



engineering — mechanical engineering technology

bachelor of science

Program Description

The Mechanical Engineering Technology (MET) program is designed for those who want an engineering-related career with a hands-on, practical approach. The emphasis in the MET program is placed on understanding how engineering principles are applied in practice rather than on the mathematical methods used in the derivation of new technologies. At the same time, the program goes beyond the teaching of current procedures, so that the graduates are enabled to adapt to the changing needs of industry. Graduates find careers in many technological fields, including plant operations and management, quality assurance, product and manufacturing systems design, testing and evaluation, technical sales, and environmental testing and enforcement.

Sacramento State offers all of the courses in the MET program; however, most students take the first two years at a community college. Building on a foundation in natural science, mathematics, computer science, and engineering science and technology, the student comes to Sacramento State to develop more fully an understanding of the analysis and design of machine components, engineering measurements, energy conversion, the behavior of fluids and hydraulic machinery, and the communication of technical information. The principles learned are practiced during the two-semester senior project.

Students may also take additional courses in either Business Administration or Computer Science toward a minor. A minor broadens the student's career base and offers the opportunity for continued learning through graduate study.

Career Possibilities

Product Design • Manufacturing Systems Design • Product Testing and Evaluation • Plant Operations/Management • Quality Assurance • Technical Sales • Field Engineering • Environmental Testing/Enforcement • Energy Management • Aerospace Operations

Faculty

Robin Bandy, James Bergquam, Estelle Eke, Jose Granda, Joseph Harralson, Susan Holl, Akihiko Kumagai, Tien-I Liu, Tim Marbach, Think Ngo, Frederick Reardon, Kenneth Sprott, Yong Suh, Dongmei Zhou, Tong Zhou

Contact Information

Akihiko Kumagai, *Coordinator* • Riverside Hall 4024F • (916) 278-7081 • www.ecs.csus.edu/mel/met.htm

Special Features

- The Sacramento State Mechanical Engineering Technology program is the only one of its kind offered by a state university in northern California. It is accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET) 111 Market Place, Suite 1050, Baltimore, Maryland 21202, (410) 347-7700.
- Each student has a faculty advisor who meets with him/her at least once each semester to discuss academic progress, plan the following semester, explain University regulations, and answer questions about the Mechanical Engineering Technology program. General Education advising for all students is done by the Academic Advising Center.
- Most classes have enrollments of less than 30, allowing for close interactions between students and faculty. Laboratory classes, which provide practical experience, normally have fewer than 20 students.
- In addition to regular course work, many students participate in special projects, such as the design competitions sponsored by national engineering professional societies, the American Society of Mechanical Engineers, and the Society of Automotive Engineers.
- Students may wish to take the Fundamentals of Engineering (formerly Engineer-in-Training) examination during their senior year. Successful completion of this examination is the first step toward registration as a Professional Engineer in the State of California.

Academic Policies and Procedures

Course Repeat Policy – Undergraduate engineering and mechanical engineering technology courses that are used to meet the Bachelor of Science in Mechanical Engineering Technology degree requirements may be repeated only twice (for a total of three attempts). Grades of the second and third attempts will be averaged in grade point calculations.

Incomplete Grades – Incomplete grades are issued only in accordance with University policy. The student must be passing the course at the time an “Incomplete” is requested. An Incomplete Petition must be submitted to the Department with the student's and the course instructor's signature. The Incomplete Petition (obtained in the Department office) must specify the work to be completed, the basis by which the student's final grade will be determined, and the last date for completion of the incomplete work. An incomplete grade that is not cleared by the set date will lapse to an “F” grade.

Undergraduate Program

The first two years of the MET program can be completed at a community college. Students who have completed most of the lower division courses listed below may apply for admission to the University and will be classified as pre-majors. All pre-majors must apply at the Mechanical Engineering Technology Program office for transfer to the major. A complete set of transcripts will be needed for evaluation. Students must complete all lower division preparation before being admitted to the major. Students will not be admitted to any upper division MET courses without being admitted to the major.

Program Educational Objectives

The objectives of this program are to prepare graduates to:

- enter engineering-related employment in the following areas of mechanical engineering practice: machine design, thermal and fluid systems, and manufacturing;
- identify, analyze, and solve practical problems, making use of appropriate technology;
- apply creativity in the design process, functioning cooperatively within multi-disciplinary teams;
- communicate effectively through speaking, writing, and graphics; and
- use their understanding of professional, ethical, and social responsibilities and the importance of life-long learning in the conduct of their careers.

Requirements • Bachelor of Science Degree

Units required for the Major: 53

Units required for Pre-major: 42

Minimum total units for the BS: 131

Additional units may be required to meet the Sacramento State foreign language requirement.

