engineering problems.
2. Use industry standard tools to analyze, design, develop and test computer-based systems containing both hardware and software components.
3. Achieve success in graduate programs in electrical engineering or a related field.
4. Continue to develop their knowledge and skills after graduation in order to succeed personally and contribute to employer success.
5. Work effectively as a member of a multi-disciplinary development team and undertake leadership roles when appropriate.
6. Communicate their thoughts, in both written and oral forms, so that others can comprehend and build on their work.
7. Appreciate the importance of ethics in the profession and the need to act in society’s best interest.

Highlighted text indicates a change from the original publication.
Electrical/Electronic Engineering Design Experience

Design is a fundamental aspect of the electrical/electronic engineering curriculum, and it is integrated into the curriculum in the freshman year where students are introduced to both hardware and software design. As students expand their knowledge and analysis skills through the sophomore and junior years, the design problems they are assigned increase in complexity. Design problems are assigned in analog electronics, digital systems, control systems, and digital signal processing.

The design experience culminates in the senior year when all students are required to identify a design project, create testable requirements to the project, design the project, and construct the project to prove the design. In the past, students have designed computer-controlled robots, digital signal processing systems, communication systems, remote video control and display systems, and audio systems.

THE BACHELOR OF SCIENCE IN ELECTRICAL/ELECTRONIC ENGINEERING

Total Course Requirements for the Bachelor’s Degree: 132 units

See “Requirements for the Bachelor’s Degree” in The University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

The department has prepared a suggested Four Year Advising Plan to help students meet all graduation requirements within four years. Please request a plan from your major adviser or view it and other current advising information on the CSU, Chico Web.

General Education Requirements

See the General Education Requirements under the BS in Computer Engineering. Please see the Accreditation, Cultural Diversity, U.S. History, and Literacy Requirements under the BS in Computer Engineering.

Course Requirements for the Major: 108 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree.

Lower-Division Requirements: 51 units

16 courses required:

-BIOL 008 Principles of Biology 3.0 FS *
Prerequisites: High school biology and chemistry.

-CHEM 037 General Chemistry 4.0 FS *
Prerequisites: Second-year high school algebra; one year high school chemistry or CHEM 016. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)

-EC 084 Intro Elec/Computer Engineering 2.0 FS
-EC 085 Logic: Design Fundamentals 3.0 FS
Prerequisites: Either ECE 084 or M E 025 or permission of instructor.

-Corequisites: ECE 097.

-EC 095 Electrical Circuits and Devices 3.0 FS
Prerequisites: PHYS 004B (may be taken concurrently), MATH 007C (may be taken concurrently).

-Corequisites: ECE 095L, ECE 095.

-Corequisites: ECE 095.

-EC 097 Simulation and Analysis Tools 1.0 FS
Prerequisites: Either ECE 084 or M E 025 or permission of instructor.

-Corequisites: ECE 085.

-MATH 007A Analytic Geometry and Calculus 4.0 FS *
Prerequisites: Completion of ELM requirement; both MATH 004 and MATH 006 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.

-MATH 007B Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007A with a grade of C- or higher.

-MATH 007C Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007B with a grade of C- or higher.

-MATH 007D Elem Diff Equation/Vector Calc 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007C with a grade of C- or better.

-MATH 007E Advanced Calculus 3.0 FS *
Prerequisites: MATH 007D and MATH 007F (or high school equivalent).

-MATH 007F Advanced Calculus 3.0 FS *
Prerequisites: MATH 007E and MATH 007G (or high school equivalent).

-MATH 007G Advanced Calculus 3.0 FS *
Prerequisites: MATH 007F and MATH 007H (or high school equivalent).

-Physics 004A Mechanics 4.0 FS *
Prerequisites: High school physics or faculty permission. Concurrent enrollment in or prior completion of MATH 007B (second semester of calculus) or equivalent.

-Physics 004B Electricity and Magnetism 4.0 FS
Prerequisites: MATH 007B, PHYS 004A.

-Physics 004C Heat/Wave Motion/Sound/Light 4.0 FS
Prerequisites: MATH 007B, PHYS 004A.

Upper-Division Requirements: 57 units

19 courses required:

-C E 121 Engineering Economy & Statistics 3.0 FS
Prerequisites: Either C E 020 or CSCI 065 or ECE 090 or M E 038; CMST 011 (may be taken concurrently); junior standing (completion of 60 college units).

-ECE 140 Linear Circuits 3.0 FS
Prerequisites: ECE 095; ECE 097, MATH 007D (both may be taken concurrently).

-ECE 141 Signals and Transforms 3.0 FS
Prerequisites: ECE 140.

-ECE 142 Fields and Waves 3.0 SP
Prerequisites: ECE 095, ECE 095L, PHYS 004B (may be taken concurrently).

-ECE 145 Electronics I 3.0 FS
Prerequisites: ECE 095, ECE 095L, ECE 097, ECE 140 (both may be taken concurrently).

-ECE 146 Electronics II 4.0 FS
Prerequisites: ECE 145.

-ECE 180 Project Requirements/Design/Test 3.0 FS
Prerequisites: ENGL 001; either CSCI 015B or ECE 086.
This course is the same as CSCI 180 which may be substituted.

-ECE 186 Digital Systems Design 3.0 FS
Prerequisites: ECE 085, ECE 086; either ECE 030 or ECE 031 or ECE 095 and ECE 095L.

-ECE 188 Computer Interface Circuits 3.0 FS
Prerequisites: ECE 085, ECE 145.

-ECE 224 Engineering Analysis 3.0 FA
Prerequisites: MATH 007D, PHYS 004B, ECE 095.

-ECE 228 Communication Systems Design 3.0 SP
Prerequisites: ECE 141.

-ECE 248 Solid State Electronics 3.0 FA
Prerequisites: CHEM 037, ECE 145; either MATH 110 or ECE 224.

-ECE 290A Senior Project Planning 1.0 FS
Prerequisites: ECE 091 (or its equivalent) with a grade of C- or higher, faculty permission.

-ECE 290B Senior Project 1.0 FS
Prerequisites: ECE 290A.

-ECE 295 Control Systems 4.0 FA
Prerequisites: ECE 141; either M E 135 or M E 192; ECE 224 (may be taken concurrently).

-ECE 297 Digital Signal Processing 3.0 SP
Prerequisites: MATH 007D; ECE 141 (may be taken concurrently).

-ENGR 195 Lifelong Development Engineers 3.0 FS
Prerequisites: ENGL 001; graduation in engineering expected within 12 months.

-M E 192 Elements Engineering Mechanics 3.0 FA
Prerequisites: MATH 007D, PHYS 004A.

-M E 296 Adv Topic Mechanical Engineer 1.0-3.0 Inq
Prerequisites: To be established when course is formulated.

-M E 298 must be taken for 2 units.

-C E 121 and ENGR 195 are approved General Education Courses for Electrical/Electronic Engineering majors.

3 units selected from:

Any approved upper-division Electrical and Computer Engineering (ECE) courses not otherwise required for graduation.

Grading Requirement:

All courses taken to fulfill major course requirements must be taken for a letter grade, except those courses specified by the department as Credit/No Credit grading only.

All students must attain a 2.0 Grade Point Average (GPA) in all college courses attempted and for all courses attempted at Chico. Electrical/Electronic Engineering majors must also attain a 2.0 GPA in:

(a) All courses required for the major, and

(b) All Electrical and Computer Engineering (ECE) courses taken to meet major requirements at CSU, Chico.

