MECHANICAL ENGINEERING (MECH)

MECH 200 - CLASSICAL THERMODYNAMICS
Short Title: CLASSICAL THERMODYNAMICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: Explication of the fundamental laws of classical thermodynamics and deductions from them. Includes applications with particular attention to pure substances. Required for mechanical engineering majors. Department Permission Required. Recommended Prerequisite(s): PHYS 101 and PHYS 102.

MECH 202 - MECHANICS/STATICS
Short Title: MECHANICS/STATICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Prerequisite(s): (MATH 101 or MATH 105 or MATH 102 or MATH 106) and PHYS 101
Description: Mechanics is the branch of the physical sciences that deals with the response of bodies to the action of forces and is based on the implementation of Newton's laws. This class is divided into two sections: study of rigid bodies in equilibrium; and strength of materials. Fundamental concepts such as equilibrium, stress and strain, deformations and displacements, elasticity and inelasticity, strain energy, and load-carrying capacity will be covered.

MECH 203 - MECHANICAL ENGINEERING DESIGN TOOLS
Short Title: MECH ENG DESIGN TOOLS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Prerequisite(s): PHYS 101
Description: Learning the use of computer aided design tools for preparing complex solid parts, assemblies, and their dimensioned drawings. Learn to apply black-box simulation tools for stress analysis, heat transfer, vibration, etc. of complex parts and assemblies.

MECH 210 - INTRODUCTION TO NUMERICAL METHODS
Short Title: INTRO TO NUMERICAL METHODS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Prerequisite(s): PHYS 101 and PHYS 102 and (MATH 101 or MATH 105) and (MATH 102 or MATH 106)
Description: Numerical Methods covers computational methods for generating numerical solutions to mathematical problems, with an emphasis on engineering applications and computer implementation in MATLAB.

MECH 211 - ENGINEERING MECHANICS
Short Title: ENGINEERING MECHANICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Prerequisite(s): (PHYS 101 or PHYS 111 or PHYS 125 or PHYS 141) and (MATH 101 or MATH 105) and (MATH 102 or MATH 106)
Description: The study equilibrium of static systems, the dynamics of a particle and particle systems, and rigid-body dynamics. Required for mechanical engineering and materials science and engineering majors. Cross-list: CEVE 211.

MECH 231 - SOPHOMORE LAB
Short Title: SOPHOMORE LAB
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Laboratory
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: Instruction in application of engineering thermodynamics. Includes uncertainty analysis, measurement of thermodynamic properties, and design of experiments. Required for mechanical engineering majors in B.S. program.

MECH 238 - SPECIAL TOPICS
Short Title: SPECIAL TOPICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Seminar, Lecture, Laboratory, Internship/Practicum
Credit Hours: 1-4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Lower-Level
Description: Topics and credit hours may vary each semester. Contact department for current semester's topic(s). Repeatable for Credit.
MECH 308 - SENIOR DESIGN JUNIOR OBSERVERS
Short Title: SENIOR DESIGN JUNIOR OBSERVERS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Independent Study
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Repeatable for Credit.

MECH 310 - RIGID BODY DYNAMICS
Short Title: RIGID BODY DYNAMICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): PHYS 101 and PHYS 102 and (MATH 101 or MATH 105) and (MATH 102 or MATH 106)
Description: Mechanics is the branch of the physical sciences that deals with the response of bodies to the action of forces and is based on the implementation of Newton's laws. Statics is the study of bodies in equilibrium and is based on Newton's first and third laws, while Dynamics focuses on bodies in motion and is based on Newton's second and third laws. This class focuses on Rigid Body Dynamics.

MECH 311 - MECHANICS OF SOLIDS AND STRUCTURES
Short Title: MECHANICS OF SOLIDS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to students with a major in Bioengineering, Civil & Environmental Engineer or Mechanical Engineering. Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): CEVE 211 or MECH 211
Description: Analysis of stress and the deformation of solids with applications to beams, circular shafts, and columns. Required for following undergraduate majors: civil and environmental and mechanical engineering. Cross-list: CEVE 311.

MECH 315 - STRESS ANALYSIS
Short Title: STRESS ANALYSIS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 202
Description: Stress analysis is integral to much of mechanical engineering, whether in industrial design or academic research. This course is divided into two parts. First, the concepts of stress analysis are introduced for two-dimensional, then three-dimensional bodies. The second part of this course builds upon stress analysis by going into failure – both dynamic and static theories. A series of month long design projects will apply the tools learned in this course to specific engineering problems.

MECH 331 - JUNIOR LABORATORY I
Short Title: JUNIOR LABORATORY I
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Laboratory
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Instruction in static and impact testing of engineering materials. Includes beam deflection and shear center experiments, as well as the application and testing of strain gauges. Required for mechanical engineering majors in B.S. program. See on-line registration for sections.

