EE 247. Modern Semiconductor Devices (3)
Prerequisite: ECE 114 or permission of coordinator. Crystal structures and elastic constants; lattice energy and vibrations; thermal and dielectric properties of solids; ferroelectric and magnetic properties of crystals; free electron model of metals; quantum statistics distributions; band theory; semiconductor crystals; superconductivity; photoconductivity and luminescence; dislocations.

EE 249. Advanced Communication Engineering (3)
Prerequisite: ECE 245 or permission of coordinator. The measure of information; noiseless coding; models of communication channels; channel capacity; discrete memoryless channels; error correcting codes; information sources; discrete channels with memory; continuous channels.

EE 251. Antennas and Propagation (3)
Wave equation, plane waves, metallic boundary conditions; wave equation for the potentials Lorentz transformation; covariant formulation of electrodynamics; radiation from a moving charge; scattering and dispersion; Hamiltonian formulation of Maxwell's equations.

EE 255. Digital Signal Processing (3)
Prerequisite: ECE 107 or permission of coordinator. Discrete-time signals; Fourier transforms; random discrete-time signals; filtered random signals; correlation functions; power-spectral-density estimation; cross-spectral estimates; detection of signals in noise; estimation of signals in noise; recursive estimation of time-varying signals.

EE 257. Optical Communications and Lasers (3)
Quantum measure of light, linear, elliptical, and circular polarization; optical waveguide equations, ray and mode theory; source and detector characteristics; attenuation, dispersion, and noise effects; correlation, spectral density, noise equivalent bandwidth, coding, modulation, multiplexing techniques; systems and link design.

EE 259. Radar System Design (3)
The nature and history of radar, the radar equation, PRF and range considerations, CW and FM radars. MTI and pulse-Doppler radars, tracking radars. Radar power generation, antenna types and design considerations, receivers, detection of signals in noise, extraction of information from radar signals, propagation of radar wave, the effects of clutter, weather and interference. Examples of radar system engineering and design.

EE 290. Independent Study (1-3; max total 6)
Prerequisite: graduate status in engineering. See *Academic Placement — Independent Study*. Approved for ***RP*** grading.

EE 291T. Topics in Electrical Engineering (1-3; max total 6)
Prerequisite: graduate status in engineering or permission of instructor. Selected electrical engineering subjects not in current courses.

EE 298. Project (3; max total 3)
Prerequisite: graduate status in engineering. See *Criteria for Thesis and Project.* Independent investigation of advanced character such as analysis and/or design of special engineering systems or projects; critical review of state-of-the-art special topics, as the culminating requirement of the master's degree. Abstract required. Approved for ***RP*** grading.

EE 299. Thesis (3-6; max total 6)
Prerequisite: see *Criteria for Thesis and Project.* Preparation, completion, and submission of an acceptable thesis for master's degree. Approved for ***RP*** grading.

Geomatics Engineering
James K. Crossfield, *Coordinator*
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Program Description

Geomatics engineers manage the global spatial infrastructure. This effort includes real property boundary determination, digital mapping, Geographic Information Systems (GIS), Global Positioning Systems (GPS), remote sensing, photogrammetric mapping, applications programming, project management, and construction layout activities. Students use a wide selection of specialized equipment while acquiring a solid theoretical background. Integration of geomatics engineering design concepts spans a sequence of courses throughout the curriculum. Intensive design coursework during the senior year provides a culminating focus. Coursework containing design components includes the following: Computer-Aided Mapping (GME 66) first year; Route and Construction Surveying (GME 40) second year; Stereophotogrammetry (GME 123) and Digital Mapping (GME 126) third year; Subdivision Design (GME 159) and two upper-level technical design courses — Senior Project (GME 180) and Project Design (GME 181) — senior year.

Career Opportunities

The need for specialists in geomatics engineering continue to grow with rapid advancements in analytical photogrammetry, geographic information systems, and inertial and satellite positioning technologies. Most graduates of this program have been employed by federal and state government agencies, the petroleum industry, and private consulting firms.

