ENGINEERING - MECHANICAL

College of Engineering and Computer Science

Program Description

Mechanical Engineering involves the design of all types of machines and equipment including vehicles used in ground, air, and space transportation; machines for the conversion of fuels into energy; food processing; consumer products; robots; biomedical devices; the machines used to manufacture all of the above; and the climate control of buildings. Mechanical engineers bring together the fields of design graphics, manufacturing, engineering materials, thermodynamics and heat transfer, and the principles of mathematics and science to find solutions to societal needs. They often work directly in the design and operation of food processing plants, power plants, manufacturing plants, refineries, and other industrial operations. A major goal of the curriculum is to provide the graduates with the analytical and practical skills needed to perform mechanical design in a variety of fields, preparing graduates to take advantage of the many employment opportunities.

The Mechanical Engineering Program includes courses on design, thermal sciences, manufacturing, properties and selection of materials, and computer applications related to these topics. The curriculum maintains a balance among basic fundamentals, analytical methods, and design applications of current knowledge, preparing the graduates for both entry into the profession and a life-long career.

The employers of Mechanical Engineering graduates include aircraft and automobile companies, food processing companies, machinery and equipment companies, gas and electric utilities, architectural and engineering firms, and many agencies in federal, state, and local governments. Some graduates continue their education by completing advanced degrees in Engineering or Management.

Specializations

- **MS:** Design and Dynamic Systems; Manufacturing and Materials; Thermal and Fluid Systems

Special Features

- The Mechanical Engineering program is ABET accredited by the Engineering Accreditation Commission (EAC/ABET),
  Engineering Accreditation Commission (EAC/ABET)
  111 Market Place, Suite 1050
  Baltimore, Maryland 21202
  (410) 347-7700.
  In keeping with its accreditation, the Mechanical Engineering program has strong engineering design content. In particular, the program includes a four-semester sequence on modern design and manufacturing methods.
- Faculty members have backgrounds in Mechanical, Aeronautical, Manufacturing, and Materials Science. The faculty has a variety of research interests; the majority has industrial experience which contributes to the applied emphasis in the Mechanical Engineering program. Most of the faculty has doctorates; some are registered Professional Engineers (PE).
- Lectures and lab are arranged so students can participate in meaningful discussions and a real exchange of ideas between students and faculty.
- Upper division students do cooperative work on team projects and often develop study groups for other courses.
- Courses taken in the freshman and sophomore years form a foundation for the upper division program; e.g., the dynamics and strength of materials studied in the junior year depend on the sophomore mechanics, calculus, and physics courses. Building on analytical and communications skills learned in the lower division, students take a four semester design-project sequence which includes the study of design methods, and the procedures for developing a design solution from concept through a fully-developed design and finally to production. The courses in mechanics, energy transformation, manufacturing, and materials support this sequence.
- Students can take elective courses in computer analysis, heating, ventilating and air-conditioning, manufacturing methods, and systems and materials engineering.

Program Educational Objectives

Mechanical Engineering Graduates will have:

- utilized a foundation in engineering and science to engage in successful careers in mechanical engineering or other fields to the benefit of society.
- become effective participants or leaders in innovation and multi-disciplinary collaboration to address global technical, social, and industrial issues.
- engaged in career and professional development through self-study, continuing education, or graduate studies in engineering or other professional fields.

Academic Policies and Procedures

Course Repeat Policy - Undergraduate engineering and mechanical engineering courses that are used to meet the Bachelor of Science in Mechanical Engineering 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.

Career Possibilities

Aeronautical Engineer · Automotive Engineer · Design Engineer · Development Engineer · Energy Management Engineering Manager · Environmental Engineer · Food Processing Machine Designer · Manufacturing Engineer · Plant Engineer · Project Engineer · Research Engineer · Technical Sales Engineer

Contact Information

Susan L. Holl, Department Chair
Ryan Gorsiski, Administrative Support Coordinator
Riverside Hall 4024
(916) 278-6624
http://www.ecs.csus.edu/wcm/me/

Faculty

BANDY, RABINDRANATH

EKE, ESTELLE M.

GRANDA, JOSE

HOLL, SUSAN L.

HOMEN, PATRICK

KUMAGAI, AKIHIKO

MARBACH, TIMOTHY L.

SPROTT, KENNETH S.

SUH, YONG S.

TUZCU, ILHAN

ZHOU, DONGMEI

Undergraduate Program

Sequence of Study: Courses taken in the Freshman and Sophomore years, either at Sacramento State, or at a Community College or transfer college, directly contribute to the upper division (Junior-Senior) program. For example, upper division work in Computer-Aided Design (CAD) develops skills introduced in freshman graphics and CAD courses; upper division analytical courses depend on the freshman and sophomore calculus and physics courses. Communication skills learned in the lower division are developed through the writing of reports and oral presentations.

Mechanical Engineering design involves far more than solving the types of problems found in chemistry, physics, and calculus courses; design work involves a large measure of analytical and creative work. The principles of mathematics and science are extremely useful when developing a detailed design solution but contribute little to the critical issues of correctly defining the problem, specifying the solution, and locating and organizing needed information. In addition, the design cannot violate fundamental physical laws and must be built from real materials using real manufacturing methods at a reasonable cost while satisfying safety and environmental factors.

The work in the four semester design-project sequence and other courses addresses these issues by including the study of design methods, procedures for developing a design solution from concept through a fully-developed design, and construction of a prototype. The courses in mechanics, thermodynamics, manufacturing, and materials complement the design sequence. The design work includes a mixture of problem and project work in individual courses; some of the course-level projects are team projects to help the student develop the ability to efficiently and effectively work with other engineers making decisions, use the abilities of different colleagues, and distribute the work of large projects. The design sequence includes classical as well as computer aided design and analysis techniques. The work in the two-semester, capstone and senior project sequence involves team effort on a significant design problem. Students interested in furthering their skills in analysis, including finite element analysis, and dynamic modeling of systems, can choose from a number of elective courses which rely heavily on computer methods.

Advising: Each student has a faculty advisor who meets with him/her at least once a semester to discuss academic progress, plan the following semester, explain University requirements, and answer questions about the Mechanical Engineering program.

BS Degree in Mechanical Engineering

Units required for Pre-Major: 42 plus GE/GR courses
Units required for Major: 50 plus GE/GR courses
Minimum total units required for the BS: 122
A grade of "C-" or better is required in all courses applied to a Mechanical Engineering major.
Students graduating with a BS in Mechanical Engineering will not be subject to the University's Foreign Language Graduation Requirement. Students who change major may be subject to the University's Foreign Language Graduation Requirement.