MECH 332 - JUNIOR LABORATORY II
Short Title: JUNIOR LABORATORY II
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Laboratory
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Corequisite: MECH 371
Description: Instruction in fluid mechanics and thermodynamics. Students work in groups and perform classic experiments in fluid flow. This laboratory course provides experimental support to MECH 371. Required course for mechanical engineering majors in B.S. program. See on-line registration for sections.
MECH 340 - INDUSTRIAL PROCESS LAB
Short Title: INDUSTRIAL PROCESS LAB
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Laboratory
Credit Hour: 1
Restrictions: Enrollment is limited to students with a major in Mechanical Engineering. Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Practical experience in, and observation of, selected industrial processes. Must sign up in department office at the beginning of registration for sections; each section is limited to 8 students. Open only to mechanical engineering majors. Required for mechanical engineering majors in B.S. program. Final registration confirmed after the first week’s organizational meeting. Meeting announcements posted in the MEMS department.

MECH 343 - MODELING OF DYNAMIC SYSTEMS
Short Title: MODELING OF DYNAMIC SYSTEMS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): (MECH 211 or CEVE 211) and MECH 200 and MATH 211
Description: Energy-based modeling of dynamic systems. The focus of the course will be mechanical systems and electrical circuits, but will also involve fluid, thermal and other domains. The course will introduce modeling and simulation of systems via MATLAB, Simulink, and Labview, and an introduction to systems theory. Modeling and simulation of systems via MATLAB, and an introduction to systems theory. Includes laboratory assignments. Required for mechanical engineering majors in B.S. program. Recommended Prerequisite(s): CAAM 335.

MECH 350 - MECHANICAL ELEMENTS
Short Title: MECHANICAL ELEMENTS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 211 and MECH 311 or CEVE 300
Description: The principles of mechanics are applied to the design of machine elements, including load path and stress analysis, selection of mechanical components, and materials selection. A semester design project requires using the analysis tools learned in the course. Required for mechanical engineering majors in B.S. program.

MECH 371 - FLUID MECHANICS I
Short Title: FLUID MECHANICS I
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 200 and MATH 212
Description: Introduction to fluid statics and dynamics. Includes the development of the fundamental equations of fluid mechanics and their application to problems of engineering interest. Required for mechanical engineering majors in B.S. program. Department Permission Required.

MECH 373 - ACOUSTICS
Short Title: ACOUSTICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Basics of technical acoustics, including generation, propagation, reception and reproduction of sound, speech and hearing, musical and architectural acoustics, and noise control. Offered alternate years.

MECH 380 - INTRODUCTION TO MECHANICAL EFFECTS IN TISSUES
Short Title: INTRO TO MECHANICAL EFFECTS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 211 and MECH 311 or CEVE 300
Description: Development of a general background in physiology and in advanced mechanics for applications in medicine. Includes bone mechanics in remodeling, cartilage and ligament mechanics, and muscle mechanics, as well as an on paper design project on a subject selected by students.
MECH 383 - INTRODUCTION TO BIOMEDICAL INSTRUMENTATION AND MEASUREMENT TECHNIQUES
Short Title: BIOMED INSTRUMENTATION
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 211 or CEVE 211 and (MECH 311 or CEVE 311)
Description: This discussion based class will focus on current events and how engineering can be used to directly address them throughout a career. Topics will include energy, environmental, space, and societal (e.g., inequality, social media, etc.) related issues amongst others.

MECH 390 - TOPICAL ISSUES IN ENGINEERING
Short Title: TOPICAL ISSUES IN ENG
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: This discussion based class will focus on current events and how engineering can be used to directly address them throughout a career. Topics will include energy, environmental, space, and societal (e.g., inequality, social media, etc.) related issues amongst others.

MECH 400 - ADVANCED MECHANICS OF MATERIALS
Short Title: ADV MECHANICS OF MATERIALS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): (MECH 211 or CEVE 211) and (MECH 311 or CEVE 311)
Description: Advanced topics in solid mechanics and strength of materials including energy methods, principle of virtual work, conservation laws, constitutive modeling, aspects of elasticity theory, stability and fracture mechanics with application to the analysis and design of reliable structures. Cross-list: CEVE 400. Graduate/Undergraduate Equivalency: MECH 500. Mutually Exclusive: Cannot register for MECH 400 if student has credit for MECH 500.

MECH 401 - MECHANICAL DESIGN APPLICATIONS
Short Title: MECHANICAL DESIGN APPLICATIONS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 311 or CEVE 311
Description: Brief review of solid mechanics with introduction to failure theories and fatigue analysis. The principles of mechanics are applied to the design of machine elements. A semester design project requires using the analysis tools learned in the course. Required for mechanical engineering majors in B.S. program.