Mission of Geomatics Engineering

The mission of the Geomatics Engineering Program is to provide an educational experience that enriches the lives of students. The program teaches necessary discipline related knowledge and skills to prepare students for their profession. Students learn how to protect the health and welfare of the public while expanding their base of knowledge through research and scholarship.

Educational Objectives of the Instructional Program

- Provide a broad based curriculum in geomatics engineering that generates graduates having competency in boundary surveying, geographic information systems (GIS), photogrammetry, digital mapping, and geodesy (GPS).
- Provide graduates with the knowledge and skills necessary to pursue professional careers in the geomatics engineering arena.
- Provide graduates with the educational rigor necessary to prepare them for graduate educational experiences in geomatics education or related fields if desired.
- Provide students with leadership opportunities associated with geomatics engineering related student clubs (SAGE, ACSM, CLSA, ASPRS, etc.), the Annual Geomatics Engineering Conference, *The Foresight!* magazine and external professional forums.
- Provide students with hands on laboratory experiences associated with each of the competency areas outlined in the first bulleted item in this list.

- Provide students with meaningful design experiences associated with each of the curricular competency areas outlined in number one in this list.
- Provide students with multidisciplinary design team experiences while demonstrating effective communication skills and a knowledge of contemporary issues.
- Provide students with an understanding of professional and ethical responsibility.
- Provide students with a recognition of the need for, and the ability to engage in, lifelong learning.
- Provide students with the broad education necessary to understand the impact of engineering solutions in a global and social context.

Bachelor of Science Degree Requirements

Geomatics Engineering Major *Units*

Major requirements 66

GME 1, 15, 15L, 16, 23L, 34, 40, 50, 61, 66, 102, 108, 123, 125, 126, 135, 159, 173, 180, 181 ..... (52)

CE 150, 161 ..... (5)

Technical Courses ..... (9)

Select mandatory technical courses from the following list subject to the *Design Courses* statement listed below: GME 73, 100, 101, 105, 109, 114, 129, 140, 145, 152, 153, 161, 174, 175, 177, 190, 191T; CSCI 115, 124, 150, 172; CONST 114, 122, 124; BA 154; CRP 100; FIN 180, 181; MATH 101, 121; PHYS 110

Design Courses: At least 6 units of technical courses must be selected from the following design courses: GME 145, 153, 161, 175

Other requirements 60

General Education

Select one course from each of the G.E. areas: Area A1, A2, B2, C1, D1, D2, D3. (See pages 89-92 for G. E. listings.)

The following courses are required to satisfy both G.E. and major requirements: MATH 75 [B4], CHEM 3A [B1], PHIL 1 or 10 [C2], GME 151 [IB], PHIL 120 [IC], PLSI 120 [M/I]

Additional requirements

MATH 76, 77; PHYS 4A, 4AL, 4B; GEOL 1

Total 126

Note: Engineering majors are exempt from G.E. Area A3, third course Area C, Area E, and Area ID.

See the catalog Web Site for recommended program at *www.csufresno.edu/catoffice/current/enggeorec.html*.

Advising Notes

1. Courses in engineering, mathematics, the physical sciences, and mandatory technical courses taken ***CR/NC*** are not counted toward fulfillment of degree requirements in geomatics engineering.
2. All geomatics engineering students must consult with their academic advisers at least once each year.
3. The Upper-Division Writing Skills requirement can be met by passing the university examination or by completing a "W" course with a letter grade of ***C*** or better no sooner than the term in which 60 units of coursework are completed.

COURSES

Geomatics Engineering (GME)

GME 1. Introduction to Geomatics Engineering (1)
An introduction to geomatics engineering philosophical thought; geomatics engineering profession and career opportunities; professional ethics and safety; creative and critical thinking applied to the geomatics engineering decision-making process.

GME 5. Critical Reasoning (3)
Fundamentals of analysis and evaluation in the context of technology. Evaluating the viewpoints of experts. Patterns of deductive and inductive arguments. Common fallacies of reasoning. G.E. Foundation A3.