A grade of “C-” or better is required in all courses applied to a Mechanical Engineering Technology major.

Courses in parentheses are prerequisites.

A. Required Lower Division Courses (Pre-major)

Lower division requirements should be taken at a community college and completed before beginning upper division work.

Basic Science and Mathematics (27 units)

- (3) Math Elective (such as MATH 024 and MATH 029)
- (6) Differential and Integral Calculus* (such as MATH 026A and MATH 026B)
- (3) Statistics* (such as STAT 001)
- (5) General Chemistry* with a lab (such as CHEM 006A)
- (8) Physics* — mechanics and heat with lab and Physics* — electricity and magnetism with lab (such as PHYS 005A and PHYS 005B)
- (2) Visual Basic or other programming language (such as CSC 022)

* Courses in these areas may be used to fulfill up to 9 units of general education requirements if the courses are specified as general education by the institution in which they are taken.

Lower Division Technology (15 units)

- (6) Drafting, including 3 units of engineering graphics and computer aided drafting (such as ENGR 006), 3 units of 3-D solid modeling (such as ENGR 007)
- (3) Manufacturing Processes, primarily machine tool processes (such as ME 037)
- (3) Properties of Engineering Materials (such as ENGR 045)
- (3) Statics (such as MET 030)

Note: Additional lower division courses may be required to complete a minor in either Business Administration or Computer Science.

Lower Division General Education

The General Education and graduation requirements at Sacramento State are 54 units of course work in the following areas: Communications; Science; Arts and Humanities; Social Sciences; and Self Development. 18 of these units are satisfied by required courses in the MET curriculum, the remaining 36 units of general education are specified below.

The 24 units in the area of Communications, Humanities, and Social Sciences stipulated by the National Accreditation Board for Engineering and Technology are covered by the Sacramento State General Education requirements.

The 30 units of General Education courses in the lower division must include:

- (3) English Composition (such as ENGL 001A)
- (3) Oral Communications
- (3) ENGL 020, Expository Writing (ENGL 001A with a grade “C-” or better, or equivalent)

Recommended additional courses:

- U.S. History
- U.S. and California Government
- Life Science
- Economics (such as ECON 001A)
- Arts, Humanities, or Foreign Languages

Note: A second year foreign language course (2A or equivalent) may also satisfy 3 units of GE when the course is being taken to comply with the Sacramento State foreign language requirement. Students should consult with an advisor for exact GE eligibility of these courses.

B. Required Upper Division Courses (Major) (53 units)

MET courses are offered only once a year. Students should plan to begin the upper division during the fall semester. Students will not be enrolled in upper division MET courses unless all required lower division preparation (Basic Science and Math and Lower Division Technology) has been satisfactorily completed. The Writing Proficiency Examination (WPE) is a prerequisite for MET 190; therefore students are encouraged to take the WPE in the first semester of the junior year.

First Semester Junior Year (15 units)

MET courses listed below are offered in fall only.

- (3) MET 141 Fluid Mechanics and Machinery (PHYS 005A, MET 030; MET 030 may be taken concurrently)
- (3) MET 150 Electric Circuits and Equipment (PHYS 005B, MET 030; MET 030 may be taken concurrently)
- (3) MET 164 Product Design and Engineering Graphics (ENGR 006)
- (3) MET 173 Computer Applications in Mechanical Engineering Technology (MET 030; may be taken concurrently)
- (3) General Education course

Second Semester Junior Year (14 units)

MET courses listed below are offered in spring only.

- (2) ENGR 140 Engineering Economics (ENGR 017, ENGR 030, MET 030 or instructor permission)
- (3) MET 111 Dynamics (MET 030, MET 173)
- (3) MET 112 Strength of Materials (MET 030, MET 173, ENGR 045)
- (3) MET 140 Thermodynamics for Engineering Technology (MET 141, MET 173)
- (3) MET 151 Measurements for Engineering Technology (MET 140, MET 141, MET 173; MET 140 may be taken concurrently;)

First Semester Senior Year (16 units)

MET courses listed below are offered in fall only.

- (3) MET 142 Advanced Thermodynamics Technology (MET 140, MET 141)
- (3) MET 166 Machinery Design (MET 112, MET 164)
- (3) MET 190* Senior Project I (ME 037, MET 142, MET 166, passing score on WPE; MET 142, MET 166 may be taken concurrently)
- (1) ENGR 194 Career Development in Engineering and Engineering Technology (Senior status)
- (3) Upper Division Technical Elective
- (3) Upper Division Technical or Business Administration Elective

Second Semester Senior Year (14 units)

MET courses listed below are offered in spring only.