MECH 403 - COMPUTER AIDED DESIGN
Short Title: COMPUTER AIDED DESIGN
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Investigation of the integration of the computer into the area of mechanical design. Includes such subjects as optimization, finite element, analysis, and commercial software. Graduate/Undergraduate Equivalency: MECH 503. Mutually Exclusive: Cannot register for MECH 403 if student has credit for MECH 503.

MECH 404 - MECHANICAL DESIGN PROJECT
Short Title: MECHANICAL DESIGN PROJECT
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 1-4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Project based course for group or individual design projects relating to mechanical engineering topics.

MECH 407 - CAPSTONE DESIGN PROJECT I
Short Title: CAPSTONE DESIGN PROJECT I
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: An interdisciplinary capstone design experience in mechanical engineering. This course provides an opportunity for students to apply knowledge and skills acquired in previous courses to the solution of a realistic engineering problem. Teams of students will specify, design, and build a system to meet a prescribed set of requirements. The topics covered in this course will include design methodology, effective teamwork, project management, documentation, and presentation skills. Must complete MECH 408 to receive credit for MECH 407. Required for mechanical engineering majors in B.S. program.
MECH 408 - CAPSTONE DESIGN PROJECT II
Short Title: CAPSTONE DESIGN PROJECT II
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: An interdisciplinary capstone design experience in mechanical engineering. This course provides an opportunity for students to apply knowledge and skills acquired in previous courses to the solution of a realistic engineering problem. Teams of students will specify, design, and build a system to meet a prescribed set of requirements. The topics covered in this course will include design methodology, effective teamwork, project management, documentation, and presentation skills. Must complete MECH 408 to receive credit for MECH 407. Required for mechanical engineering majors in B.S. program. Department Permission Required.

MECH 411 - DYNAMICS AND CONTROL OF MECHANICAL SYSTEMS
Short Title: DYNAMICS & CONTROL OF MECH SYS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 343 and MECH 420
Description: The application of the principles of kinematics, dynamics and systems and control theory to the design and analysis of controlled mechanical systems. Kinematics and Newtonian dynamics of particles and rigid bodies, elements of analytical dynamics, system analysis, stability, and simulation of dynamical behavior, control of mechanical systems. Demonstrations and laboratory examples. Graduate/Undergraduate Equivalency: MECH 501. Mutually Exclusive: Cannot register for MECH 411 if student has credit for MECH 501.

MECH 412 - VIBRATIONS
Short Title: VIBRATIONS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 343
Description: Analysis of discrete and continuous linear vibrating systems, with emphasis on multi-degree-of-freedom systems. Includes approximate methods. Coverage of statistics (e.g. Gaussian and other distributions; and power spectra) as a foundation for random vibrations analysis. Required for mechanical engineering majors in B.S. program. Graduate/Undergraduate Equivalency: MECH 502. Mutually Exclusive: Cannot register for MECH 412 if student has credit for MECH 502.

MECH 417 - FINITE ELEMENT ANALYSIS
Short Title: FINITE ELEMENT ANALYSIS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): (MATH 212 or MATH 222) and (CAAM 210 or CAAM 211)
Description: An introduction to finite element analysis by Galerkin's method and the method of least squares as applied to both ordinary and partial differential equations common in engineering applications. Element interpolations, numerical integration, computational considerations for efficient solution and post-processing methods. Application of the commercial codes to ANSYS and Cosmosworks. Cross-list: CEVE 417. Graduate/Undergraduate Equivalency: MECH 517. Mutually Exclusive: Cannot register for MECH 417 if student has credit for MECH 517.

MECH 420 - FUNDAMENTALS OF CONTROL SYSTEMS
Short Title: FUNDAMENTALS OF CONTROL SYST
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): (CAAM 335 and MECH 343) or (CAAM 335 and ELEC 242 and ELEC 244)
Description: Linear systems and the fundamental principles of classical feedback control, state variable analysis of linear dynamic systems, stability of linear control systems, time-domain analysis and control of linear systems, root-locus analysis and design and pole-zero synthesis, frequency domain techniques for the analysis and design of control systems. Required for mechanical engineering majors in B.S. program. Cross-list: ELEC 436. Graduate/Undergraduate Equivalency: MECH 620. Mutually Exclusive: Cannot register for MECH 420 if student has credit for MECH 620.