GME 15. Engineering Surveying (2)
Prerequisite: MATH 5. Principles of surveying measurements for distance, direction, and elevation; topographic and planimetric mapping, horizontal curves, vertical curves, earthwork and engineering applications.

GME 15L. Engineering Surveying Laboratory (1)
Prerequisite: GME 15 or concurrently. Field practice in geomatics measurement, construction stakeout, and curve alignment problems. (3 lab hours; field trips required)

GME 16. Municipal Surveying (3)
Prerequisites: GME 15. Instrumentation; automated electronic survey data collection; local plane control survey, land survey; introduction to photogrammetry, GPS, GIS, remote sensing and control surveys. GIS overlay mapping and astronomy for azimuth applications.

GME 23L. Optics and Waves (1)
Visual optics, prisms, lenses, and collimated light, electromagnetic spectrum and waves, wave properties and atmospheric interactions, optical and electromagnetic imaging systems. GPS, GIS, remote sensing, photogrammetric, and EDM applications. (3 lab hours; field trips required)

GME 34. Adjustment Computations (3)
Prerequisites: GME 15, 61, MATH 76. Error theory, adjustment of simple survey networks, and matrix methods; digital computer solutions of geomatics computation and adjustment problems.

GME 40. Route and Construction Surveying (3)
Prerequisites: GME 15, 15L or permission of instructor. Computations and theory covering surveys for highway, irrigation, rail, pipeline, and other transportation alignment projects. Includes computer solutions and applications. (2 lecture, 3 lab hours; field trips required)

GME 50. Land Surveying (3)
Prerequisite: GME 15. The United States Public Land Survey System with special emphasis on California; introduction to the California Land Surveyors Act, Certified, A.L.T.A. and mortgage surveys; sectionalized land subdivision, corner restoration, resurveys, evidence, and descriptions. (Field trips required)

GME 61. Microcomputers in Engineering (3)
Prerequisite: GME 15 or concurrently. Microcomputer operating systems; introduction to high level computer languages, file processing, program documentation, testing, and debugging.

GME 66. Computer-Aided Mapping (3)
Prerequisite: GME 15 (may be taken concurrently). Preparing transportation alignment, topographic, property boundary, environmental, cross section, structural, and GIS maps and plans. Civil and geomatics engineering and construction applications. Includes comprehensive computer mapping design experience.

GME 73. Geomatics (3)
Introduction to Geographic and Land Information Systems; software and hardware issues; practical exercises.

GME 100. Land and Society (3)
Prerequisite: junior standing. How private land ownership rights have shaped the development of our nation into a superpower; the effects of virtually "free" western land; land tenure systems and land ethics; current state, national and international societal trends and implications.

GME 101. Green Design/Creative Thinking (3)
Prerequisites: permission of instructor, G.E. A2 completed, trigonometry. Creative thinking about solar friendly Green Building. Styles of thinking. Obstacles to overcome. Divergent versus convergent thinking. Idea stimulation. Gaining acceptance for new ideas.

GME 102. Geodetic Surveying (3)
Prerequisites: GME 16, 34 or concurrently. Horizontal and vertical geodetic networks for deformation, industrial tooling and local area applications; theory and application of State Plane Coordinate systems. (2 lecture, 3 lab hours; field trips required)

GME 108. Geodesy (3)
Prerequisites: MATH 77, PHYS 4A, 4AL, GME 34 or concurrently. Size and shape of the earth; three-dimensional coordinate systems; computations on the spheroid; reduction to plane coordinates; introduction to differential equations, gravity modeling and gravity measurements.

