MECHANICAL ENGINEERING

Degrees Offered

Bachelor of Science in Mechanical Engineering

Program Educational Objectives

Through their careers in Mechanical Engineering or a related profession, Pacific BSME graduates are expected to demonstrate one or more of the following within a few years of earning their BSME:

- Competence and/or leadership via promotion to positions of increasing responsibility, publications, and/or conference presentations;
- Adaptability to new developments in science and technology by successfully completing or pursuing graduate education in engineering and related fields, or participating in professional development and/or industrial training courses;
- Creativity and innovation in engineering and technology through participation in activities such as research, design, intellectual property development, and/or entrepreneurial endeavors;

Pacific BSME graduates are also expected to demonstrate an awareness of humanistic, societal, and environmental issues through involvement in local, national, and/or global activities.

Bachelor of Science in Mechanical Engineering

Students must complete a minimum of 120 units of academic work and a minimum of 32 units of Cooperative Education in order to earn the bachelor of science in mechanical engineering.

I. General Education Requirements

PACS 001	What is a Good Society	4
PACS 002	Topical Seminar on a Good Society	4
PACS 003	What is an Ethical Life?	3

Note: 1) *Pacific Seminars cannot be taken for Pass/No Credit.* ***2)*** *Transfer students with 28 or more transfer units complete 2 additional General Education elective courses from below in place of taking* PACS 001 *and* PACS 002.

One course from each subdivision below:

Social and Behavioral Sciences	
Two courses from the following:	
IA. Individual and Interpersonal Behavior	
IB. U.S. Studies	
IC. Global Studies	
Arts and Humanities	
IIB. ENGR 030	
One course from the following categories:	
IIA. Language and Literature	
IIC. Visual and Performing Arts	

Note: 1) *Only one course can come from each subcategory (A, B, or C) within each category.* ***2)*** *No more than 2 courses from a single department are applied to meet the breadth program requirements, with the exception of certain 1-unit GE IIC courses.*

II. Diversity Requirement

Students must complete one diversity course (3-4 units)

ENGR 030	Engineering Ethics and Society	3

Note: 1) *Transfer students with 28 units or more transfer units prior to fall 2011 are encouraged but not required to complete a designated diversity course prior to graduation.* ***2)*** *Courses are also used to meet general education and/or major/minor requirements.*

III. Fundamental Skills

Students must demonstrate competence in:

Writing
Quantitative analysis

Note: 1) *Fundamental skills must be satisfied prior to enrolling in upper division courses.*

IV. Major Requirements

Mathematics/Basic Science - Minimum 30 units that include:		
MATH 051	Calculus I	4
MATH 053	Calculus II	4
MATH 055	Calculus III	4
MATH 057	Applied Differential Equations I: ODEs	4
PHYS 053	Principles of Physics I	5
PHYS 055	Principles of Physics II	5
Select one of the following:		4-5
CHEM 024	Fundamentals of Chem	
CHEM 025	General Chemistry	
CHEM 027	General Chemistry	
One Math or Science Elective (from approved list)		3-4
Engineering Science		
CIVL 130	Fluid Mechanics I	3
CIVL 130L	Fluid Mechanics I Lab	1
ENGR 010	Dean's Seminar	1
ENGR 019	Computer Applications in Engineering	3
ENGR 020	Engineering Mechanics I (Statics)	3
ENGR 025	Professional Practice Seminar	1
ECPE 041	Circuits	3
ECPE 041L	Circuits Laboratory	1
ENGR 045	Materials Science- Properties and Measurements	4
ENGR 110	Instrumentation and Experimental Methods	3
ENGR 120	Engineering Mechanics II (Dynamics)	3
ENGR 121	Mechanics of Materials	4
ENGR 122	Thermodynamics I	3
Mechanical Engineering		
MECH 015	Mechanical Engineering Graphics	3
MECH 100	Manufacturing Processes	4
MECH 120	Machine Design and Analysis I	3
MECH 125	Machine Design and Analysis II	3
MECH 129	Vibrations	3