MECH 427 - COMPUTATIONAL STRUCTURAL MECHANICS AND FEM
Short Title: COMPUTATIONAL STR MECH & FEM
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): CEVE 311 or MECH 311
Description: Introduction to matrix structural analysis, trusses, beams, frames. Use of computer programs for structural analysis of Civil, Mechanical, and Aerospace Structures. Cross-list: CEVE 427. Mutually Exclusive: Cannot register for MECH 427 if student has credit for MECH 527.
**MECH 435 - INTRODUCTION TO ENERGY-EFFICIENT MECHATRONICS**

**Short Title:** INTRO TO MECHATRONICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture/Laboratory  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Description:** Introduction to electromechanical systems, focusing on motor mechanics, electric drives & electronics, & modern digital control algorithms. Covers basic principles of electromechanical energy conversion & motor control. Students are introduced to energy efficiency considerations of modern electric drives. Includes hands-on laboratory projects involving digital computer control of various motor types. Cross-list: ELEC 435. Graduate/Undergraduate Equivalency: MECH 535. Mutually Exclusive: Cannot register for MECH 435 if student has credit for MECH 535.

**MECH 450 - ALGORITHMIC ROBOTICS**

**Short Title:** ALGORITHMIC ROBOTICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 4  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** (COMP 221 or COMP 321) and COMP 215  
**Description:** Robots have fascinated people for generations. Today, robots are built for applications as diverse as exploring remote planets, de-mining war zones, cleaning toxic waste, assembling cars, inspecting pipes in industrial plants and mowing lawns. Robots are also interacting with humans in a variety of ways: robots are museum guides, robots assist surgeon sin life threatening operations, and robotic cars can drive us around. The field of robotics studies not only the design of new mechanisms but also the development of artificial intelligence frameworks to make these mechanisms useful in the physical world, integrating computer science, engineering, mathematics and more recently biology and sociology, in a unique way. This class will present fundamental algorithmic advances that enable today’s robots to move in real environments and plan their actions. It will also explore fundamentals of the field of Artificial Intelligence through the prism of robotics. The class involves a significant programming project. Cross-list: COMP 450, ELEC 450. Graduate/Undergraduate Equivalency: MECH 550. Mutually Exclusive: Cannot register for MECH 450 if student has credit for MECH 550.

**MECH 454 - COMPUTATIONAL FLUID MECHANICS**

**Short Title:** COMPUTATIONAL FLUID MECHANICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** MECH 371 (may be taken concurrently) or CEVE 363 (may be taken concurrently) or CHBE 401 (may be taken concurrently) or BIOE 420 (may be taken concurrently) or CHBE 420 (may be taken concurrently)  
**Description:** Introduction to fundamental concepts of finite element methods in fluid mechanics, including spatial discretization and numerical integration in multidimensions, time-integration, and solution of nonlinear ordinary differential equation systems. Advanced numerical stabilization techniques designed for fluid mechanics problems. Strategies for solution of complex, real-world problems. Topics in large-scale computing, parallel processing, and visualization. Prerequisites may be taken concurrently. Cross-list: BIOE 454, CEVE 454. Graduate/Undergraduate Equivalency: MECH 554. Mutually Exclusive: Cannot register for MECH 454 if student has credit for MECH 554.

**MECH 456 - LEGAL THEMES IN ENGINEERING AND MANAGING PRACTICES**

**Short Title:** LEGAL THEMES IN ENGI PRACTICES  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Description:** Introduction to fundamental legal concepts of the American legal system for upper level undergraduate students, primarily aimed at what engineers, scientists and other professionals could expect to encounter in their professional careers. The primary focus is to provide students with the basic tools to understand and interact with lawyers. Cross-list: MANA 499. Graduate/Undergraduate Equivalency: MECH 556. Mutually Exclusive: Cannot register for MECH 456 if student has credit for MECH 556.