Required Lower Division Courses (Pre-Major) (60 Units) [1]		
First Semester Freshman Year		
CHEM 1E	General Chemistry for Engineering	4
ENGR 6	Engineering Graphics and CADD (Computer Aided Drafting and Design)	3
MATH 30	Calculus I [2]	4
Select one General Education course		3
Second Semester Freshman Year		
MATH 31	Calculus II [2]	4
ME 37	Manufacturing Processes	3
PHYS 11A	General Physics: Mechanics [2]	4
Select one General Education course		3
First Semester Sophomore Year		
ENGR 45	Engineering Materials	3
MATH 32	Calculus III	4
PHYS 11C	General Physics: Electricity and Magnetism [2]	4
Select one General Education course		3
Select one General Education/Graduation Requirement Course		3
Second Semester Sophomore Year		
ENGR 17	Introductory Circuit Analysis	3
ENGR 30	Analytic Mechanics: Statics	3
MATH 45	Differential Equations for Science and Engineering	3
Select two General Education courses		6
Required Upper Division Courses (Major) (62 Units) [3]		
First Semester Junior Year		
ENGR 110	Analytic Mechanics - Dynamics	3
ENGR 112	Mechanics Of Materials	3
ENGR 124	Thermodynamics	3
ME 116	Machinery Design I	2
ME 105	Introduction to Technical Problem Solving	3
ME 108	Professional Topics for Mechanical Engineers	2
Second Semester Junior Year		
ENGR 132	Fluid Mechanics	3
ME 117	Machinery Design II	2
ME 138	Concurrent Product and Process Design	3
ME 171	Modeling and Simulation of Mechatronics and Control Systems	3
ME 180	Mechanical Properties of Materials	3
Select one General Education Course		3
First Semester Senior Year		

ME 126	Heat Transfer	3
ME 128	Thermal-Fluid Systems	3
ME 172	Control System Design	3
ME 190	Project Engineering I [4]	3
Select one General Education course		3
Second Semester Senior Year		
ME 191	Project Engineering II [4]	2
Select two General Education courses		6
Select two of the following: [5]		6
ME 114	Vibrations	
ME 115	Dynamics of Machinery and Multi-Body Systems	
ME 121	Solar Thermal and Energy Storage Systems	
ME 122	Geothermal and Bioenergy Systems	
ME 123	Wind, Hydro and Ocean Energy	
ME 136	Numerical Control Programming	
ME 137	Product Design for Manufacturing and Automation	
ME 140	Introduction to Motors and Actuators	
ME 141	Introduction to Tolerance Analysis	
ME 143	Vehicle Dynamics and Design	
ME 151	Fundamentals of Combustion	
ME 152	Turbomachinery Design	
ME 153	Thermodynamics of Combustion Engines	
ME 154	Alternative Energy Systems	
ME 155	Gas Dynamics	
ME 156	Heating and Air Conditioning Systems	
ME 157	Solar Energy Engineering	
ME 159	High Efficiency HVAC	
ME 165	Introduction To Robotics	
ME 164	Introduction to Test Automation	
ME 165	Introduction To Robotics	
ME 173	Applications of Finite Element Analysis	
ME 176	Product Design CAD	
ME 177	Product Design and 3D Parametric Solid Modeling	
ME 182	Introduction to Composite Materials	
ME 184	Corrosion and Wear	
ME 186	Fracture Mechanics in Engineering Design	
Total Units		122

1 Lower division requirements are essentially common for Civil, Electrical and Electronic, and Mechanical Engineering.
Note: Courses are listed in a recommended sequence, and may be interchanged among semesters to accommodate the student's schedule, as long as prerequisites are met.

2 Course may also satisfy General Education requirements. A second year foreign language course 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.

3 Students are allowed to enroll in upper division Engineering or Mechanical Engineering courses with the Department's approval. Pre-Major students must complete a Change of Major form and submit it to the Mechanical Engineering Department Office during the application filing period.

4 Course may also satisfy General Education requirements.

5 An upper division course in Engineering, Mathematics, and Science may be selected with prior approval of the student's advisor.
Note: All elective courses are NOT offered every semester. The Mechanical Engineering Department Office maintains a listing showing when particular courses will be offered.

Cooperative Education (Pre-work Experience)

The Department of Mechanical Engineering encourages students to participate in the Cooperative Education Program, which provides alternate periods of university study and major-related, off-campus, paid employment in industry. Most students who elect to participate in cooperative education will complete the equivalent of two 6-month work periods before graduation. Students interested in the Cooperative Education Program should apply in Lassen Hall 1013. For information, call (916) 278-6231.

Blended B.S./M.S. Program in Mechanical Engineering

The Blended BS/MS program in Mechanical Engineering allows qualified students in the BS degree program to simultaneously complete requirements for both the BS and MS degree. Students in the program can progress from undergraduate to graduate status without applying for admission through the Office of Graduate Studies.

Unit Requirements
Required units: 153

Eligibility Requirements

Students majoring in Mechanical Engineering will be eligible to apply to the program if they meet the following criteria:

- Completion of the WPJ or equivalent, eligible for WI course, and completion of the prerequisites for ME 190 (Project Engineering I);
- Have not yet enrolled in ME 190; and
- Have a minimum GPA in major courses of 3.00.

Application Procedures

Students interested in applying to the Blended BS/MS Program should follow the following procedure:

- Prior to the tenth week during the semester before taking ME 190, students must complete the department application.
- Applicants do not need to pay the graduate program application fee.
- Electronic applications will be submitted to the ME Graduate Coordinator for review.
- Upon acceptance to the program, the department will notify the Registrar's Office and the Office of Graduate Studies in the change in status of the student.

Program of Study

In the two semesters of their senior year, students admitted to the program will be required to take the following graduate classes:

- ME 209 Research Methodology (2 units)
- Two graduate-level courses (200 level) in Mechanical Engineering selected in consultation with the Graduate Coordinator (3 units each)

When the students have completed the core courses for the undergraduate program and have completed the 8 units of graduate courses listed above, they will be converted to graduate status and the BS degree can be awarded. Students will be eligible to receive the MS degree when the remaining requirements for the graduate degree are completed (i.e., the requirements for the MS degree are the same whether taken separately or blended).

During their first semester in graduate status, students will be required to submit a thesis proposal to the ME department and to apply for advancement to candidacy.

Opt-Out Option

Students who wish to opt out after completing all other BS major requirements except the 6 units of ME electives may do so and the two graduate courses will count as two of the electives required in the normal undergraduate program. The total number of units taken for the BS degree will be the same (129 units) as for students who are not in the blended program.

Graduate Program

The Master of Science program in Mechanical Engineering prepares students for leadership in the practice of Mechanical Engineering. The program includes the study of scientific and technical principles underlying modern engineering practice and advanced mathematical techniques needed for their application in research and design.