MECH 140	Engineering Design/Senior Project I	3
MECH 141	Engineering Design/Senior Project II	3
MECH 150	Heat Transfer	3
MECH 157	Thermodynamics II	3
MECH 175	Systems Analysis and Control	4
MECH Electives (Two additional courses from approved list)		6
Engineering Elective (One additional engineering course from approved list)		3-4
Cooperative Education - Minimum 32 units that include:		
ENGR 181	Professional Practice	14-18
ENGR 182	Professional Practice	14-18
ENGR 183	Professional Practice	14-18

Mechanical Engineering Faculty

Chi-Wook Lee, Chair and Professor of Mechanical Engineering, 1998, BSME, Hanyang University (Korea), 1981; MSME, University of Wisconsin-Madison, 1984; PhD, Mechanical Engineering, University of Florida, 1991. Mechatronics, systems dynamics, and bio-mechanics.

Jeffrey S. Burmeister, Program Director and Associate Professor of Bioengineering, 2002, BS, Mechanical Engineering, University of Delaware,1988; PhD, Biomedical Engineering, Duke University, 1995. Biomaterials, cell adhesion.

Ashland O. Brown, Professor of Mechanical Engineering, 1991, BSME, Purdue University, 1966; MSME, University of Connecticut, 1968; PhD, 1974. Licensed Professional Engineer. Fluid mechanics, thermal sciences and finite element analysis.

Shelly Gulati, Assistant Professor of Bioengineering, 2010, BS, Chemical Engineering, Johns Hopkins University, 2000; PhD, Bioengineering, University of California, Berkeley and San Francisco, 2006. Microfluidics, biological fluid flow.

Scott Larwood, Assistant Professor of Mechanical Engineering, 2009, BS, Aeronautical Engineering, California Polytechnic State University, San Luis Obispo, 1988; MS, Aeronautics and Astronautics, Stanford University, 1993; PhD, Mechanical and Aeronautical Engineering, University of California at Davis, 2009. Licensed Professional Engineer. Wind energy, fluid mechanics, vibrations, dynamics.

Jiancheng Liu, Professor of Mechanical Engineering, 2006, BS, Taiyuan University of Technology (China), 1984; MS, 1987; PhD, Himeji Institute of Technology, now named University of Hyogo (Japan), 1996. Manufacturing, machine design.

Tien Tran Roehling, Assistant Professor, 2013, B.S., Materials Science and Engineering, 2005; Ph.D., Materials Science and Engineering, University of California, Davis, 2010. Materials Science.

Kyle A. Watson, Associate Professor of Mechanical Engineering, 2003, BSME, Villanova University, 1995; MS, North Carolina State University, 1997; PhD, 2002. Thermal sciences, fluid mechanics, combustion.

Brian L. Weick, Professor of Mechanical Engineering, 1995, BSME, Union College, 1986; MSME, Virginia Polytechnic Institute and State University, 1990; PhD, Materials Engineering Science, 1993. Manufacturing processes, materials science, design, tribology and viscoelasticity.

General Engineering Courses

ENGR 010. Dean's Seminar. 1 Unit.
This course is a survey of the profession and practice of engineering and computer science. It is an overview of the programs and methodologies of the School of Engineering and Computer Science that includes educational requirements, professional and career opportunities, introduction to the history of engineering and computing, and entrepreneurship. Hands-on activities and guest lecturers are included to complement the discussion sessions. The course provides basic skills, tools, and techniques applied to problem solving, teamwork and communication necessary for academic and professional success. Students are required to complete a design project, write a basic technical report and present their results.

ENGR 019. Computer Applications in Engineering. 3 Units.
This course introduces students to binary arithmetic,; numerical methods applicable to engineering problems and their solution that use a programming language and computation tools. Topics include root finding, solving systems of equations, curve fitting and interpolation, numerical integration and differentiation, and numerical solution of ordinary differential equations. Students develop programming skills in a high level language and learn to use mathematical computation tools including and spreadsheets. Prerequisite may be taken concurrently: MATH 053 with a "C-" or better.

ENGR 020. Engineering Mechanics I (Statics). 3 Units.
Students study the fundamental principles of static equilibrium that results from the application of forces on particles and bodies. Prerequisites: MATH 053 and PHYS 053 with a "C-" or better.

ENGR 025. Professional Practice Seminar. 1 Unit.
This course is designed to prepare students for the Cooperative Education experience. Presentations are from representatives of industry, government, education and former Co-op students. Topics include engineering ethics, professionalism, time management and mock interviewing.