**MECH 472 - THERMAL SYSTEMS DESIGN**

**Short Title:** THERMAL DESIGN  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** MECH 371 (may be taken concurrently) and MECH 481  
**Description:** Design and synthesis of systems based on applications of thermodynamics, fluid mechanics, heat transfer, economics, and optimization theories. Required for mechanical engineering majors in B.S. program.
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<th>Course Code</th>
<th>Course Title</th>
<th>Short Title</th>
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<td>MECH 473</td>
<td>ADVANCED FLUID MECHANICS I</td>
<td>ADVANCED FLUID MECHANICS I</td>
<td>Mechanical Engineering</td>
<td>Undergraduate Upper-Level</td>
<td>Lecture</td>
<td>3</td>
<td>(MECH 200 and MECH 371)</td>
<td>MECH 488</td>
<td>Rigorous study of the transfer of heat by free and forced convection. Required for mechanical engineering majors in B.S. program.</td>
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<td>MECH 474</td>
<td>ADVANCED COMPUTATIONAL MECHANICS</td>
<td>ADVANCE COMPUTATIONAL MECHANICS</td>
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<td>Lecture</td>
<td>3</td>
<td>-</td>
<td>MECH 482</td>
<td>Study of the general principles of heat transfer by conduction, convection, and radiation. Includes their application to problems of engineering practice. Required for mechanical engineering majors in B.S. program.</td>
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<td>MECH 477</td>
<td>SPECIAL TOPICS</td>
<td>SPECIAL TOPICS</td>
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<td>Internship/Practicum, Laboratory, Lecture, Seminar, Lecture/Laboratory</td>
<td>1-4</td>
<td>-</td>
<td>MECH 484</td>
<td>Graduate/Undergraduate Equivalency: MECH 573. Mutually Exclusive: Cannot register for MECH 473 if student has credit for MECH 573.</td>
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<td>MECH 481</td>
<td>HEAT TRANSFER</td>
<td>HEAT TRANSFER</td>
<td>Mechanical Engineering</td>
<td>Undergraduate Upper-Level</td>
<td>Lecture</td>
<td>3</td>
<td>-</td>
<td>MECH 488</td>
<td>This course introduces concepts in statistical mechanics and non-equilibrium thermodynamics that are used to understand the physical mechanisms of heat transfer, particularly in micro/nanoscale systems. Emphasis is placed on energy storage and thermal transport by electrons, phonons, molecules, and photons. Topics include the kinetic theory of gases, thermodynamic distribution functions, energy carrier dispersion relations, Boltzmann equation modeling of thermal and electrical properties, size effects (classical and quantum-mechanical) on material properties, and thermoelectric energy conversion. Graduate/Undergraduate Equivalency. MECH 584.</td>
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<tr>
<td>MECH 482</td>
<td>CONVECTIVE HEAT TRANSFER</td>
<td>CONVECTIVE HEAT TRANSFER</td>
<td>Mechanical Engineering</td>
<td>Undergraduate Upper-Level</td>
<td>Lecture</td>
<td>3</td>
<td>(MECH 200 and MECH 371)</td>
<td>MECH 484</td>
<td>This course introduces concepts in statistical mechanics and non-equilibrium thermodynamics that are used to understand the physical mechanisms of heat transfer, particularly in micro/nanoscale systems. Emphasis is placed on energy storage and thermal transport by electrons, phonons, molecules, and photons. Topics include the kinetic theory of gases, thermodynamic distribution functions, energy carrier dispersion relations, Boltzmann equation modeling of thermal and electrical properties, size effects (classical and quantum-mechanical) on material properties, and thermoelectric energy conversion. Graduate/Undergraduate Equivalency. MECH 584.</td>
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<td>MECH 484</td>
<td>MICROSCOPIC THERMODYNAMICS AND TRANSPORT</td>
<td>MICRO THERMO &amp; TRANSPORT</td>
<td>Mechanical Engineering</td>
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<td>MECH 488</td>
<td>Graduate/Undergraduate Equivalency: MECH 584. Recommended Prerequisite(s): MECH 211 and ELEC 436 or MECH 420. Mutually Exclusive: Cannot register for MECH 488 if student has credit for MECH 588.</td>
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<td>MECH 488</td>
<td>DESIGN OF MECHATRONIC SYSTEMS</td>
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<td>Lecture</td>
<td>3</td>
<td>-</td>
<td>MECH 484</td>
<td>Graduate/Undergraduate Equivalency: MECH 584. Recommended Prerequisite(s): MECH 211 and ELEC 436 or MECH 420. Mutually Exclusive: Cannot register for MECH 488 if student has credit for MECH 588.</td>
</tr>
</tbody>
</table>

**Course Level:** Undergraduate Upper-Level

**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

**Prerequisite(s):** (MECH 200 and MECH 371)
MECH 490 - MECHANICAL ENGINEERING RESEARCH PROJECTS
Short Title: MECH ENG RESEARCH PROJECTS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Research
Credit Hours: 1-4
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Independent investigation of a specific topic or problem in mechanical engineering. Research under the direction of a selected faculty member. Instructor Permission Required. Repeatable for Credit.

MECH 497 - NEUROMUSCULOSKELETAL MODELING AND SIMULATION
Short Title: NEUROMUSCULOSKELETAL MODELING
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): (MECH 211 or CEVE 211) and CAAM 210
Description: Introduction to computer modeling and simulation of the human neuromusculoskeletal system. Topics include measurement of human movement, 3D kinematic modeling, inverse and forward dynamic simulations, muscle and joint contact force estimation, and neural control modeling. Programming proficiency in Matlab required. Graduate/Undergraduate Equivalency: MECH 597. Mutually Exclusive: Cannot register for MECH 497 if student has credit for MECH 597.

MECH 498 - INTRODUCTION TO ROBOTICS
Short Title: INTRODUCTION TO ROBOTICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Prerequisite(s): (MECH 211 or CEVE 211) and CAAM 210
Description: The course will provide the student with a mathematical introduction to many of the key ideas used in today's intelligent robot systems. The focus of the course is on the design and control of manipulators. The course will also give an overview of common approaches to building intelligent robot systems. Cross-list: COMP 498, ELEC 498. Graduate/Undergraduate Equivalency: MECH 598. Mutually Exclusive: Cannot register for MECH 498 if student has credit for MECH 598.