GME 114. GPS Navigation (3)
Prerequisite: permission of instructor. Theory and concepts of navigation systems emphasizing real-time GPS. Design of air, sea, and land navigation applications, including automatic vehicle location and navigation (AVLN). (2 lecture, 3 lab hours; field trips required)

GME 123. Stereo-Photogrammetry (3)
Prerequisites: GME 15, 34 or concurrently. Imaging systems; image quality. Theory of stereo-photogrammetry; orientation of stereo-model. Design and operating principles of stereoplotters. Photogrammetric mapping; orthophoto mapping. Project planning. (2 lecture, 3 lab hours; field trips required)

GME 125. Analytical Photogrammetry (3)
Prerequisites: GME 123, 135. Introduction to analytical photogrammetry; strip and block aerial triangulation. Design and operating principles of analytical plotters. Introduction to soft-copy photogrammetry. (2 lecture, 3 lab hours; field trips required)

GME 126. Digital Mapping (3)
Prerequisites: GME 123, 173 or concurrently. Design of data input, editing, display and processing mechanisms for digital mapping applications; hardware considerations and software design for DTM applications. (Field trips required)

GME 135. Advanced Adjustment Computations (3)
Prerequisites: GME 34, MATH 77. Statistics, propagation of errors, advanced theory of least squares optimization algorithms. Computer programming for complex surveying and photogrammetry adjustment applications. Project design.

GME 143. Satellite Geodesy (3)
Prerequisites: GME 102, 108, 135 or concurrently. Motion of a satellite, orbit geometry and perturbations; time measuring systems; global geodesy model; reduction and adjustment of GPS and other satellite observation data; differential equations of orbit relaxation; GPS network optimization; data transformation. (Field trips required)

GME 145. Geopositioning (3)
Prerequisites: GME 102, 108, 135. Design of planning, data collection, data processing and network adjustment applications; kinematic and real-time GPS applications; case studies. (Field trips required)

GME 151. Boundary Control and Legal Principles (3)
Prerequisite: GME 50 or permission of instructor. Legal principles that control the boundary location of real property.

GME 152. Real Property Descriptions (3)
Prerequisite: GME 151 or permission of instructor. Theory and practice of real property descriptions and recording systems; metes and bounds, United States Public Land Survey System, lot and block and other styles investigated; practical exercises and case studies. (Field trips required)

GME 153. Boundary Survey Design (3)
Prerequisite: GME 151 or permission of instructor. Design of evidence gathering, resurvey, retracement, and analysis techniques for complex United States Public Land Survey System, metes and bounds, riparian, mineral, land grant and fraudulent surveys; case studies. (Field trips required)

GME 159. Subdivision Design (3)
Prerequisites: GME 40, 151. Subdivision map act, local subdivision regulations, title search, zoning study. Tentative and final subdivision layout, map drafting, computerized subdivision design, and drafting; environmental impact study. (Field trips required)

GME 161. Data Interface Design (3)
Prerequisites: GME 16, 135. Development and design of data collector software; file system generation, manipulation and transfer; microcomputer interface to data collector, electronic total station, digitizer, stereo/mono comparator and stereo-plotters. (Field trips required)

GME 173. Introduction to GIS (3)
Prerequisites: GME 15 and 66, or permission of instructor. Data quality and accuracy, privacy, ethics, institutional, governmental and technological issues associated with GIS; hardware and software considerations for geodetically controlled cadastral, resource and environmental GIS applications; existing system case studies. (Field trips required)

GME 174. GIS Applications (3)
Prerequisite: GME 173. Use of available GIS. Applications software; spatial analysis, simulation modeling and system evaluation; practical applications to specific GIS scenarios; creation, manipulations, maintenance and analysis of geodetic, cadastral, administrative, resource and environmental overlays. (Field trips required)

GME 175. GIS Design (3)
Prerequisite: GME 173. Application of data quality, accuracy, ethics and liability issues to the design of integrated Geographic Information Systems; integrated data structure, algorithm, and database considerations; major design team GIS development project required. (Field trips required)

GME 180. Senior Project (2)
Prerequisites: GME 181 or concurrently. UDWE or a "W" course or concurrently. Study of a problem under supervision of a faculty member; final typewritten report required. Individual project except by special permission. GME 180 and GME 181 satisfy the senior major requirement for the B.S. in Geomatics Engineering. (Field trips required)

GME 181. Project Design (3)
Prerequisite: GME 108, 123, 135, 151, 173. Design of control, boundary location, and photogrammetric systems. Evaluation of design requirements, economic, and social considerations. Case Studies. Student

presentations. GME 180 and 181 satisfy the senior major requirement for the B.S. in Geomatics Engineering. (Field trips required)

GME 190. Independent Study (1-3; max total 6)
See *Academic Placement — Independent Study*. Approved for ***RP*** grading.