Specializations

Four areas are offered as specializations: Design and Dynamic Systems; Manufacturing and Material Engineering; Thermal and Fluids Systems; and Aerospace Systems. In each area there are specific course requirements to be met; all four specializations encompass Engineering Design.

Elective courses allow for the development of each student's particular interests. An individual's applied research or design study, presented in a Master's thesis or project, complements the formal class work and completes the program.

Admission Requirements

Admission as a classified graduate student in Mechanical Engineering requires:

- a Bachelor of Science degree in Engineering or Computer Science;
- a minimum GPA of 3.0 in upper division engineering courses; and
- English Language Requirement (for foreign students only).

Applicants who do not meet the three admission requirements listed above because they have a Baccalaureate degree in a field other than Engineering or Computer Science, and/or because their GPA is below 3.0 but above 2.5 in the last 60 units of undergraduate work, may be admitted with conditionally classified status. Any deficiencies will be noted in a written response to the applicant.

If a student lacks some of the undergraduate courses needed for successful completion of the graduate program, such prerequisite courses must be taken before the student can be fully accepted to the program.

Admission Procedures

Applications are accepted as long as space for new students exists. All prospective graduate students, including Sacramento State graduates, must file the following with the Office of Graduate Studies, River Front Center 215, (916) 278-6470:

- an online application for admission;
- two sets of official transcripts from all colleges and universities attended *other than Sacramento State*; and
- English Language Requirement (for foreign students only).

For more admissions information and application deadlines, please visit http://csus.edu/gradstudies/.

Approximately six weeks after receipt of all items listed above, a decision regarding admission will be mailed.

Advancement to Candidacy

Each student must file an application for Advancement to Candidacy, indicating a proposed program of graduate study. This procedure should begin as soon as the classified graduate student has:

- removed any deficiencies in admission requirements;
- completed at least 12 units in the graduate program with a minimum 3.0 GPA, including ME 209 (2 units) and at least 7 other units at the 200 level. Note: For our program completion of ME 209 with a grade of "B" or above satisfies the Graduate Writing Assessment Requirement (GWAR); and
- obtained approval of a thesis/project topic using the Department of Mechanical Engineering Master's Thesis/Project Approval Form.

Advancement to Candidacy forms are available in the Office of Graduate Studies. The student fills out the form after planning a degree program in consultation with a faculty advisor. After approval by the Mechanical Engineering Graduate Coordinator, the form is then returned to the Office of Graduate Studies for approval.

MS Degree in Mechanical Engineering

Units required for MS: 30
Minimum required GPA: 3.0

A minimum semester and cumulative grade point average of 3.0 for all graded work is required for master's degree students. Up to six units of grade "C" or better may be credited toward fulfillment of the requirements for the master's degree. All other graded units must be completed with a grade of "B" or better. Grades of "C-", "D", "F", "WU", "I", "W" and "NC" may not be used to fulfill any MS degree requirements.

Required Core Courses (8 Units)		8
ENGR 201	Engineering Analysis I	3
ENGR 202	Engineering Analysis II	3
or ME 206	Stochastic Modeling for Engineers	
ME 209	Research Methodology	2
Additional Requirements for Suggested Specializations (9 Units)		
Select at least three courses with advisor approval to develop a focus area of study		9
Aerospace Systems		
Design and Dynamic Systems		
Manufacturing and Materials Engineering		
Thermal and Fluid Systems		
Electives (7-9 Units)		
Select 7-9 units [1]		7 - 9

Culminating Requirement (4-6 Units)	
Select 4-6 units [2]	4 - 6
Total Units	30-32

[1] Selected in consultation with advisor. May include two undergraduate courses.

[2] Master's Thesis (4-6 units) program consists of the following minimum requirements:
Core courses (8 units)
Specialty Area (9 units)
Electives (7-9 units)
ME 500 (4-6 units)

Thesis Defense/Presentation: The Thesis must be orally presented and defended, approved by the student's Thesis Committee and approved by the ME Graduate Coordinator or the Department Chair prior to submittal of the thesis to the Office of Graduate Studies.

Notes:

- The student cannot register for the culminating experience (ME 500), until he/she has been advanced to candidacy. One full semester prior to registering for (ME 500), the student must submit a proposed topic from to the Department office.
- The Thesis Committee consists of the student's Thesis Advisor, who is the Chairperson of the Thesis Committee, and another faculty member who serves as the second advisor.
- Advising: The Department of Mechanical Engineering has a Graduate Coordinator who is the liaison between each graduate student and the Office of Graduate Studies. After Advancing to Candidacy (see above), the student proceeds with research for the thesis. Guidance of this phase of study is done by a faculty member with expertise in the particular thesis topic.

Additional Requirements for Suggested Specializations

With advisor approval select at least **three** courses to develop a focus area of study.

Specialization - Aerospace Systems

This area focuses on the design of aerospace systems. Classical and computer-aided techniques are studied to provide a strong background in mechanical design theory and practice. Industrial software tools are used to perform finite-element modeling, dynamic system analysis, and optimum design.

ME 274	Introduction to Flight Dynamics	3
ME 275	Analysis of Aircraft Structures	3
ME 278	Space Systems Engineering Management	3

Or other courses selected in consultation with an advisor.

Specialization - Design and Dynamic Systems

This area focuses on the design of products and on the manufacturing systems needed for their production. Classical and computer-aided techniques are studied to provide a strong background in mechanical design theory and practice. Industrial software tools are used to perform finite-element modeling, dynamic system analysis, and optimum design.

ME 241	Optimum Mechanical Design	3
ME 270	Advanced Computer-Aided Design of Dynamic Systems	3
ME 272	Finite Element Modeling in Computer-Aided Design	3
ME 276	Advanced Vibration Theory	3

Or other courses selected in consultation with an advisor.

Specialization - Manufacturing and Materials Engineering

This area includes the use of mathematical methods as well as current computer techniques to solve problems encountered in planning, designing, and/or controlling manufacturing systems. Study of the techniques for product design and Manufacturing, Neural Networks, Artificial Intelligence, and Industrial Management is conducted. This area also focuses on the design of products and on the manufacturing systems needed for their production. Classical and computer-aided techniques are studied to provide a strong background in mechanical design theory and practice. Industrial software tools are used to perform finite-element modeling, dynamic system analysis, and optimum design.