MECH 499 - CURRENT TOPICS
Short Title: CURRENT TOPICS
Department: Mechanical Engineering
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Undergraduate Upper-Level
Description: Designed for undergraduate mechanical engineering students. Lectures in areas of current interest in mechanical engineering. Topics vary from term to term. Repeatable for Credit.

MECH 500 - ADVANCED MECHANICS OF MATERIALS
Short Title: ADV MECHANICS OF MATERIALS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): (MECH 211 or CEVE 211) and (MECH 311 or CEVE 311)
Description: Advanced topics in solid mechanics and strength of materials including energy methods, principle of virtual work, conservation laws, constitutive modeling, aspects of elasticity theory, stability and fracture mechanics with application to the analysis and design of reliable structures. Cross-list: CEVE 500. Graduate/Undergraduate Equivalency: MECH 400. Mutually Exclusive: Cannot register for MECH 500 if student has credit for MECH 400.

MECH 501 - DYNAMICS AND CONTROL OF MECHANICAL SYSTEMS
Short Title: DYNAMICS & CONTROL OF MECH SYS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): MECH 343 and MECH 420
Description: Graduate version of MECH 411. Offered continually with MECH 411. Graduate/Undergraduate Equivalency: MECH 411. Mutually Exclusive: Cannot register for MECH 501 if student has credit for MECH 411.

MECH 502 - VIBRATIONS
Short Title: VIBRATIONS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): MECH 343
Description: Term project is required. Graduate/Undergraduate Equivalency: MECH 412. Mutually Exclusive: Cannot register for MECH 502 if student has credit for MECH 412.

MECH 503 - COMPUTER AIDED DESIGN
Short Title: COMPUTER AIDED DESIGN
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Investigation of the integration of the computer into the area of design. Includes such subjects as optimization, finite element analysis, and commercial software. Graduate/Undergraduate Equivalency: MECH 403. Mutually Exclusive: Cannot register for MECH 503 if student has credit for MECH 403.
MECH 505 - NUMERICAL METHODS FOR ENGINEERS
Short Title: NUMERICAL METHODS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Description: Numerical methods are the computational solution of mathematical problems. This course focuses on developing a competency in the four basic areas of numerical methods: differentiation, integration, optimization, and continuation. These four categories of methods form a tool set that are used throughout the computational solution of engineering problems.

MECH 508 - NONLINEAR SYSTEMS: ANALYSIS AND CONTROL
Short Title: NONLINEAR SYSTEMS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.

MECH 510 - ELASTO DYNAMICS
Short Title: ELASTO DYNAMICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.

MECH 517 - FINITE ELEMENT ANALYSIS
Short Title: FINITE ELEMENT ANALYSIS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Prerequisite(s): (MATH 212 or MATH 222) and (CAAM 210 or CAAM 211)

MECH 519 - ELASTICITY, PLASTICITY AND DAMAGE MECHANICS
Short Title: ELASTICITY/PLASTICITY/DAMAGE
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Description: An overview of phenomena that determine the response of solids to deformation and loading: elasticity, plasticity, damage mechanics and cracking. Review of continuum mechanics with emphasis on the physical mechanisms of deformation and fracture. Classification of the behavior of solids. Modeling of different types of material behavior. The physics underlying the phenomena and methods for the numerical analysis of the resulting equations are discussed. Cross-list: CEVE 519.

MECH 520 - NONLINEAR FINITE ELEMENT ANALYSIS
Short Title: NONLINEAR FEM
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
MECH 523 - PROBABILISTIC STRUCTURAL DYNAMICS
Short Title: PROB STRUCTURAL DYNAMICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): MECH 412 or CEVE 521
Description: Introduction to probability theory and random processes. Includes the dynamic analysis of linear and nonlinear structural systems subjected to stationary and nonstationary random excitations reliability studies related to first excursion and fatigue failures, and applications to earthquake engineering, offshore engineering, and wind engineering. Recommended prerequisite(s): Basic knowledge of probability theory.

MECH 524 - ENGINEERING MATHEMATICAL AND NUMERICAL METHODS
Short Title: ENGR MATH & NUMERICAL METHODS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Elements of linear algebra, linear operators, systems of linear differential equations for discrete physical systems, calculus of variations, partial differential equations, Green's functions, examples from solid and fluid mechanics, discretization of continuous systems, finite element method.