GME 191T. Topics in Geomatics Engineering (1-3; max total 6)
Prerequisite: permission of instructor. Investigation of selected geomatics engineering subjects not in current courses.

GME 193. Internship in Geomatics Engineering (2-4)
Prerequisite: permission of adviser. Engineering practice in a consulting, industrial, professional, or government work setting. A report will be required of the student at the termination of each implemented experience. This course cannot be used to meet graduation requirements. *CR/NC* grading only.

Industrial Engineering

Industrial Engineering Admissions Suspended

As of fall 2004, admissions to the Industrial Engineering program have been suspended. Students with substantial coursework in this area should consult with the Department of Mechanical and Industrial Engineering.

COURSES
Industrial Engineering (IE)

As of fall 2004, admissions to the Industrial Engineering program have been suspended. All IE courses are currently inactive and not listed in the *General Catalog*. For more information, please contact the Department of Mechanical and Industrial Engineering.

Mechanical Engineering

Walter V. Loscutoff, *Coordinator*
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559.278.2368

Program Description

Mechanical engineering is the use of basic science in the design and manufacture of components and systems. This requires the application of physical and mechanical principles in the development of machines, energy conversion systems, materials, and equipment for measurement and control. Knowledge of mathematics, physics, and chemistry lies at the core of this field. Application of this knowledge uses engineering technology — a disciplined way of thinking, modeling, and testing that enables development of new systems despite incomplete information and uncertainty.

The program in mechanical engineering provides basics in design and in thermal and fluid mechanics. All areas include statics, dynamics, materials, fluid mechanics, thermodynamics, and experimental methods. Application areas in design include mechanics of materials, applied mechanics, structural and manufacturing aspects of producing equipment, and vibrations. Application areas in thermal and fluid mechanics focus on energy conversion and include combustion, heat engines, refrigeration, and fluid flow.

Students should consult with their advisers to select the proper courses that emphasize their areas of interest.

Engineer-in-Training and Professional Engineering registration is strongly recommended as a first step in professional lifelong learning.

Mission

Our mission is to provide an educational program that will allow our students to meet or exceed the necessary level of academic preparedness for successful professional employment and for graduate study through continuous improvement in curricula and instruction.

Educational Objectives

1. Provide broad-based curriculum in mechanical and industrial engineering fundamentals.
2. Provide a basis for successful professional careers in fields associated with mechanical and industrial engineering.
3. Provide students with a strong foundation for graduate studies in mechanical and industrial engineering and related fields.
4. Provide students with hands-on experience through projects and laboratory courses.
5. Develop students' understanding of global issues.
6. Promote understanding of ethical and professional responsibilities.
7. Develop students' abilities to communicate effectively both orally and in written form.
8. Promote ability to work effectively in teams.

Co-op Program

The department participates in the Cooperative Education Program which allows the student to gain industrial experience and financial benefits through projects with local companies and aerospace companies in Antelope Valley.

Academic Probation

A minimum GPA of 2.0 must be maintained in all courses taken in the College of Engineering. Students who fail to maintain a 2.0 GPA in courses within their major may be placed on administrative academic probation. Failure to eliminate the grade point deficiency could result in disqualification from the College of Engineering.

Career Opportunities

The creation, design, and improvement of products, processes, and systems that are mechanical in nature are the core of many industries. Solutions to such major problems as environmental pollution, lack of mass transportation, and need for new sources of energy will depend heavily on the ability to create new types of machines and mechanical systems. And full use of developments in emerging fields, such as nanotechnology and bioengineering, require mechanical systems. These needs have created a substantial demand for mechanical engineers in a broad range of fields.