ENGR 030. Engineering Ethics and Society. 3 Units.
Major engineering achievements are explored with an emphasis on ethical principles and the global impact these achievements have on society and the environment. Topics include societal needs, personal rights, whistle blowing, conflicts of interest, professional autonomy, risk assessment, sustainable development and the application of engineering codes of ethics. Contemporary technological controversies are examined along with future developments that require engineers to stay current in their field. Student participation is expected in classroom discussions, oral presentations, and written analyses. Prerequisite: Fundamental Writing Skills requirement. **(DVSY, GE2B)**

ENGR 045. Materials Science- Properties and Measurements. 4 Units.
Students examine the dependency of physical, chemical and mechanical properties on microscopic and macroscopic structure of materials. Laboratory experiments involve properties of materials such as metals, polymers, composites and ceramics. Prerequisites: CHEM 024 or CHEM 025 or CHEM 027; MATH 053 with a "C-" or better.

ENGR 110. Instrumentation and Experimental Methods. 3 Units.
Students study experimental techniques in the measurement of quantities such as biopotentials, force, pressure, sound, flow, temperature, strain and motion. Topics include statistical analysis and errors in measurement,; data analysis and transmission. Students also use of instruments in the laboratory, and prepare a measurement project. Prerequisites: Completion of all Fundamental Skills; MATH 057 and ENGR 121 with a "C-" or better or permission of instructor.

ENGR 120. Engineering Mechanics II (Dynamics). 3 Units.
Students examine the fundamental principles of particles and bodies in motion under the action of external forces. Prerequisites: Completion of all Fundamental Skills and ENGR 020 with a "C-" or better.

ENGR 121. Mechanics of Materials. 4 Units.
Students study concepts of stress, strain and deformation, and the analysis and design of simple elements of structures and machines. The course introduces the failure theory and energy methods. Prerequisites: Completion of all Fundamental Skills and ENGR 020 with a "C-" or better. Prerequisite, may be taken concurrently: MATH 057 with a "C-" or better.

ENGR 122. Thermodynamics I. 3 Units.
Students examine the first and second laws of thermodynamics for open and closed systems. Topics include properties of gases and liquids and ideal gases. Students are also introduced to cycles for power and refrigeration. Prerequisites: Completion of all Fundamental Skills; CHEM 024 or CHEM 025 or CHEM 027; PHYS 053 with a "C-" or better.

ENGR 150. Engineering and Science-Based Entrepreneurship. 4 Units.
Entrepreneurial businesses are increasingly based on new products, processes and services derived from the realms of engineering and/or science. In this hands-on course a multidisciplinary team of students will develop a business plan around a prototype for an original product or service created by students and/or faculty in engineering or the sciences. The plan will focus on the market, technical, operational, financial and organization/administrative dimensions of the business. Prerequisite: Senior standing.

ENGR 181. Professional Practice. 1-18 Units.
This course offers cooperative employment in a professional engineering environment. Students may register for a variable number of credits that depend upon the length of the work period. The course requires a satisfactory completion of the work assignment and a written report. Grading is on a Pass/Fail basis. Prerequisites: Completion of all Fundamental Skills.

ENGR 182. Professional Practice. 1-18 Units.
This course offers cooperative employment in a professional engineering environment. Students may register for a variable number of credits that depend upon the length of the work period. The course requires a satisfactory completion of the work assignment and a written report. Grading is on a Pass/Fail basis. Prerequisites: Completion of all Fundamental Skills.

ENGR 183. Professional Practice. 1-18 Units.
This course offers cooperative employment in a professional engineering environment. Students may register for a variable number of credits that depend upon the length of the work period. The course requires a satisfactory completion of the work assignment and a written report. Grading is on a Pass/Fail basis. Prerequisites: Completion of all Fundamental Skills.

ENGR 184. Professional Practice. 1-18 Units.
This course offers cooperative employment in a professional engineering environment. Students may register for a variable number of credits that depend upon the length of the work period. The course requires a satisfactory completion of the work assignment and a written report. Grading is on a Pass/Fail basis. Prerequisites: Completion of all Fundamental Skills.