Advising Requirement:

Advising is mandatory for all majors in this degree program. Consult your undergraduate adviser for specific information.

A sample program for students who wish to complete their major in four years is available upon request to the Department of Electrical and Computer Engineering, CSU, Chico, CA 95929-0888.

Please see Honors in the Major under Computer Engineering.
THE MASTER OF SCIENCE
IN ELECTRICAL ENGINEERING

The MS in Electrical Engineering is designed to serve those students who wish to obtain advanced knowledge in the design of high-speed electronic systems or computer-based systems. This knowledge prepares students for a doctoral program or an intermediate level position in industry.

Course Requirements for the Master’s Degree: 30 units

Continuous enrollment is required. A maximum of 9 semester units of transfer credit may be applied toward the degree.

Graduate Time Limit: All requirements for the degree are to be completed within five years of the end of the semester of enrollment in the oldest course applied toward the degree. See “Graduate Education” in The University Catalog for complete details on general degree requirements.

Program Selection

Students will choose either the Option in Computer Engineering or the Option in Electronic Engineering.

MS in Electrical Engineering with an Option in Computer Engineering:

This option is designed primarily for students who wish to apply electrical and software engineering principles to the design and development of computers and computer-based systems.

MS in Electrical Engineering with an Option in Electronic Engineering:

This option is designed primarily for students who wish to expand their study of principles and applications of electronic engineering to high-speed circuits, components, and systems.

Prerequisites for Admission to Conditionally Classified Status:

1. Satisfactory grade point average as specified in “Admission to Master’s Degree Programs” in The University Catalog.

2. Approval by the department and the Office of Graduate Programs.

3. A professionally accredited baccalaureate in electrical or computer engineering, or an equivalent approved by the Office of Graduate Programs.

4. Successful completion of the Graduate Record Examination if required by the Graduate Coordinator.

Prerequisites for Admission to Classified Status:

In addition to any requirements listed above:

1. Successful completion of the Graduate Writing Examination.

2. Completion of background preparation equivalent to the following undergraduate courses: ECE 086, ECE 090, ECE 141, ECE 145, ECE 186, and ECE 188.

All required undergraduate electrical and computer engineering (ECE) courses must be taken for a letter grade, and a grade of C or better must be earned in each course. Students are required to complete the background courses immediately as a matter of reasonable progress toward the master’s degree.

Advancement to Candidacy:

In addition to any requirements listed above:

1. Formation of the graduate advisory committee in consultation with the Graduate Coordinator.

2. Development of an approved program, including a thesis or project proposal if the thesis or project plan is chosen, in consultation with the Graduate Coordinator.

3. Classified graduate standing and completion at the university of at least 9 units of the proposed program with a minimum 3.00 grade point average.

Requirements for the MS Degree in Electrical Engineering

Completion of all requirements as established by the department graduate committee, the graduate advisory committee, and the Office of Graduate Programs, to include:

1. Completion of an approved program consisting of 30 units of 200/300-level courses as follows:
   
   (a) Completion of the 9-unit core:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ECE 255 Intro to Network Engineering</td>
<td>3.0 FA</td>
</tr>
<tr>
<td>ECE 345 High Frequency Design Techniques</td>
<td>3.0 FA</td>
</tr>
<tr>
<td>ECE 358 Computer-Aided Circuit Engineer</td>
<td>3.0 SP</td>
</tr>
<tr>
<td>Prerequisites: ECE 345</td>
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<tr>
<td>ECE 186</td>
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<tr>
<td>Prerequisites: ECE 141, ECE 145</td>
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<td>ECE 297</td>
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<tr>
<td>Prerequisites: ECE 086, ECE 141</td>
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<tr>
<td>ECE 328</td>
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<tr>
<td>Prerequisites: ECE 345</td>
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</tbody>
</table>

(b) At least 18 units, including a thesis or project if chosen, must be in electrical and computer engineering (ECE); remaining units may be selected from electrical or computer engineering or in related areas with the approval of the Graduate Coordinator.

(c) At least 18 of the units required for the degree must be 300-level courses.

(d) Not more than 9 semester units of transfer and/or extension credit (correspondence courses and U.C. extension course work are not acceptable); Open University course work is included in this 9 unit total.

2. Completion and final approval of one of the following three plans as specified by the graduate advisory committee:

   (a) Thesis Plan. This plan includes 24 units of course work and 6 units of thesis research (ECE 399). Research may be theoretical or applied, but must reflect an individual in-depth study into an approved topic. This plan requires a formal research thesis which must be submitted to the Office of Graduate Programs for approval and accession to the library.

   (b) Project Plan. Requirements for this plan consist of 27 units of course work and 3 units of project preparation (ECE 399). The project must show how analysis and design have been applied to a particular area of electronic or computer engineering. A written project description must be submitted to the Office of Graduate Programs for approval and accession to the library.

   (c) Examination Plan. Requirements for this plan consist of 30 units of course work and a comprehensive oral examination prepared by the faculty. The two-hour examination will cover areas covered in four courses from the candidate’s course of study.

3. Approval by the Graduate Coordinator and the Graduate Coordinators Committee on behalf of the faculty of the university.

OPTION IN COMPUTER ENGINEERING: 21 units

Undergraduate background:

Programming in C++ and assembly language

Data structures

Operating systems

Signals and transistors

Analog electronics

Digital systems and state machine design

Computer interface circuits

Microprocessor system design

9 units required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 235 Advanced Computer Architecture</td>
<td>3.0 SP</td>
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<tr>
<td>Prerequisites: Either CSCI 171 or ECE 187</td>
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<tr>
<td>ECE 310 SW Engr Processes Improvement</td>
<td>3.0 SP</td>
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<tr>
<td>Prerequisites: CSCI 151 or ECE 281</td>
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<tr>
<td>ECE 355 Adv Topics Computer Networking</td>
<td>3.0 SP</td>
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<tr>
<td>Prerequisites: ECE 186, ECE 255</td>
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</table>

12 units selected from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSCI 211 Object-Oriented Analysis/Design</td>
<td>3.0 SP</td>
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<tr>
<td>Prerequisites: Object-oriented programming experience</td>
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<tr>
<td>CSCI 278 Computer Networks</td>
<td>3.0 FS</td>
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<tr>
<td>Prerequisites: CSCI 152</td>
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<tr>
<td>ECE 210 SW Engr-Requirements &amp; Design</td>
<td>3.0 FA</td>
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<tr>
<td>Prerequisites: CSCI 013B</td>
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<tr>
<td>ECE 228 Communication Systems Design</td>
<td>3.0 SP</td>
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<tr>
<td>Prerequisites: ECE 141</td>
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<tr>
<td>ECE 230 Optics</td>
<td>3.0 SP</td>
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<tr>
<td>Prerequisites: PHYS 0048, PHYS 004C</td>
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<tr>
<td>This course is the same as PHYS 230 which may be substituted.</td>
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<tr>
<td>ECE 231 Lasers and Their Applications</td>
<td>3.0 FA</td>
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<tr>
<td>Prerequisites: PHYS 004C,C</td>
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<tr>
<td>Recommended: ECE 230</td>
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<tr>
<td>This course is the same as PHYS 231 which may be substituted.</td>
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<tr>
<td>ECE 247 Radio Frequency Circuits</td>
<td>3.0 FA</td>
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<tr>
<td>Prerequisites: ECE 145</td>
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<tr>
<td>ECE 248 Solid State Electronics</td>
<td>3.0 FA</td>
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<tr>
<td>Prerequisites: CHEM 037, ECE 145; either MATH 110 or ECE 224.</td>
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<tr>
<td>ECE 295 Control Systems I</td>
<td>4.0 FA</td>
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<tr>
<td>Prerequisites: ECE 141; either M 135 or M 192; ECE 224 (may be taken concurrently).</td>
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<td>ECE 297 Digital Signal Processing</td>
<td>3.0 SP</td>
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<tr>
<td>Prerequisites: MATH 007D, ECE 141 (may be taken concurrently).</td>
<td>2CRS ECE 310 2CRS ECE 312</td>
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<tr>
<td>ECE 333 Electronic Circuits: DSP</td>
<td>3.0 FA</td>
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<tr>
<td>Prerequisites: ECE 186; ECE 297 (may be taken concurrently).</td>
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<tr>
<td>ECE 356 High-Frequency Analog Design</td>
<td>3.0 SP</td>
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<tr>
<td>Prerequisites: ECE 247, ECE 345</td>
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<tr>
<td>ECE 357 Electromagnetic Compatibility</td>
<td>3.0 SP</td>
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<tr>
<td>ECE 397 Seminar in Advanced Topics</td>
<td>1.0-3.0 FS</td>
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<tr>
<td>ECE 398 Independent Study</td>
<td>1.0-6.0 FS</td>
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<tr>
<td>ECE 399 Master’s Study</td>
<td>1.0-6.0 FS</td>
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</tr>
</tbody>
</table>
OPTION IN ELECTRONIC ENGINEERING: 21 units
Undergraduate background:
Programming in C++ and assembly language
Signals and transistors
Advanced analog electronics
Digital systems design
Computer interface circuits
Control systems
Digital Signal Processing
Communication Systems

