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 Admissions Suspended

As of fall 2004, admissions to the Industrial Engineering program have been suspended.

Mechanical Engineering
Walter V. Loscutoff, *Chair*
Engineering East Building, Room 154
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 engineering fundamentals.
2. Provide a basis for successful professional careers in fields associated with mechanical engineering.
3. Provide students with a strong foundation for graduate studies in mechanical 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

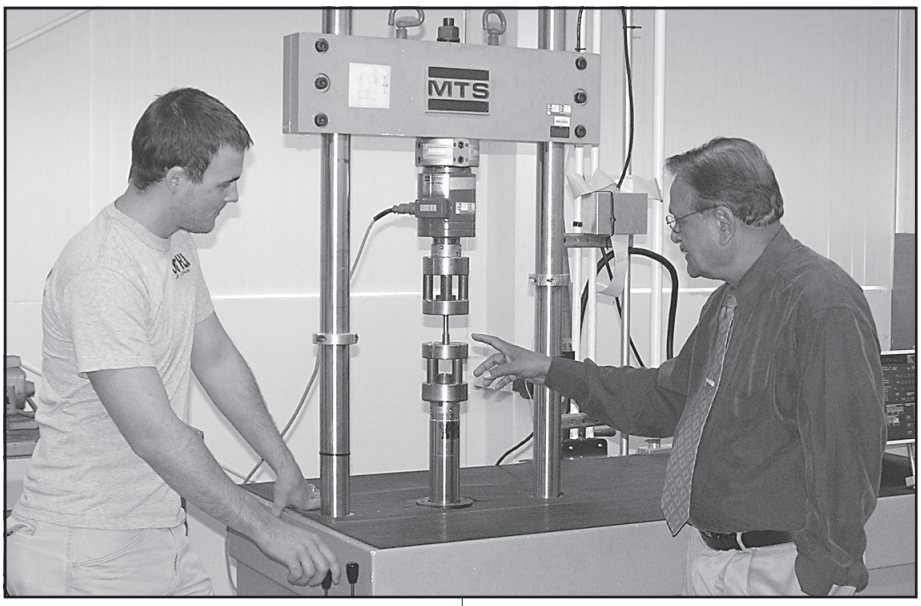
The department participates in the Cooperative Education Program which allows the student to gain industrial experience and financial benefits through projects with local companies and aerospace companies in Antelope Valley.

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. Excellent career opportunities for mechanical engineers exist in aerospace, biomedical, computer, electronics, energy,



environmental, manufacturing and fabrication, machine and tool design, transportation, and a host of other industries.

Bachelor of Science Degree Requirements

Mechanical Engineering Major *Units*

Major requirements 66

ME 1, 2, 26, 31, 32, 95, 112, 115, 116, 118, 125, 135, 136, 140, 145, 154, 155, 156 ..... (43)

CE 20, 121..... (6)

ECE 71, 91, 91L ..... (7)

Design Applications ..... (4)
ME 159 and ME 164 or ME 166

Technical Area Courses.....(6)
Take a minimum of 3 units in *Group A* (ME 137, 142, 144, 146, or 162.)
A maximum of 3 units in *Group B* (ME 180, 190, 191T; ECE 121, 121L, 155) may be substituted for a course in *Group A* with faculty adviser's approval.

Other requirements..... 63

General Education 42
COMM 3, 7, or 8 [G.E. Area A1]; ENGL 5B and 10 [G.E. Area A2]; HIST 11 or 12 [G.E. Area D1]; PLSI 2 [G.E. Area D2]; PHIL 20 [G.E. Area C2]; PHIL 120 [G.E. Area IC]; PLSI 120 [G.E. Area MI] and select one course from each of the following G.E. areas: B2, C1, D3
The following courses are required to satisfy both G.E. and major requirements: MATH 75 [G.E. Area B4], CHEM 1A [G.E. Area B1], ME 134 [G.E. Area IB]

Additional requirements 21
MATH 76, 77, 81*; PHYS 4A, 4AL, 4B, 4C

Total 129

*ENGR 101 may be taken as an alternative with faculty adviser's approval.

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

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

Advising Notes

1. Courses in mathematics, the physical sciences, or engineering taken ***CR/NC*** are not counted toward fulfillment of degree requirements in mechanical engineering.
2. Mechanical engineering majors might consider a math, physics, or business minor.
3. Since the mechanical engineering major curriculum is very demanding, many students, especially those not fully prepared in mathematics, chemistry, and/or physics, take 4½ or more years to graduate rather than the traditional 4 years. If needed, students also may go to the Learning Resource Center and request tutorial assistance.
4. Advising is mandatory in the College of Engineering. A registration hold will be placed on students who fail to see their adviser at least once per academic year.
5. The Upper-Division Writing Skills requirement has to be completed no sooner than the term in which 60 units of coursework are completed or no later than the term in which 90 units are completed. This requirement can be met by passing the university writing examination or by taking ENGR 105W or a department-approved writing course. Must be taken and passed with a letter grade of ***C*** or better in the junior year if the student fails the writing exam requirement.
6. With faculty adviser approval, ENGR 101 may be taken instead of MATH 81.