- (3) MET 165 Kinematics of Machinery (MET 111, MET 164)
- (3) MET 178 Computer-Aided Manufacturing (ME 037)
- (2) MET 191* Senior Project II (MET 190)
- (3) Upper Division Technical Elective
- (3) General Education course

* MET 190 and MET 191 may be used as 3 units to satisfy upper division GE requirements in Area E.

C. Technical Electives

- MET 170 Parametric Solid Modeling (MET 164)
- MET 172 Applied Computer-Aided Design (MET 112, MET 170)
- MET 199 Special Problems
- ME 136 Numerical Control Programming (ME 037, ME 175 or MET 173; ME 175 or MET 173 may be taken concurrently)
- ME 138 Concurrent Product and Process Design (ME 118 or MET 164; ME 118 or MET 164 may be taken concurrently)
- ME 143 Vehicle Design (ME 119 or MET 166; may be taken concurrently)
- ME 153 Thermodynamics of Combustion Engines (ME 175, ENGR 124, ENGR 132; or MET 140, MET 141, MET 173)
- ME 156 Heating and Air Conditioning Systems (ENGR 124, ENGR 132)
- ME 176 Product Design and Pro/Engineer (ENGR 006, ME 115 or MET 166, ME 175 or MET 173)

D. Business Administration Electives*

- FIN 101 Business Finance
- HROB 101 The Management of Contemporary Organizations
- HROB 151 Management of Human Resources
- HROB 157 Industrial Relations
- MGMT 101 Legal Environment of Business
- MGMT 102 Business Communications (Completion of Area A in General Education and ENGL 020)
- MKTG 101 Principles of Marketing
- OPM 101 Operations Management

*Select from these electives or other business courses approved by the student's advisor.

E. Upper Division General Education (9 units)

The 9 units of general education listed in the major must be selected according to University general education requirements. These units must be upper division courses including 3 units of advanced study. Note that MET 190 / MET 191 may be counted as 3 units of upper division general education.

Note: Business Administration or Computer Science courses can be applied both to the MET major and to a minor. A minimum of nine additional upper division units are required for either minor. The 24-unit Business Administration minor and the 18-unit Computer Science minor both require appropriate selection of lower division courses. Students interested in a minor should contact the appropriate department office for additional information.

Cooperative Education Program (work experience)

Students are encouraged to participate in the Cooperative Education Program (Co-op) which provides alternate periods of study at the University and practical work experience as junior mechanical engineers in industry or government for pay. Most participants of the Co-op plan will complete one six-month work period in their junior year and the other in their senior year. Academic credit is granted for successful completion of the Co-op phase. Students interested in the Cooperative Education Program should apply in the satellite office in Riverside Hall 2004 or the main office in Lassen Hall 2008. For information call (916) 278-7234.

Lower Division Course

MET 030. Statics. Force system and equilibrium conditions with emphasis on engineering problems covering structures, machines, distributed forces, and friction. Emphasis on equilibrium of coplanar force system, analysis of frames and trusses; non-coplanar force system and centroids of moments of inertia. Lecture three hours. **Prerequisite:** MATH 026A and MATH 026B, PHYS 005A, ENGR 6; MATH 026B may be taken concurrently. Fall only. 3 units.

Upper Division Courses

MET 111. Dynamics. Kinematics of particles and rigid bodies; dynamics of a particle, systems of particles and rigid bodies; central force fields, orbits and trajectories; computer solutions. Emphasis on kinetics and kinematics of particles; and 2 dimensional rigid bodies. Lecture three hours. **Prerequisite:** MET 30, MET 173. Spring only. 3 units.

MET 112. Strength of Materials. Practical application of structural calculations for sizing bolts, rivets, shafts, beams, trusses and columns; computer solutions of related problems. Lecture three hours.

Prerequisite: ENGR 045, MET 30, MET 173. Spring only. 3 units.

MET 140. Thermodynamics for Engineering Technology. Elements of thermodynamics including first and second laws for closed and open systems; with applications to power plants and refrigeration systems. Lecture three hours. **Prerequisite:** MET 141, MET 173. Spring only. 3 units.

MET 141. Applied Fluid Mechanics and Machinery. Theoretical principles of compressible and incompressible fluid behavior with applications to practical situations. Topics include basic principles and operation of fluid machinery, and measurement of flow, pressure and viscosity. Lecture three hours. **Prerequisite:** PHYS 5A, MET 30; MET 30 may be taken concurrently. Fall only. 3 units.

MET 142. Advanced Thermodynamics Technology. Applications of the principles of thermodynamics and heat transfer to the operation of power plants and refrigeration equipment; introductions to psychometrics, combustion and compressible flow. Lecture three hours. **Prerequisite:** MET 140, MET 141. 3 units.