9 units required:
ECE 247 Radio Frequency Circuits 3.0 FA
Prerequisites: ECE 145.
ECE 356 High-Frequency Analog Design 3.0 SP
Prerequisites: ECE 247, ECE 345.
ECE 357 Electromagnetic Compatibility 3.0 SP
Prerequisites: ECE 345.

12 units selected from:
ECE 210 SW Engr-Requirements & Design 3.0 FA
Prerequisites: CSI 015B.
ECE 230 Optics 3.0 SP
Prerequisites: PHYS 004B, PHYS 004C.
This course is the same as PHYS 230 which may be substituted.
ECE 231 Lasers and Their Applications 3.0 FA
Prerequisites: PHYS 004C. Recommended: ECE 230.
This course is the same as PHYS 231 which may be substituted.
ECE 236 State Machine Design 3.0 SP
Prerequisites: Either CSI 171 or ECE 085.
ECE 244 Consumer Electronics 3.0 Inq
Prerequisites: ECE 146, ECE 228.
ECE 248 Solid State Electronics 3.0 FA
Prerequisites: CHEM 037, ECE 145; either MATH 110 or ECE 224.
ECE 252 Real-Time Embedded Systems 3.0 SP
Prerequisites: CSI 015B; either CSI 171 or ECE 085.
ECE 285 Microprocessor Systems Design 4.0 SP
Prerequisites: ECE 186.
ECE 310 SW Engr Processes Improvement 3.0 SP
Prerequisites: CSI 171 or ECE 210.
ECE 312 SW Engr: Quality Assurance/Test 3.0 FA
Prerequisites: Either ECE 210 or CSI 171.
ECE 330 Advanced Digital Filter Design 3.0 Inq
Prerequisites: ECE 297.
ECE 333 Electronic Circuits: DSP 3.0 FA
Prerequisites: ECE 186; ECE 297 (may be taken concurrently).
ECE 397 Seminar in Advanced Topics 1.0-3.0 FS
ECE 398 Independent Study 1.0-6.0 FS
ECE 399 Master’s Study 1.0-6.0 FS

Graduate Literacy Requirement:
Writing proficiency is a graduation requirement.
Electrical Engineering students will demonstrate their writing competence through successfully completing a departmentally administered examination. Consult the Graduate Coordinator for specific information.

Graduate Grading Requirements:
All courses in the major (with the exceptions of Independent Study-398 and Master’s Study-399) must be taken for a letter grade, except those courses specified by the department as ABC/No Credit (200-level courses), AB/No Credit (300-level courses), or Credit/No Credit grading only. A maximum of 10 units combined of ABC/No Credit, AB/No Credit, and Credit/No Credit grades may be used on the approved program (including 398, 399, and courses outside the major). While grading standards are determined by individual programs and instructors, it is also the policy of the university that unsatisfactory grades may be given when work fails to reflect achievement of the high standards, including high writing standards, expected of students pursuing graduate study.

Students must maintain a 3.0 grade point average in all course work on the approved master’s degree program as well as in all course work taken subsequent to admission to conditionally classified status. In addition, students may not count more than two courses in which they received a grade of C toward the approved program.

The Faculty
Please see Computer Engineering for faculty listing.

Course Offerings
Please see Computer Engineering for course offerings.

MECHANICAL ENGINEERING

Mechanical engineering includes aspects of mechanical design, thermal-fluid systems, applied mechanics, and automation. The mechanical engineering student is prepared in all of these areas in order to analyze and design complex mechanical systems. Graduates can specialize in areas such as energy conversion systems, mechanisms and machines, manufacturing, materials, and automation through electives.

Mechanical Engineering Program Mission
The mechanical engineering program has the primary mission of providing a high-quality undergraduate engineering education by providing students with
1. A curriculum that is firmly grounded in engineering fundamentals
2. A faculty that provides superior teaching and mentoring both in and out of the classroom
3. A faculty whose focus is undergraduate education
4. Class sizes that encourage student participation
5. Project experiences that build on fundamentals and develop team skills
6. Facilities and equipment that are readily accessible
7. An environment that is conducive to learning and encourages students from different genders and backgrounds.
We are committed to offer a broad undergraduate experience that will promote professional growth and prepare students for a variety of engineering careers, graduate studies, and continuing education.

Mechanical Engineering Program Educational Objectives
The program’s educational objectives are best framed in terms of the following goals for its graduates:
1. Mechanical engineering graduates will be effective engineers and problem solvers.
2. They will be well educated in the mechanical engineering sciences.
3. They will be able to use engineering tools that will enhance their productivity.
4. They will be familiar with current technology and how it can be incorporated into their design, analysis, and testing activities. This includes an understanding of manufacturing methods and how one can use computers, sensors, and actuators to automate machines and processes.
5. They will be effective oral, written, and graphical communicators, and be able to function effectively as members of multidisciplinary teams.
6. They will have an appreciation for the individual, society, and human heritage, and they will be aware of the impact of their designs on human-kind and the environment.
7. They will be prepared for a variety of engineering careers, graduate studies, and continuing education.

Mechanical Engineering Design Experience
The mechanical engineering program at CSU, Chico is a traditional balance of engineering science and design. The design sequence for mechanical engineers is a progressive one. The courses which are primarily devoted to design are:
M E 038-Introduction to Engineering Design
M E 138-Mechanical Engineering Design
M E 238A-Mechanical Engineering Design Project I
M E 238B-Mechanical Engineering Design Project II

The freshman experience (M E 038) focuses on the creative aspects of design and gives students an opportunity to practice the engineering design process with little or no emphasis on engineering science. At the junior level (M E 138), there is an opportunity to learn about safety, failure, reliability, codes and standards, and economic considerations, while carrying out detailed design of mechanical components. In the final senior project (M E 238A and M E 238B), students are expected to exercise what they learned throughout the preceding design courses in a final project that includes manufacturing and testing, as well as the more global aspects of design including product realization, economic factors, environmental issues, and social impact. Together, these experiences prepare graduates to be successful practitioners with an awareness of the multitude of issues involved.
THE BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

Total Course Requirements for the Bachelor's Degree: 132 units

See “Requirements for the Bachelor’s Degree” in The University Catalog for complete details on General Education requirements. At least 40 units, including those required for the major, must be upper division.