MECH 527 - COMPUTATIONAL STRUCTURAL MECHANICS AND FEM
Short Title: COMPUTATIONAL STR MECH & FEM
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Introduction to differential and integral formulations, minimum principles, variational principles, weighted residuals, energy principles, and principle of virtual work. Boundary, initial, and eigenvalue problems. Finite element and finite difference methods for structural mechanics. Applications to static and dynamic truss beams and frame problems. MATLAB programming and use of computer software. Cross-list: CEVE 527. Mutually Exclusive: Cannot register for MECH 527 if student has credit for MECH 427.

MECH 535 - INTRODUCTION TO ENERGY-EFFICIENT MECHATRONICS
Short Title: INTRO TO MECHATRONICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Introduction to electromechanical systems, focusing on motor mechanics, electric drives & electronics, & modern digital control algorithms. Covers basic principles of electromechanical energy conversion & motor control. Students are introduced to energy efficiency considerations of modern electric drives. Includes hands-on laboratory projects involving digital computer control of various motor types. Additional coursework required beyond the undergraduate course requirements. Cross-list: ELEC 532. Graduate/Undergraduate Equivalency: MECH 435. Mutually Exclusive: Cannot register for MECH 535 if student has credit for MECH 435.

MECH 537 - DESIGN AND CONTROL OF COMPUTER NETWORKS
Short Title: COMMUNICATION NETWORKS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Graduate-level introduction to design and analysis of communication networks. Topics include wireless networks, medium access, routing, traffic modeling, congestion control, and scheduling. Cross-list: ELEC 537.

MECH 543 - MANUFACTURING PROCESSES AND SYSTEMS
Short Title: MANUFACTURING PROC AND SYS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.
Course Level: Graduate
Prerequisite(s): INDE 501
Description: Fundamentals of manufacturing processes and systems. Topics include machining, casting, 2D printing, material flow, capacities, bottlenecks, and just-in-time systems. Simulation and optimization of various manufacturing systems. Trade-offs among various processes. Instructor Permission Required.
MECH 550 - ALGORITHMIC ROBOTICS

Short Title: ALGORITHMIC ROBOTICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 4
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): (COMP 221 or COMP 321) and COMP 215
Description: Robots have fascinated people for generations. Today, robots are built for applications as diverse as exploring remote planets, de-mining war zones, cleaning toxic waste, assembling cars, inspecting pipes in industrial plants and mowing lawns. Robots are also interacting with humans in a variety of ways: robots are museum guides, robots assist surgeon sin life threatening operations, and robotic cars can drive us around. The field of robotics studies not only the design of new mechanisms but also the development of artificial intelligence frameworks to make these mechanism useful in the physical world, integrating computer science, engineering, mathematics and more recently biology and sociology, in a unique way. This class will present fundamental algorithmic advances that enable today's robots to move in real environments and plan their actions. It will also explore fundamentals of the field of Artificial Intelligence through the prism of robotics. The class involves a significant programming project. Cross-list: COMP 550, ELEC 550. Graduate/Undergraduate Equivalency: MECH 450. Mutually Exclusive: Cannot register for MECH 550 if student has credit for MECH 450.

MECH 554 - COMPUTATIONAL FLUID MECHANICS

Short Title: COMPUTATIONAL FLUID MECHANICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): MECH 371 (may be taken concurrently) or CEVE 363 (may be taken concurrently) or CHBE 401 (may be taken concurrently) or BIOE 420 (may be taken concurrently) or CHBE 420 (may be taken concurrently)
Description: Fundamental concepts of finite element methods in fluid mechanics, including spatial discretization and numerical integration in multidimensions, time-integration, and solution of nonlinear ordinary differential equation systems. Advanced numerical stabilization techniques designed for fluid mechanics problems. Strategies for solution of complex, real-world problems. Topics in large-scale computing, parallel processing, and visualization. Prerequisites may be taken concurrently. Additional work required. Cross-list: BIOE 554, CEVE 554. Graduate/Undergraduate Equivalency: MECH 454. Mutually Exclusive: Cannot register for MECH 554 if student has credit for MECH 454.

MECH 555 - COMPUTATIONAL FLUID-STRUCTURE INTERACTION

Short Title: COMPUTATIONAL FSI
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): (MECH 454 or BIOE 454 or CEVE 454) or (MECH 554 or BIOE 554 or CEVE 554)
Description: Components and challenges of fluid-structure interaction (FSI) computations. Finite element methods for flows with moving interfaces; space-time techniques. Fluid-structure interface projection techniques. Mesh moving and remeshing techniques. FSI coupling techniques for fluid, structure, and mesh equation blocks. FSI computation sequences. FSI contact algorithms, multiscale FSI, cardiovascular FSI, and parachute FSI.