COURSES

Mechanical Engineering (ME)

ME 1. Introduction to Mechanical Engineering (1)
Required of all freshmen and transfer students during their first or second semester of study. Introduction to engineering design; case studies in mechanical engineering; problem-solving using the engineering approach; introduction to engineering code of ethics, mechanical engineering profession, and career opportunities.

ME 2. Computer Applications in Mechanical Engineering Lab (1)
Students develop fundamental skills in basic analytical and design tools used in mechanical engineering. Topics covered include spreadsheet applications, graphing data, technical communication, programming concepts, and computer-aided design (CAD). (One 3-hour lab)

ME 26. Engineering Graphics (3)
Basic computer literacy required. Principles of orthographic projection, dimensioning, and descriptive geometry. Applications to the solution of engineering problems including the use of interactive computer graphics. (Two 3-hour lecture labs) (CAN ENGR 2)

ME 29. Engineering Mechanics (3)
(Same as CE 29.) Prerequisites: MATH 77 (or concurrently); PHYS 4A. Not open to mechanical or civil engineering majors. Study of fundamental principles of statics and dynamics by scalar and vector methods.

ME 31. Engineering Materials (3)
Prerequisites: CHEM 1A, PHYS 4A. Fundamental nature and properties of engineering materials; structure of matter and its effect on

mechanical, electrical, magnetic, and thermal properties. (CAN ENGR 4)

ME 32. Engineering Materials Laboratory (1)
Prerequisite: ME 31. Application of experimental methods to engineering materials. Study of stress and strain in metals; fatigue; hardness; toughness. (3 lab hours)

ME 95. Product Development (2)
Prerequisites: ME 26, 31, and 32 (or concurrently). Examines the overall process of product development including preliminary design, drafting, material selection, fabrication, inspection, assembly, and testing. Laboratory component introduces basic machining and fabrication skills. (1 lecture, 3 lab hours)

ME 112. Engineering Mechanics: Dynamics (3)
Prerequisites: CE 20; MATH 81 or ENGR 101. Development of principles of kinematics and kinetics in engineering.

ME 115. Instrumentation and Measurement Lab (1)
Prerequisites: PHYS 4AL; ECE 70, 91, 91L; ME 32 (or concurrently). Application of different measuring devices and techniques used in engineering systems. Examines calibration and response characteristics of instruments. Technical reports are required. (3 lab hours)

ME 116. Fluid Mechanics (3)
Prerequisites: CHEM 1A, ME 112 (or concurrently). Fundamentals of fluid mechanics as applied to engineering problems.

ME 118. Fluid Mechanics Laboratory (1)
Prerequisites: ENGR 105W or successful completion of university writing exam, ME 115 (or concurrently); ME 116 (or concurrently). Applications of experimental methods used in engineering practice to ME fluid systems. (One 3-hour lab)

ME 125. Engineering Statistics and Experimentation (3)
Prerequisites: MATH 76 and ME 115 (concurrently) or permission of instructor. Provides fundamentals of statistical and uncertainty analysis applied to engineering measurements, experimental methods, product design, and manufacturing processes. Includes probability distributions, data sampling, confidence intervals, quality control, reliability, life testing, and analysis of uncertainty in experimental measurements.

ME 134. Fundamentals of Machine Design (3)
Prerequisites: ME 26, 112; CE 121; MATH 81 or ENGR 101. Analytical, graphical, and computer solutions applied to design problems in machinery and mechanisms. Cam design, different types of followers, cam manufacturing considerations. Gear design, different types of gears, gear trains. Students will be assigned class projects related to the topics covered in class. (2 lecture, 3 lab hours)

ME 135. Engineering Product Design (3)
Prerequisites: ME 95 and 134. Introduction to product engineering with consideration given to economic, safety, quality, aesthetic, environmental, liability, and patent law issues. Open-ended design project is required.

ME 136. Thermodynamics (3)
Prerequisites: CHEM 1A, PHYS 4A, MATH 77, and upper-division standing. Fundamentals of thermodynamics and heat transfer as applied to engineering problems.

ME 137. Turbomachinery (3)
Prerequisites: ME 116 and 136. Applications of fluid mechanics and thermodynamics and rotor-fluid energy interchange. Steady flow problems of pumps, compressors, and turbines with incompressible and compressible fluids. Both closed- and open-ended homework problems.