ME 233	Intelligent Product Design and Manufacturing	3
ME 236	Computer Controlled Manufacturing Processes	3
ME 237	Digital Control of Manufacturing Processes	3
ME 238	Automated Inspection	3

Specialization - Thermal and Fluid Systems

This area concentrates on the principles of thermodynamics, heat transfer, and fluid mechanics as applied to such products as heat exchangers, internal combustion engines, gas turbines, and solar energy systems. Courses make use of computational fluid dynamics (CFD) and finite element analysis (FEA) software tools to explore the behavior of a variety of thermal energy conversion systems and components. In this area of interest, innovative system design is becoming more important as progress is made toward increasing the efficiency of thermal systems while reducing the adverse effects on the environment.

ME 253	Advanced Fluid Mechanics	3
ME 256	Mechanics and Thermodynamics of Compressible Flow	3
ME 258	Advanced Thermodynamics	3
ME 259	Introduction to Computational Fluid Dynamics	3
ME 296O	Advanced Heat Transfer	3

Or other courses selected in consultation with an advisor.

ME 37. Manufacturing Processes. 3 Units

Principles of manufacturing processes in the areas of metal removal, forming, joining and casting and fundamentals of numerical control. Study includes applications of equipment, e.g., lathe, milling machine, drill press, saw, grinder, welder, molding equipment and core makers. Emphasis on safety during hands-on operations. Two hours lecture, one three-hour lab.

ME 105. Introduction to Technical Problem Solving. 3 Units
Prerequisite(s): ENGR 17 and ENGR 30.
Introduction to the use of computers for engineering, science and mathematical computations. Introduction to linear algebra and matrix applications. Introduction to concepts of programming and visualization using MATLAB and PBasic. Practical applications involving design using a microcontroller. Applications will be drawn from a variety of science and engineering areas. Lecture two hours, Laboratory three hours.

ME 108. Professional Topics for Mechanical Engineers. 2 Units
Prerequisite(s): MATH 31
Introduction to statistical methods applied to analysis of engineering systems. Topics include data collection, distribution characteristics, probability, uses of regression analysis, and decision-making under uncertainty. Introduction to economic analysis applied to engineering designs. Topics include marginal or incremental economic analysis using multiple standard methods while addressing organizational constraints and market factors. Investigations into the roles engineers play in society in working toward sustainability, and ethical decision making in a technological world.

ME 114. Vibrations. 3 Units
Prerequisite(s): ENGR 110, ME 105.
Generation of equations of motion for single and multiple degree freedom systems. Study of natural frequencies, eigenvectors, free and forced response, modes of vibration and vibration control and isolation. Mechanical and structural vibrations with applications to rotating machinery and vehicles. Fundamentals of acoustics and the engineering of musical instruments.

ME 115. Dynamics of Machinery and Multi-Body Systems. 3 Units
Prerequisite(s): ENGR 110, ME 105.
Kinematic and kinetic analysis of mechanisms. Rigid and flexible multi-body assembly models in two and three dimensions. Use of solid modeling, dynamic analysis and finite element methods. Study of loads on linkages, cams, gears as integral functioning components of machines, ground and space vehicles. Study of forces and moments in machinery under impulsive and impact forces, balancing, and elements of vibration.

ME 116. Machinery Design I. 2 Units
Prerequisite(s): ENGR 6, ENGR 112, and ME 37; ENGR 112 may be taken concurrently.
Introduction to basic design methodology for mechanical systems and devices. Detail design of machine components; application of analytical methods in the design of complex machines. Failure mode analysis, theories of failure, yield, fracture, deflection, and fatigue analysis of machine elements. Design of common machine elements such as bearings and shafts.

ME 117. Machinery Design II. 2 Units
Prerequisite(s): ME 116.
Introduction to design of machine components; application of analytical methods in the design of complex machines. Design of common machine elements such as threaded fasteners, springs, flexible drive components, gears, and friction devices. Introduction to stress and deflection analysis using finite element software.

ME 121. Solar Thermal and Energy Storage Systems. 2 Units
Prerequisite(s): ENGR 124.
Study of solar thermal heat and power and energy storage including the characterization, theory, operation, analysis and modeling of solar thermal and energy storage systems.

ME 122. Geothermal and Bioenergy Systems. 2 Units
Prerequisite(s): ENGR 124
Study of geothermal and bioenergy systems including the characterization, theory, operation, analysis and modeling.

ME 123. Wind, Hydro and Ocean Energy. 3 Units
Prerequisite(s): ENGR 124 and ENGR 132.
Exploring sustainable energy and power generation, through study of wind, hydro and ocean energy systems, including the characterization, theory, operation, analysis, modeling, planning impacts and design process.

ME 126. Heat Transfer. 3 Units
Prerequisite(s): ENGR 124 and ENGR 132.
Basic principles of heat transfer, including processes of conduction, convection, radiation, evaporation and condensation. Lecture three hours.

ME 126W. Heat Transfer Workshop. 1 Unit
Corequisite(s): ME 126.
Problem solving and discussion of heat transfer to enhance students' understanding of subject matter.
Note: May be repeated for credit.

Credit/No Credit

ME 128. Thermal-Fluid Systems. 3 Units
Prerequisite(s): ENGR 124.
Fundamentals of the Otto, Diesel, Brayton and Rankine power cycles, vapor-compression refrigeration, psychrometric processes and chemical reactions. Theory and application of temperature, pressure, flow, and velocity instruments, introduction to experiment design, errors, uncertainty and data acquisition, data analysis and presentation.

ME 136. Numerical Control Programming. 3 Units
Prerequisite(s): ME 37 and ME 105; ME 105 may be taken concurrently.
Computer programming languages for automated manufacturing, including CNC manual programming, cutter compensation, geometric definition of products, cutting tool definition, continuous path part programming, computation, decision, looping, computer graphics programming and intelligent machines.

ME 137. Product Design for Manufacturing and Automation. 3 Units
Prerequisite(s): ME 117.
Various manufacturing and automation aspects of product design, including design for machining, design for automation, applications of CAD/CAM software in product design and automation, and rapid prototyping. Virtual design and manufacturing and agile manufacturing will also be discussed.

ME 138. Concurrent Product and Process Design. 3 Units
Prerequisite(s): ME 37 and ME 116.
Manufacturing considerations in product design including: design for manufacturing (DFM), design for assembly (DF A), design to cost (DTC), design to life cycle cost (DTLCC), design for quality and reliability (DFQR); introduction to concurrent engineering. Two hours lecture, three-hour lab.

ME 140. Introduction to Motors and Actuators. 2 Units
Prerequisite(s): ME 172 or EEE 184.
Power conversion hardware used in electromechanical systems. Operation and sizing of electric motors, both DC and AC systems, motor controllers, and power electronics; sensors; design in fluid power systems, both pneumatic and hydraulic; and power transmission systems such as ball screws and belt drivers.