The department has prepared a suggested Four Year Advising Plan to help students meet all graduation requirements within four years. Please request a plan from your major adviser or view it and other current advising information on the CSU, Chico Web.

General Education Requirement

Mechanical Engineering is a major with modifications to the university’s General Education Requirements. The following requirements, together with the approved General Education courses required for the Mechanical Engineering major (marked with an * below), fulfill the General Education Requirement.

1. Select two courses, one from each of the Core Areas A1 and A2.
2. Select one course from Breadth Area B2.
3. Select one course from Breadth Area C1 or C2 or C3.
4. Select one course from Breadth Area D1 or D2 or D3.
5. Select two courses from the same Upper-Division Theme. (Consult with an adviser or The Class Schedule to determine which two courses in the theme you select meet the Upper-Division Theme Requirement for Mechanical Engineering majors.)

Cultural Diversity Requirement: 6 units

Complete two Cultural Diversity courses, one Ethnic and one Non-Western. (See the “Bachelor’s Degree Requirements” section.) Both courses must also satisfy one of the General Education requirements in order for 132 units to fulfill all requirements for the Mechanical Engineering degree.

American Institutions Requirement: 6 units

This requirement is normally fulfilled by completing HIST 050 and POLS 055. For other alternatives, see the “Bachelor’s Degree Requirements” section.

Literacy Requirement

See “Mathematics and Writing Requirements” in The University Catalog. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfactory completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn below a C- are required to repeat the course and earn a C- or better to receive WP credit. See The Class Schedule for the designated WP courses for each semester. You must pass ENGL 001 (or its equivalent) with a C- or better before you may register for a WP course.

Course Requirements for the Major: 105 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree.

Lower-Division Requirements: 50 units

15 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C E 035</td>
<td>Statics</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>CHEM 037</td>
<td>General Chemistry</td>
<td>4.0 FS *</td>
</tr>
<tr>
<td>ECE 095</td>
<td>Electrical Circuits and Devices</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>ECE 095L</td>
<td>Circuits and Devices Activity</td>
<td>1.0 FS</td>
</tr>
<tr>
<td>MATH 007A</td>
<td>Analytic Geometry and Calculus</td>
<td>4.0 FS *</td>
</tr>
<tr>
<td>MATH 007B</td>
<td>Analytic Geometry and Calculus</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>MATH 007C</td>
<td>Analytic Geometry and Calculus</td>
<td>4.0 FS</td>
</tr>
</tbody>
</table>

Upper-Division Requirements: 55 units

15 courses required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C E 010</td>
<td>Strength of Materials</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>C E 121</td>
<td>Engineering Economy &amp; Statistics</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>M E 025</td>
<td>Engineering Graphics</td>
<td>2.0 FS</td>
</tr>
<tr>
<td>M E 038</td>
<td>Intro to Engineering Design</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>M E 045</td>
<td>Materials Engineering</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>MFGT 051</td>
<td>Intro Manufacturing Engineering</td>
<td>3.0 FS</td>
</tr>
<tr>
<td>MATH 004A</td>
<td>Mechanics</td>
<td>4.0 FS *</td>
</tr>
<tr>
<td>MATH 004B</td>
<td>Electricity and Magnetism</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>MATH 004C</td>
<td>Heat/Wave Motion/Sound/Light</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>MATH 007A</td>
<td>Elem Diff Equation/Vector Calc</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>MATH 007B</td>
<td>Elem Diff Equation/Vector Calc</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>MATH 007C</td>
<td>Elem Diff Equation/Vector Calc</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>MATH 007D</td>
<td>Elem Diff Equation/Vector Calc</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>PHYS 004A</td>
<td>Mechanics</td>
<td>4.0 FS *</td>
</tr>
<tr>
<td>PHYS 004B</td>
<td>Electricity and Magnetism</td>
<td>4.0 FS</td>
</tr>
<tr>
<td>PHYS 004C</td>
<td>Heat/Wave Motion/Sound/Light</td>
<td>4.0 FS</td>
</tr>
</tbody>
</table>

3 units selected from:

Any upper-division mechanical engineering elective.

3 units selected from:

A technical elective with adviser’s approval.

Grading Requirement:

All courses taken to fulfill major course requirements must be taken for a letter grade, except those courses specified by the department as Credit/No Credit grading only.

Fundamentals of Engineering Examination (EIT)

The Fundamentals of Engineering Examination, also known as the Engineer-in-Training (EIT) Exam, is the first of two exams that the California State Board of Registration requires to be passed to be a licensed professional engineer. Prior to graduation, those majoring in Mechanical Engineering must apply to the California State Board of Registration and take the exam. Passing the exam is not required for graduation.

Advising Requirement:

Advising is strongly recommended for all majors in this degree program.
Honors in the Major

Honors in the Major is a program of independent work in your major. It involves 6 units of honors course work completed over two semesters. Your Honors work will be recognized at your graduation, on your permanent transcripts, and on your diploma. It is often accompanied by letters of commendation from your mentor in the department or the department chair. Most importantly, however, the Honors in the Major program allows you to work closely with a faculty mentor in your area of interest on an original research project or creative endeavor. This year-long collaboration allows you to work in your field at a professional level and culminates in a public presentation of your work. Students sometimes take their projects beyond the university for submission in professional journals, presentation at conferences, and competition in shows; such experience is valuable for graduate school and later professional life.

Some common features of Honors in the Major program are:
1. You must take 6 units of Honors in the Major course work. At least 3 of these 6 units are independent study (299H) as specified by your department. You must complete each class with a minimum grade of B.
2. You must have completed 9 units of upper-division course work or 21 overall units in your major before you can be admitted to Honors in the Major. Check the requirements carefully, as there may be specific courses that must be included in these units.
3. Your cumulative GPA should be at least 3.5 or within the top 5 percent of majors in your department.
4. Your GPA in your major should be at least 3.5 or within the top 5 percent of majors in your department.
5. Most students apply for or are invited to participate in Honors in the Major during the second semester of their junior year. Then they complete the 6 units of course work over the two semesters of their senior year.
6. Your honors work culminates with a public presentation of your Honors project.

While Honors in the Major is part of the Honors Program, each department administers its own program. Please contact your major department or major adviser for further information.

The Faculty

Mechanical Engineering
Chuen H. Hsu, 1982, Professor, PhD, Iowa St U.
Gregory A. Kalillo, 1988, Professor, PhD, WA State U.
Ronald Roth, 1986, Chair, Professor, MD, PhD, Stanford U.
Jimmy Tan-atitchat, 1987, Professor, PhD, IL Inst of Tech.
Ramesh M. Varahamurti, 1984, Professor, PhD, WA State U.
Michael G. Ward, 1988, Associate Dean, Professor, PE, PhD, Stanford U.

Emeritus Faculty
Charles Allen, 1966, Professor Emeritus, PE, PhD, UC Davis.
Dennis O. Blacketter, 1984, Professor Emeritus, PE, PhD, U Arizona.
Robert G. Colwell, 1966, Professor Emeritus, PE, PhD, Oregon State Univ.
William A. Gelonek, 1982, Professor Emeritus, PE, MA, CSU Chico.
Ralph C. Huntsinger, 1971, Professor Emeritus, PE, PhD, Montana State Univ.
Donald S. Smith, 1969, Professor Emeritus, PhD, UC Berkeley.