ME 140. Advanced Engineering Analysis (3)
Prerequisites: MATH 81 or ENGR 101; ECE 70, ME 112 (or concurrently), ME 116 (or concurrently), ME 136 (or concurrently). Development of the finite element method of engineering analysis; specific applications to heat flow, fluid flow, vibrations in mechanical systems, and stresses in mechanical component design using appropriate numerical techniques, closed-form solutions of partial differential equations and the digital computer.

ME 142. Mechanical Vibration (3)
Prerequisites: ME 112, CE 121. Mathematical and physical basis of vibration theory with applications to engineering analysis and design. Includes transient and steady state phenomena, distributed and lumped parameter systems, coupled systems, and computer solutions.

ME 144. Advanced Mechanics of Materials (3)
Prerequisites: CE 121, ECE 70, MATH 81. Advanced topics in mechanics of materials. Statistical considerations in design, stress, and strain theories; contact stresses, strain energy, Castigliano's theorem; failures resulting from static and dynamic loading; static and fatigue theories of failure; stress concentrations.

ME 145. Heat and Mass Transfer (3)
Prerequisites: ECE 70, MATH 81, ME 116, 136, 140. Analytical, numerical, and electrical analogy methods are used to solve a variety of heat transfer and mass transfer problems. Advanced topics in radiation, boundary layer flow, and heat exchanger design.

ME 146. Air Conditioning (3)
Prerequisites: ME 116, 136. Theory and practice in air conditioning including psychrometrics, load estimating, heating and cooling systems, fluid design and controls.

ME 154. Design of Machine Elements (3)
Prerequisites: ME 95, 134. Design of machine elements and components using theory learned in prerequisite courses. Both individual and team-type open-ended design projects are required. Use of computers for design is required. (2 lecture, 3 lab hours)

ME 155. Elements of Systems Design (3)
Prerequisites: ENGR 105W or successful completion of university writing exam, ME 145, 154, 156, senior standing. Design of a commercially feasible mechanical engineering system. Students work in teams to design, build, and test prototype engineering systems using industry-supported projects. Basis of course is formed by meeting realistic constraints, including client-based specification; optimizing designs, working in a team environment, and developing project management skills.

ME 156. Advanced Thermodynamics — Fluid Mechanics (3)
Prerequisites: ME 116, 136. Advanced topics in thermodynamics and fluid mechanics including analysis of solar and nuclear systems as applied to engineering problems.

ME 159. Mechanical Engineering Laboratory (1)
Prerequisites: ME 118, 145, 156, and senior standing. Analysis of mechanical engineering

and measurement systems. Students conduct experiments dealing with advanced thermal and mechanical systems. Using knowledge and experience gained from experimentation, students design and conduct their own group experiments. Both written and oral technical reports are required.

ME 162. Computer-Aided Design (3)
Prerequisites: ME 26, 140. Survey of computer applications for design, analysis of mechanical systems, and manufacturing of mechanical components. Typical programming language software packages used in industry (CAD/CAM and FEA) will be introduced.

ME 164. Machine Design (3)
Prerequisites: ME 135 (or concurrently), 145, 154; ENGR 105W or successful completion of university writing exam. Open-ended design problems of complete machine systems. Integration of prerequisite course material into final design project. Satisfies the senior major requirement for the B.S. in Mechanical Engineering. (Two 3-hour lecture-labs)

ME 166. Energy Systems Design (3)
Prerequisites: ME 135, 145, 156; ENGR 105W or successful completion of university writing exam. Design of conventional and alternative energy conversion systems, i.e. solar; selection and integration of components of the system; use of codes and standards. Group project report required. Satisfies the senior major requirement for the B.S. in Mechanical Engineering.

ME 180. Special Projects
(1-3; max total 3)
Prerequisites: senior standing in mechanical engineering, department-approved writing course or approved subject; successful completion of writing exam. Study of a problem under supervision of a faculty member; final typewritten report required. Individual project except by special permission.

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

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

ME 193. Mechanical Engineering Cooperative Internship
(1-6; max total 12)
Prerequisite: permission of adviser. Engineering practice in an industrial or government installation. Each cooperative internship period usually spans a summer-fall or spring-summer interval. This course cannot be used to meet graduation requirements. ***CR/NC*** grading only.

GRADUATE COURSES

(See *Catalog Numbering System.*)

Mechanical Engineering (ME)

ME 211. Advanced Dynamics (3)
Prerequisite: ME 134 or permission of coordinator. Dynamics of mechanical systems with emphasis on equations of motion. Kinematics of particles, energy and momentum methods, variational methods, LaGrange's method, kinematics and plane motion of rigid bodies, kinetics of rigid bodies in three dimensions, mechanical vibrations.