ME 141. Introduction to Tolerance Analysis. 2 Units
Prerequisite(s): ME 116
Introduction to techniques used in manufacturing tolerance analysis. Assembly tolerance analysis using standard industry practices; application of geometric dimensioning techniques to tolerance analysis; drawing practices for indicating dimensional tolerances; statistical techniques; tolerance allocation. Introduction to computer aided tolerance analysis.

ME 143. Vehicle Dynamics and Design. 3 Units
Prerequisite(s): ENGR 110 and ME 117.
Principles and practice in vehicle dynamics and design using computer aided techniques. Design methods for passenger vehicles, SUVs, trucks, motorcycles and space vehicles. Study of tires, drivetrain and gear boxes in ground vehicles. Kinematics and kinetics of mechanisms in two and three dimensions with applications to suspensions, steering mechanisms. Frame design using finite element analysis, power trains, braking, auxiliary systems. Computer dynamic models for analysis of vehicle stability, collisions rollovers, and failure analysis using state-of-the-art software.

ME 151. Fundamentals of Combustion. 3 Units
Principles of combustion and pyrolysis of gaseous, liquid, and solid materials. Applications of principles, including analysis and design of stationary and mobile powerplants, waste management, and fire safety.

ME 152. Turbomachinery Design. 3 Units
Prerequisite(s): ME 105.
Theoretical analysis of energy transfer between fluid and rotor; principles of axial, mixed, and radial flow compressors and turbines. Applications and computer-aided design of various types of turbomachines.

ME 153. Thermodynamics of Combustion Engines. 3 Units
Prerequisite(s): ENGR 124, ENGR 132, ME 105.
Application of thermodynamic and fluid mechanical analysis to various kinds of engines, including those based on Otto, Diesel, Brayton, Rankine, and Stirling cycles. Development of computer models and comparison of cycles in terms of applications to land, marine, and aerospace propulsion.

ME 154. Alternative Energy Systems. 3 Units
Prerequisite(s): ENGR 124.
Study of alternative energy technologies, such as renewable fuels, wind, solar, oceanic and geothermal power. Concentration on fundamental thermodynamic principles, modern design features and non-technical aspects of each technology.

ME 155. Gas Dynamics. 3 Units
Prerequisite(s): ME 105.
Thermodynamics and mechanics of one-dimensional compressible flow; isentropic flow; normal and oblique shock waves; Prandtl-Meyer flow. Combined effects in one-dimensional compressible flow. Nozzles, diffusers and shock tubes. Computer use in gas dynamics.

ME 156. Heating and Air Conditioning Systems. 3 Units
Prerequisite(s): ENGR 124, ENGR 132.
Theory and design of heating, ventilating and air conditioning for industrial and comfort applications. Topics include refrigeration cycles, heating and cooling load calculations, psychrometrics, solar heating and cooling component, and system design.

ME 157. Solar Energy Engineering. 3 Units
Prerequisite(s): ME 126; may be taken concurrently.
In-depth study of the basics of solar engineering, including the nature and availability of solar radiation; operation, theory and performance of solar collectors; energy storage and model of solar systems.

ME 159. High Efficiency HVAC. 3 Units
Prerequisite(s): ME 156 or instructor permission.
Starts with a review of the theory and design of HVAC systems. Recent improvements and new developments in cooling and heating equipment are studied in detail. Computer models such as the Trane TRACE Program are used to size an HVAC system with an emphasis on high efficiency. Computer based controls and energy management systems are discussed and demonstrated. Field trips to energy efficient installations are included.
Field trip(s) may be required.

ME 164. Introduction to Test Automation. 3 Units
Prerequisite(s): ME 105, ME 117.
Basic concepts to automate testing procedures. Introduction to sensors, signal conditioning, sampling theory, design of experiments, data acquisition software, and data reduction techniques. Hands-on experience with PC based data acquisition software and hardware which will be used to create testing programs. Lecture two hours; laboratory three hours.

ME 165. Introduction To Robotics. 3 Units
Prerequisite(s): ME 105, ME 116
Fundamentals of design and application of industrial robotics. Manipulator kinematics, trajectory planning and controller design, design of end effectors and actuators, sensors, programming languages, and machine vision. Applications in manufacturing, approach to implementing robotics, economic analysis for robotics. Lecture two hours; laboratory three hours.

ME 171. Modeling and Simulation of Mechatronics and Control Systems. 3 Units
Prerequisite(s): ENGR 110, ME 105.
Computer modeling and mathematical representation of mechanical, electrical, hydraulic, thermal, and electronic systems or combinations of these. Development of system design criteria and solutions using computer simulation. Use of state of the art automated modeling and simulation methods to build models of multi-energy mechatronics and control systems. Vibration concepts, applied, natural frequencies, eigenvectors, and solution of differential equations using computer simulation. Introduction to state variable feedback control systems. A design project is required.

ME 172. Control System Design. 3 Units
Prerequisite(s): ME 171.
Use of mathematical models for the generation of equations of motion for mechanical and electrical systems. Evaluation of single and multiple degrees of freedom systems in the time and frequency domain. Topics include feedback control systems, Laplace transform, state space representation, transfer functions, error analysis, stability of control systems and system response. Automatic control system design using root locus and frequency response methods. Design of compensating controls using state of the art software and automation tools. Introduction to digital control.

ME 173. Applications of Finite Element Analysis. 3 Units
Prerequisite(s): ENGR 112, ME 105.
Mathematical fundamentals of Finite Element Modeling (FEA). Engineering analysis and design of structural members, and machinery components using FEA models. Model generation using computer graphics. Computer solutions of static, dynamic, heat transfer, stress analysis, fluid mechanics and structural problems.

ME 176. Product Design CAD. 3 Units

Prerequisite(s): ENGR 6, ME 105 and ME 116.

Digital product development using an integrated CAD system. Philosophy of parametric design. Component and assembly design, basic drawing creation, and simulations. Team product design investigating the effects of variations in geometry, dimensions, and material selection. Lecture two hours; laboratory three hours.

ME 177. Product Design and 3D Parametric Solid Modeling. 3 Units

Prerequisite(s): ENGR 6, ME 105 and ME 116.

Introduction to Solid Modeling and its application to mechanical product design. Digital product development using 3D Parametric Solid Modeling tools. Also covers component and assembly design, basic drawing creation. Reverse design project engineering investigating the effects of variations in geometry, dimensions, and material selection. Lecture two hours; laboratory three hours.

ME 180. Mechanical Properties of Materials. 3 Units

Prerequisite(s): ENGR 112

Principles of mechanical properties of metals, including strength under combined loads, fatigue, and fracture mechanics. Laboratory includes study of strengthening mechanisms, and principles of experimental stress analysis. Lecture two hours; Laboratory three hours.