Adjunct Faculty
Darby Makel, 2001, Lecturer A, PhD, UC Davis.
Nick Repanich, 2001, Lecturer A, BS, Cal Poly.
PE designates Registered Professional Engineer

Mechanical Engineering Course Offerings

Please see the section on “Course Description Symbols and Terms” in the University Catalog for an explanation of course description terminology. The course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web.

M E 025 Engineering Graphics 2.0 Fa/Spr
An introduction to graphical design and problem solving using both traditional and computer-aided drawing methods. 1.0 hour discussion, 3.0 hours laboratory. Special fee required; see Class Schedule.

M E 038 Introduction to Engineering Design 3.0 Fa/Spr
An introduction to the art and science of engineering design. Techniques for enhancing creative problem solving. Use of a computer to control devices. Projects requiring design, construction, and testing of devices, including a computer-controlled electromechanical system. 2.0 hours discussion, 2.0 hours activity. Special fee required; see Class Schedule.

M E 045 Materials Engineering 3.0 Fa/Spr
Principles of JAN 007, PHYS 004A.
Processing, structure, properties, and performance of engineering materials. Applied knowledge of material properties as engineering design parameters. Advanced manufacturing processes, including microfabrication. 1.0 hour discussion, 3.0 hours laboratory. 2.0 hours activity. Special fee required; see Class Schedule. CAN ENGR 4.

M E 135 Dynamics 3.0 Fa/Spr
Prerequisites: C E 015; MATH 007D (may be taken concurrently).
Kinematics and dynamics of mechanical systems composed of rigid bodies. Moments and products of inertia, forces of interaction, inertia forces and torques. Equations of motion of non-planar systems.

M E 138 Mechanical Engineering Design 3.0 Spring
Design and performance of machine components and systems subjected to both steady and variable loading conditions. Introduction to failure theories, reliability, use of codes and standards, and standard design practices. 2.0 hours discussion, 2.0 hours activity.

M E 142 Equation Solving Techniques for Design 4.0 Fall
Prerequisites: MATH 007D. Recommended: PHYS 004A.
Numerical analysis, analytical methods, and equation solving techniques for mechanical engineering design. Structured problem formulation, parametric studies, introduction to programming concepts, and optimization for design. 3.0 hours discussion, 2.0 hours activity.

M E 152 Thermodynamics 3.0 Fa/Spr
Prerequisites: PHY 004A. Recommended: PHY 004C.
Properties of substances, ideal gas equation of state, heat and work, laws of thermodynamics, analysis of closed and open systems, entropy, gas and vapor power cycles, refrigeration, psychrometrics.

M E 192 Elements of Engineering Mechanics 3.0 Fall
Prerequisites: MATH 007D, PHY 004A.

M E 198 Special Topics 1.0-3.0 Inquire
Prerequisites: To be established when course is formulated.
The course is for special topics offered as 198A-C for 1.0 to 3.0 units respectively. Typically the topic is offered on a one-time-only basis and may vary from term to term and be different for different sections. See Class Schedule for the specific topic being offered.

M E 199 Special Problems 1.0-3.0 Inquire
Prerequisites: Approval of supervising faculty member.
This course is an independent study of special problems offered as 199A-C for 1.0 to 3.0 units respectively. See the department office for information on registration. Credit/no credit grading only.

M E 201 Control System Design 3.0 Fall
Prerequisites: M E 135, M E 261.
Modeling and simulation of dynamic system performance. Control system design for continuous systems using both analog and digital control techniques.

M E 205 Advanced Materials Engineering 3.0 Inquire
Prerequisites: MATH 007D, M E 045. Recommended: C E 101.
Design, manufacture, and practical applications of advanced engineering materials. Failure analysis and prevention of material failure in mechanical design. Microfabrication of microelectromechanical devices.

M E 206 Fracture Mechanics 3.0 Inquire
Prerequisites: MATH 007D, M E 045. Recommended: C E 101.
Theories and practical applications of linear elastic fracture mechanics and elastic-plastic fracture mechanics. Design against fatigue, fracture criteria, and fracture control in engineering design.

M E 207 Polymer Engineering 3.0 Inquire
Prerequisites: MATH 007D, M E 045.
Major topics include polymer structure and synthesis, polymerization mechanisms, crystallinity, viscoelastic behavior in manufacturing processes and in service, deformation mechanisms, manufacture, and design with polymers. 2.0 hours discussion, 2.0 hours activity.
M E 238H Mechanical Engineering Design Project I 3.0 Inquire
Prerequisites: M E 238A. Recommended: M E 121, M E 242. 1.5 hours discussion, 2.0 hours activity.
Continuation of the capstone design project from M E 238A. Implementation of the capstone design project, including fabrication, testing, and evaluation of a working prototype. Must be taken the semester immediately following M E 238A. 3.0 hours laboratory. Formerly M E 267.

M E 238B Mechanical Engineering Design Project II 1.0 Spring
Prerequisites: M E 238B. Recommended: M E 121, M E 242. M E 259. Implementation of the capstone design project from M E 238B. 2.0 hours discussion, 3.0 hours laboratory. This is a writing proficiency, WP; course; a grade of C- or better certifies writing proficiency for majors.

M E 238C Mechanical Engineering Design Project III-Honors 3.0 Spring
Prerequisites: M E 238C. Recommended: M E 121, M E 242. M E 259. System design methods applied to mechanical systems. Group design projects. Consideration of the manufacturing cost, and environmental and social impact. Oral and written presentation of results. Initial design of the capstone design project to be continued in M E 238B. 2.0 hours discussion, 3.0 hours laboratory. This is a writing proficiency, WP; course; a grade of C- or better certifies writing proficiency for majors.

M E 240 Mechanical Vibrations 3.0 Inquire
Prerequisites: M E 135. Dynamics of forced vibrations of lumped parameter systems, transient vibrations, systems with several degrees-of-freedom. Free and forced vibrations of lumped parameter systems, transient vibrations, systems with several degrees-of-freedom.

M E 241 Rotor Dynamics 3.0 Inquire
Prerequisites: M E 135, M E 261. Dynamics of distributed mass on a flexible rotor, including modal analysis of free and forced vibration, balancing, support-bearing dynamics, rotor rub and similar phenomena. Dynamics of rotor malfunctions with vibration measurement and analysis. Diagnosis of rotor malfunctions with vibration measurement and analysis.

M E 242 Finite Element Analysis 3.0 Spring
Prerequisites: C E 101, M E 142 (or faculty permission). Recommended: M E 045, PHYS 004C. Development of finite element formulation from fundamental governing engineering equations. Coverage includes areas ranging from elasticity, vibration, and heat transfer to acoustics and composites. 2.0 hours discussion, 2.0 hours activity.

M E 245 Dynamics of Machinery 3.0 Inquire

M E 250 Thermal Packaging 3.0 Spring
Prerequisites: M E 259. Recommended: M E 142. Principles of mass, momentum, and energy transport; applications of heat transfer to electrical/electronic component packaging; design of enclosures, heat sinks, and other component cooling schemes. Not an approved M E elective.

M E 252 Thermal-Fluid Systems 4.0 Spring
Prerequisites: M E 259. Recommended: M E 142. Analysis, design, and testing of components and systems involving power generation, energy conversion, heat, refrigeration, air-conditioning, and combustion. 3.0 hours discussion, 3.0 hours laboratory.