ME 220. Compressible Fluids (3)
Prerequisite: ME 156 or permission of coordinator. Review of the foundations of fluid mechanics and thermodynamics. The velocity of sound, mach number and angle, differences between incompressible, subsonic, and supersonic flow. Isentropic flow, working charts and tables, choking, operation of nozzles. Normal shock waves, ducts, shock tube analysis. Fanno and Rayleigh analysis, oblique shock waves, the Prandtl-Meyer equation. Lift and drag on bodies in supersonic flow. Method of characteristics.

ME 221. Incompressible Fluids (3)
Prerequisite: ME 156 or permission of coordinator. The kinematics of liquids and gases, the LaGrangian and Eulerian methods, streak lines, stream tubes. Geometry of the vector field, stokes, and Gauss's theorems, acceleration of a fluid particle, homogeneous fluids and the equation of continuity. Integration of Eutor's equation, Bernoulli's equation. Potential motion and potential functions, source and sink potentials, the stream function. Vortex theory, surfaces of discontinuity.

ME 223. Jet Engine Propulsion (3)
First-year graduate course in mechanics and thermodynamics of jet engine propulsion. Thermodynamics of fluid flow and engines, boundary layer theory, subsonic and supersonic inlets, combustors, fans, compressors, turbines, nozzles, inlet distortion, fuel controls, noise reduction, ramjets and scramjets.

ME 224. Rocket Propulsion (3)
First-year graduate course in mechanics and thermodynamics of rocket engine propulsion. Nozzle theory and thermodynamics, heat transfer, flight performance, chemical

rocket propellant performance, liquid propellants, solid propellants, rocket testing, advanced propulsion concepts.

ME 225. Heat Transfer (3)
Conduction, convection, and radiation. One and two dimensional steady-state conduction, LaPlace's equation, numerical techniques. Transient heat transfer. Heisler charts, multiple-dimensional systems, boundary layers, Reynold's analogy. Forced and natural convection radiation heat transfer, Kirchoff's and Wien's laws, radiation shields.

ME 227. Advanced Thermodynamics (3)
Prerequisite: ME 156 or permission of coordinator. Review of classical thermodynamics, Maxwell relations, equations of state, nonideal gases, experimental methods. The molecular theory of gases, Clausius and Van der Waals equations of state, velocity distribution. LaGrange's method, the principle of equipartition. Maxwell-Boltzmann statistics, micro- and macro-states. Quantum statistics based on the Bose-Einstein, Maxwell-Boltzmann, and Fermi-Dirac statistics.

ME 229. Advanced Gas Dynamics (3)
Review of supersonic flow. Vibrational and chemical rate processes, nonequilibrium chemical rate equations, rate equations for dissociation and recombination. Flow with vibrational or chemical nonequilibrium. Nonequilibrium kinetic theory; evaluation of collision cross sections. Flow with translational nonequilibrium. Radiative transfer in gases, and approximate solutions of the equation of radiative transfer.

ME 230. Aircraft Stability and Control (3)
First-year graduate course covering analytical tools, system theory, reference frames, and transformations, equations of unsteady motion, longitudinal aerodynamics, lateral aerodynamics, stability of steady flight, and response to control actuation. All stability derivatives will be discussed in detail, and examples and problems based on actual airplanes will be used.

ME 232. Advanced Aircraft Stability and Control (3)
Prerequisite: ME 230. Continuation of ME 230. Validity of small disturbance theory, nonlinear equations of motion, steady state and dynamic stability and control of elastic airplanes. Frequency response methods, response to turbulence. Automatic flight control analysis and design, the human pilot in the control loop, stability augmentation, digital flight control systems, state vector methods.

ME 241. Structural Analysis (3)
Prerequisite: ME 134 or permission of coordinator. Graduate-level course in the principles of structural mechanics. Stress, strain and displacements, static and dynamic loads, energy methods, virtual work, discrete and continuous system analysis, finite element analysis, elastic beams, plates, and frames; single and multi degree-of-freedom modal analysis.

ME 243. Structural Dynamics (3)
Prerequisite: ME 241 or permission of instructor. Continuation of ME 241. Von Karman theory, shear deformation, geometry and equilibrium of shells, theory of vibrations, vibrations of aircraft structures, coupling with the aerodynamic equations, flutter, ground and flight structural test techniques.

ME 250. Astrodynamics (3)
Introductory course in astrodynamics. Two-body orbital mechanics, orbit determination, basic orbital maneuvers, rendezvous, ballistic missile trajectories, lunar and interplanetary trajectories, orbital perturbations, launch trajectories, reentry, spacecraft dynamics and attitude control.

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

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

ME 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 for the master's degree. Abstract required. Approved for ***RP*** grading.

ME 299. Thesis (3; 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.***