

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

<http://www.pacific.edu/Academics/Schools-and-Colleges/School-of-Engineering-and-Computer-Science/Academics-/Majors/Mechanical-Engineering-.html>

Phone: (209) 946-2377

Location: Khoury Hall

Programs 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 via promotion to positions of increasing responsibility and/or leadership, publications, and/or conference presentations;
- Adaptability to new developments in science and technology in the workplace, pursuing graduate education in engineering and related fields, or participating in professional development activities;
- 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 pursue lifelong learning while demonstrating an awareness of humanistic, societal, and environmental issues through application of these concerns within their professional activities.

Student Outcomes Required to Achieve M.E. Program Educational Objectives

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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

For more details, see General Education (<https://catalog.pacific.edu/uop/generalinformation/generaleducation/>)

Minimum 28 units and 9 courses that include:

A. CORE Seminars (2 courses)

CORE 001	Problem Solving & Oral Comm	3
CORE 002	Writing and Critical Thinking	4

Note: 1) CORE Seminars cannot be taken for Pass/No Credit. **2)** Transfer students with 28 or more transfer credits taken after high school are exempt from both CORE seminars.

B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

Artistic Process & Creation
Civic & Global Responsibility
Language & Narratives
Quantitative Reasoning
Scientific Inquiry
Social Inquiry
World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

C. Diversity and Inclusion Requirement

All students must complete Diversity and Inclusion coursework (at least 3 units)

Note: 1) Diversity and Inclusion courses can also be used to meet the breadth category requirements, or major or minor requirements.

D. Fundamental Skills

Students must demonstrate competence in:

Writing
Quantitative Analysis (Math)

Note: 1) Failure to satisfy the fundamental skills requirements by the end of four semesters of full-time study at the University is grounds for academic disqualification.

II. 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 for Chem Requirement: 4-5

AP CHEM scores of 4 or 5, or IB CHEM Higher Level scores of 5, 6, or 7

CHEM 024	Fundamentals of Chem
CHEM 025	General Chemistry
CHEM 027	General Chemistry

Select one of the following Math courses: 4

MATH 037	Introduction to Statistics and Probability	
MATH 075	Introduction to Linear Algebra	
Mechanical Engineering Required Courses		
IDEA 010	Interdisciplinary Design and Success	2
ENGR 019	Computer Applications in Engineering	3
ENGR 020	Engineering Mechanics I (Statics)	3
ENGR 025	Professional Practice Seminar	1
ENGR 030	Engineering and Computing Ethics in Society	3
ECPE 041	Circuits	3
ECPE 041L	Circuits Laboratory	1
ENGR 045	Materials Engineering	3
ENGR 045L	Materials Engineering Lab	1
ENGR 120	Engineering Mechanics II (Dynamics)	3
ENGR 121	Mechanics of Materials	3
ENGR 122	Thermodynamics I	3
CIVL 130	Fluid Mechanics I	3
CIVL 130L	Fluid Mechanics I Lab	1
MECH 015	Mechanical Engineering Graphics	3
MECH 100	Manufacturing Processes	3
MECH 100L	Manufacturing Process Lab	1
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

Mechanical Electives Courses: A Minimum of 12 units of Mechanical Electives Courses are required, 3 of which may be non-MECH. 12

List of MECH Electives:

MECH 104	Introduction to Mechatronics
MECH 123	Kinematics and Dynamics of Machinery
MECH 151	Applied Heat Transfer
MECH 155	Solar Energy Engineering
MECH 157	Thermodynamics II
MECH 158	Air Conditioning
MECH 160	Fluid Dynamics
MECH 175	Systems Analysis and Control
MECH 178	Finite Element Methods
MECH 191	Independent Study
MECH 193A	Special Topics
MECH 197	Undergraduate Research
MECH 200	Computer Aided Manufacturing
MECH 202	Polymer and Composite Materials
MECH 204	Advanced Mechatronics
MECH 262	Combustion
MECH 293	Special Topics
IDEA 130	Introduction to Mobile Robotics
or IDEA 131	Autonomous Mobile Robotics

List of Engineering Electives

BENG 100 level courses; COMP 100 level courses; CIVL 100 level courses; ECPE 071/071L, and 100 level courses; EMGT 100 level courses, ENGR 100 level courses not list of ME required courses; MATH 110, MATH 145, MATH 152, MATH 157

Cooperative Education - Minimum 32 units that include:

ENGR 181	Professional Practice	1-16
ENGR 182	Professional Practice	1-16
ENGR 183	Professional Practice	1-16

Master of Science in Engineering Curriculum

All students who receive an MSE complete a set of core courses that cover the broader subjects of research and analysis. Students choose from one of four concentrations: Civil Engineering, Mechanical Engineering, Engineering Management, or Computer Engineering/Electrical Engineering. Students must complete a minimum of 30 units with a Pacific cumulative grade point average of 3.0 in order to earn the Master of Science in Engineering.