M E 253 Air Pollution Control 3.0 Inquire
Prerequisites: C E 150 (or faculty permission), CHEM 037; either CHEM 210A or M E 152. Recommended: C E 121, M E 142. Air pollution legislation and regulation.

M E 254 Aerodynamics 3.0 Inquire
Prerequisites: C E 150, MATH 007D, M E 152. Recommended: M E 142. Flow around elementary shapes, concepts of flow circulation, lift and drag. Incompressible inviscid flows around thin airfoils and wings of finite span.

M E 255 Building Energy Engineering 3.0 Inquire

M E 259H Honors Project 3.0 Inquire
Prerequisites: Completion of 12 units of upper-division M E courses, faculty permission. Open by invitation to M E majors who have a GPA among the top 5% of M E students based upon courses taken at CSU, Chico. This is an “Honors in the Major” course; a grade of B or higher in 6 units of M E 299H certifies the designation of “Honors in the Major” to be printed on the transcript and the diploma. If taken twice, prerequisite to the second semester is a grade of B or higher in the first semester. Each 3-unit course will require both formal written and oral presentations. You may take this course more than once for a maximum of 6.0 units.

M E 305 Control Systems Engineering 3.0 Inquire
Prerequisites: M E 201, faculty permission. Computer-aided analysis and design of automatic control techniques to mechanical engineering problems. Single and multivariable feedback systems. Controllability, observability, and state estimation. Simulation of control systems.

M E 335 Advanced Dynamics 3.0 Inquire
Prerequisites: M E 135. Formulation of equations of motion of mechanical systems using Kane’s dynamics equations. Holonomic and non-holonomic systems. Linearization and numerical solution of equations of motion.

M E 336 Advanced Gas Dynamics 3.0 Inquire
Prerequisites: M E 259, faculty permission. Advanced analysis of fluid flow in engineering processes; application of Navier-Stokes equations to laminar and turbulent flows, with introduction to computational fluid dynamics (CFD); selected design applications, such as piping systems, lubrication, aerodynamics, turbomachinery, multiphase flow, and flow measurement.

M E 354 Fluids Engineering 3.0 Inquire
Prerequisites: C E 150, M E 142, faculty permission. Advanced analysis of fluid flow in engineering processes; application of Navier-Stokes equations to laminar and turbulent flows, with introduction to computational fluid dynamics (CFD); selected design applications, such as piping systems, lubrication, aerodynamics, turbomachinery, multiphase flow, and flow measurement.

M E 356 Advanced Topics in Heat and Mass Transfer 3.0 Inquire
Prerequisites: M E 259, faculty permission. Application of thermal energy and mass diffusions to complex heat and mass transfer processes; variable property conduction, numerical methods, boiling and condensation, spectral analysis of thermal radiation, multi-mode problems, compact heat exchangers, gas absorption and adsorption, thermoelectric and heat pipe applications.
MECHATRONIC ENGINEERING

Mechatronic Engineering is a new discipline that combines many of the skills of a mechanical engineer with those of a computer engineer and an electrical engineer. The mechatronic engineering graduate is prepared to design "intelligent" products such as "jitter-free" camcorders, active vehicle suspension systems that adjust to road conditions, anti-lock braking systems, and laser printers.

Mechatronic Engineering Program Mission

The mechatronic engineering program has the primary mission of providing a high-quality undergraduate engineering education by providing students with

1. A curriculum that is firmly grounded in engineering fundamentals
2. A faculty that provides superior teaching and mentoring both in and out of the classroom
3. A faculty whose focus is undergraduate education
4. Class sizes that encourage student participation
5. Project experiences that build on fundamentals and develop team skills
6. Facilities and equipment that are readily accessible
7. An environment that is conducive to learning and encourages students from different genders and backgrounds.

We are committed to offer a broad undergraduate experience that will promote professional growth and prepare students for a variety of engineering careers, graduate studies, and continuing education.

Mechatronic Engineering Program Educational Objectives

The program's educational objectives are best stated in terms of the goals for its graduates:

1. Mechatronic engineering graduates will be effective interdisciplinary engineers and problem solvers.
2. They will be well educated in the basic engineering sciences and fundamentals of mechanical, electrical, and computer engineering.
3. They will be able to design, analyze, and test "intelligent" products or processes that incorporate suitable computers, sensors, and actuators.
4. They will be able to use engineering tools that will enhance their productivity.
5. They will be able to design, analyze, and test "intelligent" products or processes that incorporate suitable computers, sensors, and actuators.
6. They will have an appreciation for the individual, society, and human heritage, and they will be aware of the impact of their designs on human-kind and the environment.
7. They will be prepared for a variety of engineering careers, graduate studies, and continuing education.

Mechatronic Engineering Design Experience

The design experience for mechatronic engineers is integrated throughout the curriculum. The courses which include design experiences are:

- ECE 085-Logic Design Fundamentals
- ECE 086-Processor Architecture and Assembly Language Programming
- ECE 145-Electronics I
- ECE 146-Electronics II
- ECE 186-Digital Systems Design
- ECE 188-Computer Interface Circuits
- ME 138-Mechanical Engineering Design
- MECA 238A-Mechatronic Engineering Design Project I
- MECA 238B-Mechatronic Engineering Design Project II

At the freshman level, logic networks are designed in ECE 085. At the sophomore level, software design experience teaches students to think logically in developing efficient, structured computer programs in ECE 086. At the junior level, there is an opportunity to learn about safety, failure, reliability, codes and standards, and economic considerations, while carrying out detailed design of mechanical components in ME 138, electrical circuits and systems in ECE 145, ECE 146, ECE 186, and ECE 188. In the final senior project (MECA 238A and MECA 238B), students are expected to exercise what they learned throughout the preceding design courses in a final project that includes assembly and testing, as well as the more global aspects of design including product realization, economic factors, environmental issues, and social impact. Together, these experiences prepare graduates to be successful practitioners with an awareness of the multitude of issues involved.
THE BACHELOR OF SCIENCE IN MECHATRONIC ENGINEERING

Total Course Requirements for the Bachelor's Degree: 132 units
See “Requirements for the Bachelor’s Degree” in The University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

The department has prepared a suggested Four Year Advising Plan to help students meet all graduation requirements within four years. Please request a plan from your major adviser or view it and other current advising information on the CSU, Chico Web.

General Education Requirement

Mechatronic Engineering is a major with modifications to the university’s General Education Requirements. The following courses, together with the approved General Education courses required for the Mechatronic Engineering major marked with an * below, fulfill the General Education Requirement.

1. Select two courses, one from each of the Core Areas A1 and A2.
2. Select one course from Breadth Area B2.
3. Select one course from Breadth Area C1 or C2 or C3.
4. Select one course from Breadth Area D1 or D2 or D3.
5. Select two courses from the same Upper-Division Theme. (Consult with an adviser or The Class Schedule to determine which two courses in the theme you select meet the Upper-Division Theme Requirement for Mechatronic Engineering majors.)

Cultural Diversity Requirement: 6 units

Complete two Cultural Diversity courses, one Ethnic and one Non-Western. (See the “Bachelor’s Degree Requirements” section.) Both courses must also satisfy one of the General Education Requirements in order for 132 units to fulfill all requirements for the Mechatronic Engineering degree.

American Institutions Requirement: 6 units

This requirement is normally fulfilled by completing HIST 050 and POLS 055. For other alternatives, see the “Bachelor’s Degree Requirements” section.

Course Requirements for the Major: 105 units

The following courses, or their approved transfer equivalents, are required of all candidates for this degree.