ME 180W. Mechanical Properties of Materials Workshop. 1 Unit

Corequisite(s): ME 180.

Problem solving and discussion of mechanical properties of materials to enhance students' understanding of subject matter.

Credit/No Credit

ME 182. Introduction to Composite Materials. 3 Units

Prerequisite(s): ME 180.

Properties, mechanics, and applications of anisotropic fiber-reinforced materials with an emphasis on the considerations and methods used in the design of composite structures.

ME 184. Corrosion and Wear. 3 Units

Prerequisite(s): ME 180.

Introduction to the phenomena of corrosion and wear, including the electro-mechanical bases of corrosion, examples of corrosion of iron, steel and stainless steels, and prevention of corrosion. Fundamentals of wear are covered including effects of loads, material properties, and lubrication on wear rates.

ME 186. Fracture Mechanics in Engineering Design. 3 Units

Prerequisite(s): ME 180.

Fracture mechanics approach to mechanical design; role of microstructure in fracture toughness and embrittlement; environmentally-induced cracking under monotonic and fatigue loads; laboratory techniques; service failures in various industries and failure mechanisms.

ME 190. Project Engineering I. 3 Units

Prerequisite(s): ME 117

Beginning of a two semester project; design of a product, device, or apparatus that will be fabricated in ME 191. Students work in small groups, interacting with product users, vendors, technicians, and faculty advisors. Lecture two hours; laboratory three hours.

ME 191. Project Engineering II. 2 Units

Prerequisite(s): ME 190.

Continuation of the project begun in ME 190. Part II consists of fabrication and assembly of equipment, testing and evaluation, and reporting. Seminar one hour; laboratory three hours.

ME 194. Career Development in Mechanical Engineering. 1 Unit

Prerequisite(s): Senior status.

Designed for Mechanical Engineering students making career decisions. Instruction will include effective career planning strategies and techniques including skill assessment, employment search strategy, goal setting, time management, interview techniques and resume writing. Lecture one hour.

Note: Units earned can not be used to satisfy major requirements.

Credit/No Credit

ME 195. Professional Practice. 1 - 6 Units

Prerequisite(s): Instructor permission.

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report.

Credit/No Credit

ME 195A. Professional Practice. 1 - 12 Units

Prerequisite(s): Instructor permission.

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report.

Credit/No Credit

ME 196A. Motion and Dynamic Analysis using Solid Modeling. 3 Units

Prerequisite(s): ENGR 6 and ME 117.

Practical approach to study of motion and dynamic analysis of machine components and assemblies in two or three dimensions. Uses solid modeling software to analyze the forces, moments and dynamic loads for parts and entire assemblies in motion. Topics include stress and strain during motion, kinematics, kinetics, drop tests in two and three dimensions, frequency analysis, buckling, dynamic fatigue and finite element analysis, time history of motion, harmonics, and vibrations.

ME 196B. Engineering Systems Approach to Product Design. 2 Units

Prerequisite(s): ME 116

Study of product design process and formal design methodologies. Various topics in product and system design including creativity, visualizations and communications, human factors, design for X methodology decision science, economics, product design and robust quality design.

ME 196C. Computer Programming for Mechanical Engineering Applications. 2 Units

Prerequisite(s): ME 105

Computer programming languages such as C/C++, Java, Processing, and their applications to engineering problem solving using computer graphics, simulations, and physical prototyping. Programming computer communications with microprocessors for controlling sensors and motors.

ME 196D. Ground Vehicle Aerodynamics. 3 Units

Prerequisite(s): ENGR 132

Fundamental and applied subjects of aerodynamics for ground vehicle design and performance including flow features, aerodynamic forces, drag reduction strategies, and different methodologies for evaluation of aerodynamic forces and vehicle design. Numerical modeling approaches with experience of running a commercial computational fluid dynamics program. Units: 3 Units (2 Unit Lecture and 1 Unit Lab)

ME 196E. Vehicle Safety and Crash Reconstruction. 3 Units
Study of forensic engineering using state of the art technology in vehicles that contribute to passenger safety and stability. Application of principles of dynamics for forensic investigation and reconstruction of vehicle collisions. Study of seat belts, airbags, and electrohydraulic stabilizers. Study of the Event Data Recorders (EDRs), data analysis and verification with real cases using classical reconstruction techniques, and the use of computer simulations in two and three dimensions.

ME 196F. Materials Selection in Engineering Design. 3 Units
Prerequisite(s): ENGR 45 and ME 116. ME 116 may be taken concurrently.
Quantitative treatment of materials selection for engineering applications. Discussion of the relationship between design parameters and materials properties. Emphasis on the influence of processing and fabrication on the properties of metals, ceramics, polymers and composites as related to the overall design process. Sustainability, Eco-Design, and manufacturability considerations.

ME 196G. Power Plant Design. 3 Units
Prerequisite(s): ENGR 124 and ME 128. ME 128 may be taken concurrently.
Study of modern power plants for electric power generation and cogeneration, covering technologies such as nuclear and fossil-fueled steam plants, gas turbine based systems, and emerging technologies. Thermos-economic analysis, parametric design, and environmental impact studies of different plant concepts. Utilization of industry-standard software tools to simulate complex plant configurations.

ME 196H. Air Resources Engineering. 2 Units
Prerequisite(s): ENGR 124 and ENGR 132. ENGR 132 may be taken concurrently.
Air quality standards. Stationary and transportation emission sources. Chemical and physical interactions of air pollutants, including greenhouse gases, with the atmosphere. Introduction to air quality modeling, including atmospheric temperature effects due to longwave thermal radiation. Air Quality measurement. Emission control strategies and design. Air resources economics and policy.

ME 199. Special Problems. 1 - 3 Units
Individual projects or directed reading.
Note: Open only to students who appear competent to carry on individual work. Admission requires approval of an instructor and the student's advisor. May be repeated for credit.

Credit/No Credit

ME 206. Stochastic Modeling for Engineers. 3 Units
Prerequisite(s): MATH 45 or equivalent.
Fundamentals and applications of stochastic processes for engineers, including a review of engineering statistics, autoregression moving average (ARMA) models, characteristics of ARMA models, ARMA modeling and forecasting, and transformation from discrete models to continuous models. Applications of stochastic processes in engineering field, e.g., precision manufacturing, monitoring and diagnosis of machines, tools, and processes, system identification, vibrations, and statistical process control (SPC).

ME 209. Research Methodology. 2 Units
Prerequisite(s): Graduate status in Mechanical Engineering.
Research methodology and engineering approach to problem solving. Includes an orientation to the requirements for Master's thesis in Mechanical Engineering. Students will be exposed to a variety of possible thesis topics. Students will be required to complete an essay concerning aspects of engineering research. The student will be required to prepare a presentation and also review other students work.
Note: Graduate Writing Intensive (GWI) course.