ENGR 185. Professional Practice. 1-18 Units.
This course offers cooperative employment in a professional engineering environment. Students may register for a variable number of credits that depend upon the length of the work period. The course requires a satisfactory completion of the work assignment and a written report. Grading is on a Pass/Fail basis. Prerequisites: Completion of all Fundamental Skills.

ENGR 191. Independent Study. 1-4 Units.

Mechanical Engineering Courses

MECH 015. Mechanical Engineering Graphics. 3 Units.
This course covers the principles and applications of graphics in engineering design. Topics include pictorial and isometric sketching and orthographic projection, the use of auxiliary views and sections, drafting standards and conventions, dimensioning and tolerances, in addition to layout and assembly drawings, detail drawings and production drawings with SolidWorks and AutoCAD software. A laboratory is included. Prerequisite, may be taken concurrently: ENGR 010 with a "C-" or better.

MECH 100. Manufacturing Processes. 4 Units.
This course is a study of traditional manufacturing processes such as formatting, cutting, joining, casting, and heat treating as well as advanced processing methods; manufacturing with polymers, composites, and ceramics in addition to metals, tribology, nondestructive evaluation, and quality control. Laboratory projects involve manufacturing skills, reverse engineering, automated machines, geometric dimensioning and tolerancing, and statistical process control. Prerequisites: Completion of all Fundamental Skills; MECH 015 and ENGR 045 with a "C-" or better.

MECH 104. Introduction to Mechatronics. 3 Units.
Students examine a broad understanding of the main components of mechatronic systems and understanding of the general principles involved in computer-controlled machinery. Topics include sensing, actuation and control, practical knowledge of the development of simple embedded computer programs, understanding of the practical application of mechatronic systems in applications such as manufacturing, automobile systems and robotics. Prerequisites: Completion of all Fundamental Skills; ECPE 041, ENGR 120, ENGR 110 with a "C-" or better.

MECH 120. Machine Design and Analysis I. 3 Units.
This course builds on fundamental principles learned in statistics, dynamics, and mechanics of materials, and applies them to the design and analysis of machines. Methods for performing load and stress analysis are learned along with analytical methods for solving deflection and stability problems. Static, impact, and fatigue failure theories for machines are also studied. Statistical methods for solving machine design problems are presented, and engineering design practices are integrated throughout the course. Prerequisites: Completion of all Fundamental Skills; ENGR 045, ENGR 120, ENGR 121; MECH 015 with a "C-" or better. (Fall).

MECH 123. Kinematics and Dynamics of Machinery. 3 Units.
Students learn how to design, analyze and prepare a simulation of complex mechanisms with emphasis on high speed and precision applications. Topics include kinematics and dynamics of planar and three dimensional mechanisms; gyroscopic forces in machines and balancing, and applications to robotics. Prerequisites: Completion of all Fundamental Skills; ENGR 120 and ENGR 121 with a "C-" or better.

MECH 125. Machine Design and Analysis II. 3 Units.
Students learn how to design, analyze, and incorporate a variety of standard parts and devices into machines. These parts and devices include fasteners, gear systems, belt drives, chain drives, shafts, couplings, bearings, springs, clutches, and brakes. Principles of tribology (friction, wear, and lubrication) are introduced and applied to the design of machines. Engineering design practices are integrated throughout the course. Prerequisites: Completion of all Fundamental Skills and MECH 120 with a "C-" or better.

MECH 129. Vibrations. 3 Units.
Students study models of physical systems with lumped and distributed parameters. The studies include free and forced vibrations of machines and structures as well as excitation and response of single degree of freedom systems. The course introduces multiple degrees of freedom systems, finite element formulations and mode superposition techniques. Prerequisites: Completion of all Fundamental Skills; MATH 057, ENGR 019, ENGR 120 with a "C-" or better.

MECH 140. Engineering Design/Senior Project I. 3 Units.
This course discusses methods of initiating, planning, conceptualizing, and configuring engineering designs. The student uses these methods to develop an engineering design for a product or process that involves mechanical engineering. Product realization methods, project management, materials selection, manufacturing for designers, guided iteration, communication skills, economics, ethics, liability, and safety issues are put into practice through class activities. Prerequisites: Completion of all Fundamental Skills; ENGR 121 and ENGR 122 with a "C-" or better. Prerequisite, may be taken concurrently: ENGR 110; MECH 120 or MECH 150 with a "C-" or better.