A. Thesis Option

1. Students must complete a minimum of 30 units.
2. All students must perform independent research that must culminate in the completion of a thesis based on the findings of the research. For successful completion of the thesis course, students must submit a research proposal, conduct the research, write the thesis, and successfully complete a final oral defense.
3. All students complete six units of ENGR 299, Thesis Research.
4. The Concentration Requirements specified must be satisfied.

B. Non-thesis Option

1. Students must complete a minimum of 30 units.
2. For the Non-thesis Option, students may choose to do a project or they may satisfy all the unit requirements through coursework.
 - a. For the *project* option, students complete up to 6 units of research under the supervision of an SOECS faculty member. Upon completion of the project, the student submits a comprehensive report.
 - b. Students may elect to satisfy the entire degree through *coursework*.
 - c. Both project and coursework options must satisfy the Concentration Requirements specified.

Master of Science in Engineering with a concentration in Mechanical Engineering

Students must complete a minimum of 30 units with a Pacific cumulative grade point average of 3.0 in order to earn the Master of Science in Engineering degree.

Core Courses

Select one of the following Math or Computational Science Elective: 3

ENGR 219	Numerical Methods for Engineering
ENGR 250	Probability and Statistics for Engineering and Computer Science

Breadth Elective (one from approved list for concentration) 3-4

Select one of the following options: 6

A) Thesis Option

ENGR 299	Thesis
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B) Project Option (non-thesis)

ENGR 291	Graduate Independent Study
ENGR 297	Graduate Research

C) Course Work Option (non-thesis)

Courses approved by advisor as coherent plan

Concentration Requirements	
Four electives approved by advisor as coherent plan	12
Additional Electives	6

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Note: 1) CORE Seminars cannot be taken for Pass/No Credit. **2)** Transfer students with 28 or more transfer credits taken after high school are exempt from both CORE seminars.

B. Breadth Requirement (7 courses, at least 3 units each)

At least one course from each of the following areas:

Artistic Process & Creation
Civic & Global Responsibility
Language & Narratives
Quantitative Reasoning
Scientific Inquiry
Social Inquiry
World Perspectives & Ethics

Note: 1) No more than 2 courses from a single discipline can be used to meet the Breadth Requirement.

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All students must complete Diversity and Inclusion coursework (at least 3 units)

Note: 1) Diversity and Inclusion courses can also be used to meet the breadth category requirements, or major or minor requirements.

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CHEM 027	General Chemistry	
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MATH 075	Introduction to Linear Algebra	

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ENGR 045	Materials Engineering	3
ENGR 045L	Materials Engineering Lab	1
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ENGR 121	Mechanics of Materials	3
ENGR 122	Thermodynamics I	3
CIVL 130	Fluid Mechanics I	3
CIVL 130L	Fluid Mechanics I Lab	1
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MECH 100	Manufacturing Processes	3
MECH 100L	Manufacturing Process Lab	1
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

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MECH 123	Kinematics and Dynamics of Machinery
MECH 151	Applied Heat Transfer
MECH 155	Solar Energy Engineering
MECH 157	Thermodynamics II
MECH 158	Air Conditioning
MECH 160	Fluid Dynamics
MECH 175	Systems Analysis and Control
MECH 178	Finite Element Methods
MECH 191	Independent Study
MECH 193A	Special Topics
MECH 197	Undergraduate Research
MECH 200	Computer Aided Manufacturing
MECH 202	Polymer and Composite Materials
MECH 204	Advanced Mechatronics
MECH 262	Combustion
MECH 293	Special Topics

IDEA 130 Introduction to Mobile Robotics
or IDEA 131 Autonomous Mobile Robotics

List of Engineering Electives

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Cooperative Education - Minimum 32 units that include:

ENGR 181	Professional Practice	1-16
ENGR 182	Professional Practice	1-16
ENGR 183	Professional Practice	1-16

Mechanical Engineering Courses

MECH 010. Introduction to Mechanical Engineering. 3 Units.

Students will be introduced to the many subdisciplines of Mechanical Engineering, future career paths, and what essential skill sets are needed for each subdiscipline. Students will learn how to work collaboratively and equitably in diverse groups. The ethics of working in groups in a mechanical engineering context will be discussed as students learn how to perform experimentation, technical writing skills, data analysis, statistics, and are trained on common instrumentation/apparatuses used by Mechanical Engineers.