Lower-Division Requirements: 54 units

17 courses required:

C E 035 Statics 3.0 FS
Prerequisites: M E 025, PHYS 004A; MATH 007C (may be taken concurrently).
CHEM 037 General Chemistry
Prerequisites: Second-year high school algebra; one year high school chemistry or CHEM 016. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)
ECE 085 Logic Design Fundamentals 3.0 FS
Prerequisites: Either ECE 084 or M E 025 or permission of instructor.
Corequisites: CHEM 097.
ECE 086 Processor Architecture/Assembly Lang 3.0 FS
Prerequisites: Either CSCI 015A or ECE 090.
ECE 090 Algorithms & Programs for Engrs 3.0 FS
Prerequisites: MATH 007A is recommended.
ECE 095 Electrical Circuits and Devices 3.0 FS
Prerequisites: PHYS 004B (may be taken concurrently), MATH 007C (may be taken concurrently).
Corequisites: ECE 095L.
ECE 095L Circuits and Devices Activity 1.0 FS
Corequisite: ECE 095.
ECE 097 Simulation and Analysis Tools 1.0 FS
Prerequisites: Either ECE 084 or M E 025 or permission of instructor.
Corequisites: ECE 085.
MATH 007A Analytic Geometry and Calculus 4.0 FS *
Prerequisites: Completion of ELM requirement; both MATH 004 and MATH 006 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.
MATH 007B Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007A with a grade of C- or higher.
MATH 007C Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007B with a grade of C- or higher.
MATH 007D Elem Diff Equation/Vector Calc 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007C with a grade of C- or better.
M E 025 Engineering Graphics 2.0 FS
M E 045 Materials Engineering 3.0 FS
Prerequisites: CHEM 037, PHYS 004A.

Upper-Division Requirements: 51 units

15 courses required:

C E 101 Strength of Materials 4.0 FS
Prerequisites: C E 035, MATH 007C. Recommended: M E 045.
C E 121 Engineering Design, Economics & Statistics 3.0 FS
Prerequisites: Either C E 020 or CSCI 065 or ECE 090 or M E 038; CMST 011 (may be taken concurrently); junior standing (completion of 60 college units).
ECE 140 Linear Circuits 3.0 FS
Prerequisites: ECE 095; ECE 097, MATH 007D (both may be taken concurrently).
ECE 145 Electronics I 3.0 FS
Prerequisites: ECE 095, ECE 095L; ECE 097, ECE 140 (both may be taken concurrently).
ECE 146 Electronics II 4.0 FS
Prerequisites: ECE 145.
ECE 186 Digital Systems Design 3.0 FS
Prerequisites: ECE 085, ECE 086; either ECE 030 or ECE 031 or ECE 095 and ECE 095L.
ECE 188 Computer Interface Circuits 3.0 FS
Prerequisites: ECE 085, ECE 145.
ENGR 195 Lifelong Development Engineers 3.0 FS
Prerequisites: ENGL 001; graduation in engineering expected within 12 months.
M E 135 Dynamics 3.0 FS
Prerequisites: C E 035; MATH 007D (may be taken concurrently).
M E 138 Mechanical Engineer Design 3.0 SP
Prerequisites: C E 101, M E 045. Recommended: M E 038, M E 135, M E 142, MGT 051.
M E 201 Control System Design 4.0 FA
Prerequisites: M E 135, M E 261.
M E 250 Thermal Packaging 3.0 SP
Prerequisites: MATH 007D, PHYS 004C.
M E 261 Measurements & Instrumentation 3.0 SP
Prerequisites: C E 121, ECE 095, ECE 095L; either ECE 090 or M E 142.
MECA 238A Mechatronic Engr Design Project I 3.0 FA
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher, ECE 186, ECE 136, M E 261. Recommended: C E 121.
MECA 238B Mechatronic Engr Design Project II 1.0 SP
Prerequisites: MECA 238A. Recommended: C E 121.

1 course selected from:

ECE 187 System Architecture/Performance 3.0 FA
Prerequisites: Either CSCI 171 or ECE 186 (may be taken concurrently).
ECE 236 State Machine Design 3.0 SP
Prerequisites: Either CSCI 171 or ECE 085.

2 units selected from:

A technical elective with adviser’s approval.

Grading Requirement:

All courses taken to fulfill major course requirements must be taken for a letter grade, except those courses specified by the department as Credit/No Credit grading only.

Advising Requirement:

Advising is strongly recommended for all majors in this degree program. Consult your undergraduate adviser for specific information.

Honors in the Major

Honors in the Major is a program of independent work in your major. It involves 6 units of honors course work completed over two semesters. Your Honors work will be recognized at your graduation, on your permanent transcripts, and on your diploma. It is often accompanied by letters of commendation from your mentor in the department or the department chair. Most importantly, however, the Honors in the Major program allows you to work closely with a faculty mentor in your area of interest on an original performance or research project. This year-long collaboration allows you to work in your field at a professional level and culminates in a public presentation of your work. Students sometimes take their projects beyond the university for submission in professional journals, presentation at conferences, or competition in shows; such experience is valuable for graduate school and later professional life.
4. Your GPA in your major should be at least 3.5 or within the top 5 percent of majors in your department. While Honors in the Major is part of the Honors Program, each department administers its own program. Please contact your major department or major adviser for further information.

The Faculty

Mechatronic Engineering
Roy E. Crosbie, 1983, Director of Academic Develop., Professor, PhD, UK: Univ of Liverpool.
Chuen H. Hsu, 1982, Professor, PhD, Iowa St U.
Gregory A. Kalilo, 1988, Professor, PhD, WA State U.
Hede Ma, 2000, Assoc Professor, PhD, SUNY Binghamton.
Albert O. Richardson, 1989, Professor, PhD, Penn St U.
Ronald Roth, 1986, Chair, Professor, MD; PhD, Stanford U.
Jimmy Tan-atichat, 1987, Professor, PhD, IL Inst of Tech.
Ben-Dau Tseng, 1982, Professor, PhD, U Windsor.
Ramesh M. Varahamurti, 1984, Professor, PhD, WA State U.
Michael G. Ward, 1988, Associate Dean, Professor, PE, PhD, Stanford U.
Larry L. Wear, 1972, Chair, Professor, PhD, Santa Clara Univ.
John J. Zenor, 1982, Professor, PhD, U Missouri.

Adjunct Faculty
Nick Repanich, 2001, Lecturer A, BS, Cal Poly.

PE designates Registered Professional Engineer

Mechatronic Engineering Course Offerings

Please see the section on “Course Description Symbols and Terms” in The University Catalog for an explanation of course description terminology and symbols, the course numbering system, and course credit units. All courses are lecture and discussion and employ letter grading unless otherwise stated. Some prerequisites may be waived with faculty permission. Many syllabi are available on the Chico Web.

MECA 198 Special Topics 1.0-3.0 Inquire
Prerequisites: To be established when course is formulated.
This course is for special topics offered as 198A-C for 1.0 to 3.0 units respectively. Typically the topic is offered on a one-time-only basis and will vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered.

MECA 199 Special Problems 1.0-3.0 Inquire
Prerequisites: Approval of supervising faculty member.
This course is an independent study of special problems offered as 199A-C for 1.0 to 3.0 units respectively. See the department office for information on registering. Credit/no credit grading only.