MET 150. Electrical Circuits and Equipment. Fundamentals of electric circuits and components including resistive, inductive and capacitive circuits; rectifiers, transformers, generators, and motors. Principles and practice in the use of electrical machinery. Lecture two hours; laboratory three hours. **Prerequisite:** PHYS 5B, MET 30; MET 30 may be taken concurrently. Fall only. 3 units.

MET 151. Measurements for Engineering Technology. Theory and practice of the application of basic temperature, acceleration, pressure, flow, force, and strain instrumentation to engineering technology problems. Lecture two hours; laboratory three hours. **Prerequisite:** MET 140, MET 141, MET 173; MET 140 may be taken concurrently. 3 units.

MET 164. Product Design and Engineering Graphics. Introduction to basic design methodology for mechanical systems and devices. A broad overview of design from concept to production, including: creativity, analysis strategies, project planning, design for production, and document control. A thorough understanding of how the design is communicated through engineering graphics. Analyzes and CAD drawing solutions are required for various design problems. Topics covered include: dimensioning, fits and clearances, tolerance buildup, geometric dimensioning and tolerancing, and drawing control (checking, release, changes). Final team projects require a design solution and complete documentation. Lecture two hours, laboratory three hours. **Prerequisite:** ENGR 006. Fall only. 3 units.

MET 165. Kinematics of Machinery. Analyzes the function of machine components. Emphasis on the kinematics of motion and the elements of kinetics. Practice in the design of linkages, cams and reduction systems. Computer solutions of kinematic problems. Lecture two hours; laboratory three hours. **Prerequisite:** MET 111, MET 164. Spring only. 3 units.

MET 166. Machinery Design. Introduction to fatigue with applications to the design of mechanical systems incorporating gears, bearings, clutches, brakes and couplings. Computer solutions of related problems. Lecture two hours; laboratory three hours. **Prerequisite:** MET 112, MET 164. Fall only. 3 units.

MET 170. Parametric Solid Modeling. Application of three-dimensional representation techniques as used in a typical large CAD software package. Fundamentals of working with a CAD software system for creating, storing and modifying engineering drawings. Introduction, discussion and use of typical CAD input/output hardware. Comparison of important differences among engineering computer graphic systems. Lecture two hours; laboratory three hours. **Prerequisite:** MET 164. Fall only. 3 units.

MET 172. Applied Computer-Aided Design. Application of software packages for analysis of stress, deflection and vibration. Brief introduction to finite element theory with emphasis on model building; software operation; applications of finite element analysis and comparison of results with experimental and theoretical values;

theories of failure; and 3 dimensional states of stress. Lecture three hours. **Prerequisite:** MET 112, MET 170. Spring only. 3 units.

MET 173. Computer Applications in Mechanical Engineering Technology. Introduction to the application of computers to solve problems typically encountered in mechanical engineering technology. Includes the use of spreadsheet (e.g., Excel); and equation-solver (e.g., TK Solver) software to perform calculations and analyze data, using built-in and user-supplied functions, presenting the results in tabular and/or graphical form. Lecture two hours; laboratory three hours. **Prerequisite:** MET 030; may be taken concurrently. Fall only. 3 units.

MET 178. Computer-Aided Manufacturing. Overall view of factory automation and computer-aided manufacturing, including group technology, flexible manufacturing systems, automated inspection and testing, machine vision for inspection, computer-aided process planning, artificial intelligence applications in manufacturing, and computer networks for manufacturing. Lecture two hours; laboratory three hours. **Prerequisite:** ME 037. 3 units.

MET 190. Senior Project I. Problem solutions in Mechanical Engineering Technology through team effort, supervised study and guided investigations. Part I includes problem definition, conceptualization of solution, project planning and detailed design, together with professionalism and ethics. Lecture one hour, laboratory three hours. **Prerequisite:** ME 037, MET 142, MET 166, and passing score on the WPE; MET 142, MET 166 may be taken concurrently. Fall only. 3 units.

MET 191. Senior Project II. Continuation of the project begun in MET 190. Part II includes fabrication and assembly of equipment, testing and evaluation, and reporting. Laboratory six hours. **Prerequisite:** MET 190. Spring only. 2 units.

MET 195. Industrial Internship. Supervised work experience in industry or government, which can be considered of equal sophistication and value to senior courses in mechanical engineering technology, may be substituted for up to three units of senior mechanical engineering technology courses. **Note:** Open to seniors in mechanical engineering technology and only through prior arrangement between the instructor and the company or agency. Graded Credit/No Credit. 1-3 units.

MET 196. Experimental Offerings in Engineering Technology. When a sufficient number of qualified students apply, one of the staff will conduct a seminar in some topic of engineering technology. **Note:** May be repeated for credit with permission of advisor. 1-4 units.

MET 199. Special Problems. Individual projects or directed reading. **Note:** Departmental petition required. 1-3 units.