MECH 141. Engineering Design/Senior Project II. 3 Units.
The student completes the design phase of their project. Parametric design techniques such as guided iteration, optimization, and Taguchi's methods are used to complete the detailed design of a product or process that involves mechanical engineering. Manufacturing necessary to complete the product or process is a requirement. Weekly oral and written progress reports are required along with final comprehensive oral and written reports. Prerequisites: Completion of all Fundamental Skills; MECH 100 and MECH 140 with a "C-" or better.

MECH 150. Heat Transfer. 3 Units.
Students study heat transfer by conduction in one, two and three dimensions in transient and steady state and heat transfer in extended surfaces. Topics include solutions by numerical methods, convection in external and internal flow, free convection, and radiation. Prerequisites: Completion of all Fundamental Skills; ENGR 122 and MATH 057 with a "C-" or better.

MECH 151. Applied Heat Transfer. 3 Units.
Applications and extensions of the topics in MECH 150. Multimode heat transfer; heat exchangers. Heat transfer with phase change. Prerequisites: Completion of all Fundamental Skills and MECH 150 with a "C-" or better.

MECH 155. Solar Energy Engineering. 3 Units.
This course introduces students to solar energy, sun-earth geometry, radiation measurement, insulation on surfaces, principles of solar collectors, applications such as space heating and solar ovens, and photovoltaics. Laboratory experiments are included. Prerequisites: Completion of all Fundamental Skills and ENGR 122 with a "C-" or better.

MECH 157. Thermodynamics II. 3 Units.
Students continue to examine of topics in Thermodynamics I which include availability, chemical reactions, combustion, and fuels. Students also study processes involving air and water mixtures relating that relate to heating, cooling and ventilating for human comfort. The course also introduces to the thermodynamics of the flow of ideal gases. Prerequisites: Completion of all Fundamental Skills and ENGR 122 with a "C-" or better.

MECH 158. Air Conditioning. 3 Units.
Students are introduced to air conditioning purpose, terminology and typical systems. Students study the analysis and design of air conditioning as applied to residential and small commercial buildings, and they learn the codes and standards applicable to this field. Prerequisites: Completion of all Fundamental Skills; ENGR 122 with a "C-" or better.

MECH 160. Fluid Dynamics. 3 Units.
Students study equations of continuity, energy, and momentum as applied to fluid flow. Topics include one dimensional compressible flow, and the introduction to more advanced topics, such as turbomachinery, viscous flow and potential flow. Prerequisites: Completion of all Fundamental Skills; CIVL 130 and ENGR 122 with a "C-" or better.

MECH 175. Systems Analysis and Control. 4 Units.
Students study dynamic analysis and control of systems composed of mechanical, electrical, hydraulic and thermal components. Students use of system modeling and simulation techniques to predict transient and steady state response, lumped parameter approximations and linearization. Students also use feedback to enhance system performance and stability and they study design of linear control systems in the time and frequency domains. Prerequisites: Completion of all Fundamental Skills; ECPE 041, ECPE 041L, ENGR 110, MECH 129 with a "C-" or better.

MECH 178. Finite Element Methods. 3 Units.
This course introduces the finite element method for engineering problems. Topics include matrix formulation of finite element models for problems in solid mechanics, heat transfer and fluid flow as well as solution of finite element equilibrium equations. Students study the development of computer algorithms and applications that use commercial finite element computer programs. Some familiarity with matrix methods is desirable. Prerequisites: Completion of all Fundamental Skills; ENGR 121 and ENGR 122 with a "C-" or better. Prerequisite, may be taken concurrently: CIVL 130 with a "C-" or better.

MECH 191. Independent Study. 1-4 Units.
Special individual projects are undertaken under the direction of one or more faculty members knowledgeable in the particular field of study. Permission of department chairperson and faculty members involved.

MECH 197. Undergraduate Research. 2-4 Units.
This course includes applied or basic research in mechanical engineering under faculty supervision. Projects may be experimental, mathematical or computational in nature. Permission of faculty supervisor and department chairperson. Student must be in good academic standing.