MECA 202 Motion and Machine Automation 3.0 Inquire
Prerequisites: ECE 095, ECE 095L, either M E 135 or M E 192. Recommended: Either ECE 295 or M E 201.
This course combines and applies machine automation concepts in electrical circuits, fundamental mechanics, control systems, and programming. Lectures address specific technical topics such as motor sizing, gearing, couplings, ground loops, servo control loops, regeneration, networking, I/O, power supplies, vibration and resonance, and troubleshooting. Labs simulate application concepts such as point-to-point moves, registration, following, camming, and CAD to-Motion. 2.0 hours discussion, 3.0 hours laboratory.

MECA 238A Mechatronic Engineering Design Project I 3.0 Fall
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher, ECE 186, M E 138, M E 261. Recommended: C E 121.
System design methods applied to mechatronic systems. Group design projects. Consideration of the manufacturing cost, and environmental and social impact. Oral and written presentation of results. Initial design of the capstone design project to be continued in MECA 238B. 2.0 hours discussion, 3.0 hours laboratory. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors.

MECA 238B Mechatronic Engineering Design Project II 1.0 Spring
Prerequisites: MECA 238A. Recommended: C E 121.
Continuation of the capstone design project from MECA 238A. Implementation of the capstone design project, including fabrication, testing, and evaluation of a working prototype. Must be taken the semester immediately following MECA 238A. 3.0 hours laboratory. Formerly MECA 267.

MECA 238H Mechatronic Engineering Design Project I-Honors 3.0 Inquire
Prerequisites: ENGL 001 (or its equivalent) with a grade of C- or higher, ECE 186, M E 138, M E 261, acceptance into the Honors in the Major program. Recommended: C E 121.
System design methods applied to mechatronic systems. Group design projects. Consideration of the manufacturing cost, and environmental and social impact. Oral and written presentation of results. Initial design of the Honors/capstone design project to be continued in MECA 238B. 2.0 hours discussion, 3.0 hours laboratory. This is a writing proficiency, WP, course; a grade of C- or better certifies writing proficiency for majors.

MECA 289 Industrial Internship 1.0-3.0 Fa/Spr
Prerequisites: Approval of faculty internship coordinator prior to off-campus assignment.
Engineering experience in an industrial setting. Minimum duration of 400, 700, or 1,000 hours of work (for 1.0, 2.0, or 3.0 units respectively) under the direct supervision of an on-site engineering supervisor. On completion of the internship, a written report prepared under the direction of a faculty member is required. May be taken only once for credit. Credit/no credit grading only.

MECA 298 Advanced Topics in Mechatronics 1.0-3.0 Inquire
Prerequisites: To be established when course is formulated.
This course is for special topics offered as 298A-C for 1.0 to 3.0 units respectively. Typically the topic is offered on a one-time-only basis and will vary from term to term and be different for different sections. See The Class Schedule for the specific topic being offered.

MECA 299H Honors Project 3.0 Inquire
Prerequisites: Completion of 12 units of upper-division ECE, M E, or MECA courses, faculty permission.
Open by invitation to MECA majors who have a GPA among the top 5% of MECA students based on courses taken at CSU, Chico. This is an “Honors in the Major” course; a grade of B or higher in 6 units of 299H certifies the designation of “Honors in the Major” can be printed on the transcript and the diploma. If taken twice, prerequisite to the second semester is a grade of B or higher in the first semester. Each 3-unit course will require both formal written and oral presentations. You may take this course more than once for a maximum of 6.0 units.
INTERDISCIPLINARY
ENGINEERING PROGRAMS

THE CERTIFICATE IN
ENVIRONMENTAL ENGINEERING

Prerequisites for admission to the certificate program:
The program is designed for individuals who have a civil engineering degree, an engineering degree and extensive experience in civil engineering, or senior standing in a civil engineering program at another university. The following courses, their approved transfer equivalents, or appropriate work experience are required of all candidates prior to admission to this certificate program. Applicants should consult with an adviser to determine whether these requirements have been fully satisfied or whether additional courses are required.

BIOL 008 Principles of Biology 3.0 FS *
Prerequisites: High school biology and chemistry.

CHEM 037 General Chemistry 4.0 FS *
Prerequisites: Second-year high school algebra; one year high school chemistry or CHEM 016. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)

C E 035 Statics 3.0 FS
Prerequisites: M E 025, PHYS 004A; MATH 007C (may be taken concurrently).
C E 150 Fluid Mechanics 4.0 FS
Prerequisites: C E 035, MATH 007C; either C E 020 or ECE 090 or M E 038 (may be taken concurrently); Recommended: M E 135 (may be taken concurrently).
CHEM 090 Algorithms & Programs for Engrs 3.0 FS
Prerequisites: MATH 007A is recommended.

MATH 007A Analytic Geometry and Calculus 4.0 FS *
Prerequisites: Completion of ELM requirement; both MATH 004 and MATH 006 (or high school equivalent); a score that meets department guidelines on a department administered calculus readiness exam.

MATH 007B Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007A with a grade of C- or higher.
MATH 007C Analytic Geometry and Calculus 4.0 FS
Prerequisites: Completion of ELM requirement; MATH 007B with a grade of C- or higher.
M E 025 Engineering Graphics 2.0 FS
M E 152 Thermodynamics 3.0 FS
Prerequisites: PHYS 004A, Recommended: PHYS 004C.

Physics 004A Mechanics 4.0 FS *
Prerequisites: High school physics or faculty permission. Concurrent enrollment in or prior completion of MATH 007B (second semester of calculus) or equivalent.

Course Requirements for the Certificate: 24 units
The following courses, or their approved transfer equivalents, are required of all candidates for this certificate.

A grade point average of 2.5 or better must be earned for courses required for the certificate program, with at least a “C” earned in each course.

3 courses required:
BIOL 011 General Microbiology 4.0 FS
Prerequisites: A college course in biology and in general chemistry.
CHEM 038 General Chemistry 4.0 FS
Prerequisites: CHEM 037.
C E 288 Environmental Engineering I 4.0 SP
Prerequisites: CHEM 037; C E 150.

2 courses selected from:
C E 252 Engineering Hydrology 3.0 Inq
Prerequisites: MATH 007A. Completion of C E 150 is recommended.
C E 291 Environmental Engineering II 3.0 Inq
Prerequisites: C E 150. Completion of C E 288 is recommended.
C E 293 Water Quality Engineering 3.0 Inq
Prerequisites: C E 150. Completion of C E 288 is recommended.
C E 295 Solid Waste Management 3.0 Inq
Prerequisites: CHEM 037; BIOL 008; C E 150.

2 courses selected from:
BIOL 259 Aquatic Ecology 4.0 FA
Prerequisites: BIOL 006B, CHEM 038.
GEOG 119 Intro to Geographical Info Syst 3.0 FS
Prerequisites: GEOG 110 or equivalent.
GEOG 218 Remote Sensing 3.0 SP
Prerequisites: GEOG 108 and GEOG 115 or equivalents.
GEOS 215 Hydrogeology 3.0 SP
Prerequisites: CHEM 037, GEOS 106; MATH 007A; either PHYS 002A or PHYS 004A; either GEOS 070 or GEOS 180. Recommended: GEOS 107.
GEOS 260 Water Resources Management 3.0 SP
Prerequisites: Upper-division standing; GEOS 130 or GEOS 180.
GEOS 270 Environmental/Engineering Geol 3.0 S2
Prerequisites: GEOG 002; GEOG 003; GEOS 106. For majors in related sciences and technical fields, GEOS 002.
M E 253 Air Pollution Control 3.0 Inq
Prerequisites: C E 150 (or faculty permission), CHEM 037; either CHEM 210A or M E 152. Recommended: C E 121, M E 142.