ME 233. Intelligent Product Design and Manufacturing. 3 Units
Prerequisite(s): ME 105, ME 138.
Application of expert systems, fuzzy logic and neural networks in product design and manufacturing. Concurrent product and process design using expert systems and fuzzy logic. Monitoring tool conditions and manufacturing processes using neural networks so as to achieve high quality, high efficiency, and automation.

ME 236. Computer Controlled Manufacturing Processes. 3 Units
Prerequisite(s): ME 105, ME 138.
Applications of logic and motion controls in manufacturing. Computer controlled open and feedback systems. CNC machining processes, CNC programming. Applications of robots in manufacturing, programming for robots. PLC logic controls, sensors and output devices, creating ladder logic diagrams for the PLCs. Design for Manufacturing (DFM) and Design for Assembly (DFA) of modern computer controlled machines.
Note: Lectures as well as some tutorial activities are covered in two 75-minute classes per week.

ME 237. Digital Control of Manufacturing Processes. 3 Units
Prerequisite(s): ME 105, ME 138, MATH 45.
Introduction to both the theory and applications of digital control of manufacturing processes, including the discrete controller for manufacturing, digital controlled systems for manufacturing, sensors of control loop for manufacturing, discrete process models for manufacturing, manufacturing system input and response, and stability analysis of manufacturing systems.

ME 238. Automated Inspection. 3 Units
Prerequisite(s): ME 105, ME 138.
Introduction to measurement for machine accuracy and process quality including the use of coordinate measuring machines; system considerations and sensor technology in automated visual inspection; applications of pattern recognition in automated inspection.

ME 240. Mechanical Design Analysis. 3 Units
Prerequisite(s): ENGR 201; ENGR 201 may be taken concurrently.
Analyzes mechanical designs with respect to strength or deformation criteria. Elastic and inelastic failure criteria, energy methods, effects of temperature, stress concentrations, and fatigue are discussed.

ME 241. Optimum Mechanical Design. 3 Units
Prerequisite(s): ENGR 201; ENGR 201 may be taken concurrently.
Mathematical methods of optimum design using linear and non-linear optimization; constrained and unconstrained optimum design. Optimization of mechanical elements and assemblies to meet design requirements, material characteristics and geometry. Numerical methods and computer usage in optimal design. Application of these principles to realistic design problems.

ME 250. Heat Transfer: Conduction. 3 Units
Prerequisite(s): ME 126, ENGR 202; ENGR 202 may be taken concurrently.
Theory and analytical methods in steady-state and transient heat conduction. Development of the differential equations and initial and boundary conditions. Solutions by separation of variables, transforms, finite differences and integral methods. Heat transfer from extended surfaces.

ME 251. Heat Transfer: Convection. 3 Units
Prerequisite(s): ME 126, ENGR 201; ENGR 201 may be taken concurrently.
Analyzes convective heat and mass transfer. Development of the Navier-Stokes and energy equations for two-dimensional flows. Boundary layer theory and numerical techniques in solving convection problems. Analyzes turbulence, transport by Reynold's stresses and Prandtl's mixing length theory.

ME 252. Heat Transfer: Radiation. 3 Units
Prerequisite(s): ME 126, ENGR 202.
Fundamentals and basic laws of radiative transfer. Properties of surfaces, spectral characteristics and configuration factors. Radiation transfer between surfaces. Absorbing, emitting and scattering media. Combined conduction, convection and radiation. Applications to solar energy systems.

ME 253. Advanced Fluid Mechanics. 3 Units
Prerequisite(s): ENGR 132, graduate status.
Analytical and numerical analysis of Navier-Stokes equations for laminar flow; stability of laminar flow and its transition to turbulence. Analyzes stream functions and the velocity potential, and vorticity dynamics. The mathematical analysis of incompressible turbulent flows; development of Reynolds stress equations, turbulent boundary layer equations, turbulent flow in pipes and channels, and turbulent jets and wakes.

ME 256. Mechanics and Thermodynamics of Compressible Flow. 3 Units
Prerequisite(s): ENGR 201 or ENGR 202; ENGR 201 or ENGR 202 may be taken concurrently.
Application of the laws of fluid mechanics and thermodynamics to problems of compressible flow in two and three dimensions; small perturbation theory, hodograph method and similarity rules for subsonic flow. Method of characteristics, shock wave analysis for steady, unsteady and supersonic, one-dimensional flows.

ME 258. Advanced Thermodynamics. 3 Units
Prerequisite(s): ENGR 202.
Advanced topics in thermodynamics including applications of fundamental postulates to chemical, mechanical, magnetic and electric systems, theory of fluctuations, and irreversible thermodynamics.

ME 259. Introduction to Computational Fluid Dynamics. 3 Units
Prerequisite(s): ENGR 132, ME 105 and ME 126.
Fundamentals of computational fluid dynamics, modeling of physical processes, including the fluid flow, heat and mass transfer, and computer skills. Basic concepts of numerical analysis using computer, including the solutions of ordinary and partial differential equations. Basic hands-on experience on using commercial computational fluid dynamics software packages.

ME 270. Advanced Computer-Aided Design of Dynamic Systems. 3 Units
Prerequisite(s): ME 114 or ME 171.
Computer analysis, synthesis and modeling of physical systems including single and multiple degree of freedom, and linear/nonlinear systems. Use of Computer-Aided Modeling software (CAMP-G) and Advanced Digital Simulation Languages (ADSL). Design and analysis of multi-energy systems using Block Diagrams, Bond Graphs, and state space equation representation. Design of electromagnetic, electro-hydraulic servomechanisms, actuators and driven systems; introduction to multi-variable control of complex systems; stability, controllability, and observability.

ME 272. Finite Element Modeling in Computer-Aided Design. 3 Units
Prerequisite(s): ME 105, ME 173.
Finite-element methods in the analysis and optimal design of machine components, structures, and distributed systems. Generation of FEA models using computers. Theoretical and practical application of a finite element code such as PATRAN to the solution of engineering problems. Topics include static and vibration analysis, stress analysis buckling, normal modes, direct and modal frequency response, transient analysis, and heat transfer.

ME 273. Multibody Dynamics of Rigid and Flexible Systems. 3 Units
Prerequisite(s): Graduate standing.
Analysis and design of rigid and flexible multi-body assemblies in two and three dimensions with applications to mechanisms, machinery, ground and space vehicles. Kinematic and kinetic analysis in two and three dimensions; impulsive and impact forces; modes of vibration. Use of solid modeling, dynamic analysis and finite element analysis methods.