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.

MECH 100. Manufacturing Processes. 3 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 or PDEP 046 with a "C-" or better. Corequisite: MECH 100L.

MECH 100L. Manufacturing Process Lab. 1 Unit.

Experimental analysis of concepts are discussed in MECH 100. Prerequisites: Completion of all Fundamental Skills; MECH 015; and ENGR 045 or PDEP 046 with a "C-" or better.

MECH 104. Introduction to Mechatronics. 3 Units.

A broad understanding of the main components of mechatronic systems; Understanding of the general principles involved in computer controlled machinery, including 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 and ENGR 019 with a "C-" or better.

MECH 120. Machine Design and Analysis I. 3 Units.

This course builds on fundamental principles learned in statics, 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.

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: ENGR 120, MATH 057, ENGR 019 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, design thinking, rapid prototyping, 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 122 with a "C-" or better; and Prerequisite that may be taken concurrently: 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. Guided iteration and optimization are used to complete the detailed design of a product or process involving mechanical engineering. Manufacturing and rapid prototyping are used to complete the fabrication of a product or process. Failure modes and effects analysis, safety, and liability are considered. Regular 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 and simulation techniques, 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 examine the thermodynamics of cycles for power and refrigeration. Other topics include the thermodynamics of gas mixtures, chemical reactions, chemical equilibrium, combustion, fuels, and processes involving air and water mixtures relating to heating, cooling, and ventilating for human comfort. The course includes experimental activities and written laboratory reports. 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. 3 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, 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 193. Special Topics. 1-4 Units.**MECH 197. Undergraduate Research. 1-4 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.

MECH 200. Computer Aided Manufacturing. 3 Units.

Develop students' competence and self-confidence as mechanical engineers. Computer aided design, analysis and manufacturing are emphasized. Course subject depends on active learning via several major design-and-build projects. Lecture focuses on the underlying theory of parametric 3-D solid modeling and representation, transformation techniques, machining strategy, and CNC manufacturing technology. Prerequisites: ENGR 121, MECH 100 with a "C" or better, Graduate or blended students in the School of Engineering and Computer Science or permission of the instructor.

MECH 202. Polymer and Composite Materials. 3 Units.

Fundamental characteristics of polymers, fibers, and polymer-based composite materials are studied. Advanced mechanics of materials are used to develop tools to predict the mechanical behavior of composite laminates. Experimental and analytical methods for characterizing the mechanical and thermal behavior of polymers are studied, and laboratory-based experiences are used to enhance the learning process. Design methods for using these advanced materials in engineering applications are discussed. Prerequisites: ENGR 045, ENGR 121 with a "C" or better and Graduate or blended students in the School of Engineering and Computer Science or permission of instructor.

MECH 204. Advanced Mechatronics. 3 Units.

Students study the design of mechatronic systems that integrate mechanical, electrical, and control systems engineering. Laboratories form the core of the course. They cover topics such as mechanism design, motors and sensors, interfacing and programming microprocessors, mechanical prototyping, and creativity in the design process. Project topics vary from year to year. Prerequisites: MECH 104 with a "C" or better and Graduate or blended students in the School of Engineering and Computer Science or permission of instructor.

MECH 262. Combustion. 3 Units.

This course introduces students to combustion processes and systems. Students study the conservation equations for reacting flows, chemical kinetics, conserved scalars, premixed flames, diffusion flames and droplet burning. Primary applications studied are internal combustion engines and gas turbine combustors. Prerequisites: Graduate or blended students in the School of Engineering and Computer Science and ENGR 122 with a "C" or better or permission of instructor.

MECH 291. Graduate Independent Study. 1-4 Units.

Special individual projects are undertaken under the direction of one or more faculty. Prerequisite: Graduate or blended students in the School of Engineering and Computer Science or permission of instructor.

MECH 293. Special Topics. 1-4 Units.

Special courses are organized and offered from time to time to meet the needs or interests of a group of students. Prerequisite: Graduate or blended students in the School of Engineering and Computer Science or permission of the instructor.

MECH 297. Graduate Research. 1-4 Units.

Prerequisite: Graduate or blended students in the School of Engineering and Computer Science or permission of instructor. Permission of faculty supervisor and department chair.

MECH 299. Thesis. 1-6 Units.

Minimum of six units is required for Thesis Option students.

Prerequisites: Graduate or blended students in the School of Engineering and Computer Science and permission of research advisor.