ME 274. Introduction to Flight Dynamics. 3 Units
Prerequisite(s): MATH 45, ENGR 110.
Review of Laplace Transforms, matrix algebra, and aerodynamics. Derivation of aircraft rigid body equations of motion. Linearization of the equation of motion about reference flight (trim) condition, and separation into longitudinal and lateral equations of motion. Determination of aerodynamic stability derivatives and control effectiveness. Trim analysis, static and dynamic stability and control. Aircraft handling qualities and stability augmentation. Simulation of aircraft response to control and atmospheric inputs.

ME 275. Analysis of Aircraft Structures. 3 Units
Prerequisite(s): Graduate standing.
Review of structural analysis: elasticity, virtual work and energy methods, torsion of solid sections, bending of plates, columns. Analysis of aircraft structures: materials, structural components of aircraft, airworthiness, airframe loads, fatigue, structural idealization, fuselages, wings.

ME 276. Advanced Vibration Theory. 3 Units
Prerequisite(s): ME 114, ME 171, or CE 166.
Advanced study of mechanical and structural vibrations. Discrete and distributed parameter systems with linear and nonlinear characteristics. Variational principle, Lagrange's equation and finite element method. Matrix equation and eigenvalue problems. Modal analysis and modal testing. Stability and control. Theory developed through physical problems.

ME 278. Space Systems Engineering Management. 3 Units
Prerequisite(s): ENGR 110.
Systems Engineering approach to plan and direct engineering projects. Emphasizes systems engineering process, requirement design fundamentals, subsystem fundamentals, trade studies, integration, technical reviews, case studies and ethics. Space exploration used as an example; skills applicable to any engineering project. Project-orientated course to plan the design of space and ground vehicles, satellites, airplanes and multidisciplinary subsystems.

ME 280. Advanced Mechanical Properties of Materials. 3 Units
Prerequisite(s): ME 180
Mechanical properties of materials, with special attention to dislocations/defects and deformation and fracture control mechanisms. Mechanical properties of conventional engineering materials as well as advanced materials such as nanostructured materials are considered. Effects of defects on mechanical behavior at ambient and elevated temperature are discussed with attention given to strengthening mechanisms, creep, fatigue and fracture.

ME 295. Fieldwork. 1 - 3 Units
Prerequisite(s): Permission of Graduate Coordinator or Department Chair.
Supervised employment in industry or government that provides practical work experience. Requires satisfactory completion of the work assignment and a written report.
Note: Units may not be applied toward meeting the 30-unit requirement of the degree.

Credit/No Credit

ME 296L. Creative Engineering Design for Quality Products. 3 Units
Prerequisite(s): ME 138 and ME 180.
Introduction to analytical and systematic design methodologies in creative and quality product design. Topics include product design process, creative conceptual design tools such as axiomatic design, theory of inventive problem solving (TRIZ), and engineering decision making. Quality product design including design of experiments, robust design techniques, and design optimization. Assignments include application of these principals to solving open-ended design problems using computing tools. Two hour lecture; Three hour laboratory.

ME 296O. Advanced Heat Transfer. 3 Units
Prerequisite(s): ME 126 and ENGR 202.
Corequisite(s): ENGR 202.
Advanced topics in heat transfer including analytical and numerical solutions to heat conduction equations in both the steady and unsteady state; use of approximate and analytical techniques for the prediction of convective heat transfer in laminar and turbulent flows, heat transfer in high-velocity flows; analysis of the nature of thermal radiation and radiative heat transfer in enclosures.

ME 296P. Advanced Dynamics. 3 Units
Prerequisite(s): Graduate Standing
Newtonian mechanics: Newton's laws, impulse and momentum, work and energy. Analytical mechanics: Degrees of freedom, generalized coordinates, constraints. Lagrange multipliers, principles of virtual work, D'Alembert's principle, Hamilton's principle, Lagrange's equation of motion. Rotating reference frames. Rigid body dynamics: kinematics, linear and angular momentum, and kinetic energy of a rigid body, principle axes, equations of motion. Euler angles. Behavior of dynamic systems: motion about equilibrium points, stability, Lyapunov's direct method. Perturbation techniques: secular terms, Lindstedt's method, Duffing's equation.

ME 296Q. Advanced Solid Modeling. 3 Units
Prerequisite(s): Student must pass ME 116.
Advanced topics in computer-aided design for mechanical product design. Reviews on fundamental part and assembly modeling, and engineering drawings. Advanced modeling topics such as surface modeling, top-down assembly, macros and API programming, manufacturing oriented design such as sheet metal, plastic and mold design.

ME 296S. Advanced CAD for Aerospace Applications. 3 Units
Design of aerospace systems including profile definition, constraints, operations and visualizations, component design, transformation features, and insertions using advanced CAD software such as CATIA. Creation of complete assembly design including creation of product files, identifying, inserting and displacing components, constraining parts, numbering parts and scene creation. Specifics of sheet metal design for aerospace design including creation of flange, cut-out, joggle, holes, stampings and patterns.

ME 296T. Materials for Extreme Environments. 3 Units
Prerequisite(s): ME 180
Material applications in extreme environments with attention to mechanical, thermal and electronic behavior. Advanced, novel materials for use at extreme temperature, pressure, corrosive or toxic environments and high rate deformation. Available and emerging materials explored for specific applications in undersea, outer space, ballistic, nuclear, combustion, and other extreme application arenas.

ME 296U. Advanced Computer-Aided Product Design. 3 Units
Prerequisite(s): ENGR 6 and ME 116, or graduate-level status
Advanced topics in computer-aided design and applications for mechanical product design. Reviews of fundamental parts, assembly modeling, and engineering drawings. Advanced modeling topics such as surface modeling, design for manufacturing, simulation-based design, top-down assembly, macros and API programming.

ME 296V. Advanced Control System Design. 3 Units
Prerequisite(s): ME 172
Design of Multi-Input/Multi-Output controllers using linear quadratic regulator method and advanced controls architectures. Architectures include Proportional, Proportional Integrator and Proportional Integrator Derivative (filter) schemes. The course also includes Digital Control, Optimal Control, Introduction to Guidance, Navigation and Control techniques.

ME 299. Special Problems. 1 - 3 Units
Any properly qualified student who wishes to pursue a problem of his/her own choice may do so if the proposed subject is acceptable to the faculty member with whom he/she works and to his/her advisor.
Credit/No Credit

ME 500. Master's Thesis. 1 - 6 Units
Prerequisite(s): Open to students who have advanced to candidacy and have secured approval of a Thesis proposal form one full semester prior to registration.
Completion of a thesis. Credit given upon successful completion of a Master's Thesis (4 - 6 units; maximum 6 units).
Note: Course may be repeated for no more than 6 units total.