MECH 556 - LEGAL THEMES IN ENGINEERING AND MANAGING PRACTICE

Short Title: LEGAL THEMES IN ENGINEERING AND MANAGING PRACTICE
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Introduction to fundamental legal concepts of the American legal system for upper level undergraduate students, primarily aimed at what engineers, scientists and other professionals could expect to encounter in their professional careers. The primary focus is to provide students with the basic tools to understand and interact with lawyers. Graduate/Undergraduate Equivalency: MECH 456. Mutually Exclusive: Cannot register for MECH 556 if student has credit for MECH 456.

MECH 557 - TRIBOLOGY: THE STUDY OF FRICION, LUBRICATION, AND WEAR

Short Title: TRIBOLOGY
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Tribology is the interdisciplinary study of interacting surfaces from the nanoscale to the macro-scale. These surfaces undergo friction and wear and sometimes, have fluids between them for lubrication. This course will occur mainly in two parts: (i) Contact Mechanics, (ii) Hydrodynamic (fluid) lubrication. Fundamental topics include friction, wear, heat transfer within interfaces, thin-film lubrication and computational Tribology.
MECH 572 - AEROSPACE SYSTEMS ENGINEERING  
Short Title: AEROSPACE SYSTEMS ENGINEERING  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Integration of engineering problem solving methodologies based on systems concepts. Applications to complex, large scale aerospace systems and problems faced by engineering managers. Recommended Prerequisite(s): MECH 472 and MECH 594.

MECH 573 - ADVANCED FLUID MECHANICS I  
Short Title: ADVANCED FLUID MECHANICS I  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Additional work required. Graduate/Undergraduate Equivalency: MECH 473. Mutually Exclusive: Cannot register for MECH 573 if student has credit for MECH 473.

MECH 574 - TURBULENCE  
Short Title: TURBULENCE  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Study of the fundamentals of fluid dynamic turbulence including origins, nature, turbulent transport of momentum and heat, statistical description, spectral dynamics, and numerical modeling.

MECH 575 - INTRODUCTION TO HYDRODYNAMIC STABILITY  
Short Title:INTRO HYDRODYNAMIC STABILITY  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Introduction to linear and nonlinear instabilities that cause transition from laminar to turbulent flows in thermos-fluid systems. The physics of various canonical instability mechanisms and the mathematical and numerical frameworks common in stability analysis are discussed. Examples from industrial, geophysical, environmental, and astrophysical flows are presented. Recommended Prerequisite(s): MECH 371 or CEVE 363 or ESCI 460 or CAAM 436 or CHBE 401. Repeatable for Credit.

MECH 576 - STRUCTURAL DYNAMIC SYSTEMS  
Short Title: STRUCTURAL DYNAMIC SYSTEMS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Seminar  
Credit Hours: 3  
Restrictions: Enrollment limited to students with a class of Graduate. Enrollment is limited to Graduate level students.

MECH 578 - ORBITAL MECHANICS AND MISSION DESIGN  
Short Title: ORBITAL MECHANICS AND MISSION  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Prerequisite(s): MECH 343  
Description: Develop an understanding of orbital mechanics. Obtain a detailed knowledge of the two-body problem and its solutions with applications to geocentric orbits and interplanetary transfers. Understand the concept of impulsive thrusting and its use in orbital transfers including plane changes. Obtain a knowledge of time-of-flight relations on two-body trajectories, using both classical and universal variables.

MECH 579 - LAUNCH VEHICLE AND SPACECRAFT DESIGN  
Short Title: LV AND SPACECRAFT DESIGN  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: This course examines the design of launch vehicles and spacecraft, including the impacts of the atmosphere and the space environment on requirements and configurations. The principles and design aspects of the structure, propulsion, power, thermal, communication, and control subsystems will be examined.
MECH 580 - MECHANICS AND KINEMATICS OF RESPIRATORY MUSCLE IN OBESITY
Short Title: RESPIRATORY MECH IN OBESITY
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: The course is designed to understand unique aspects of human and animal respiratory muscles. Focus will be on remodeling of diaphragm muscle and chest wall as a consequence of obesity. In particular, alteration in the kinematics and mechanics of the diaphragm in obese subjects will be evaluated.

MECH 581 - MICRO AND NANO HEAT TRANSPORT METHODOLOGIES AND DESIGN
Short Title: MICRO & NANO HEAT TRANSPORT
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to students with a major in Mechanical Engineering or Materials Science & NanoEng. Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Prerequisite(s): MECH 481

MECH 582 - CONVECTIVE HEAT TRANSFER
Short Title: CONVECTIVE HEAT TRANSFER
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: Rigorous study of the transfer of heat by free and forced convection. Not offered every year.

MECH 583 - MICROSCOPIC THERMODYNAMICS AND TRANSPORT
Short Title: MICRO THERMO & TRANSPORT
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: This course introduces concepts in statistical mechanics and non-equilibrium thermodynamics that are used to understand the behavior of thermal systems. Focus will be on understanding the physical mechanisms of heat transfer, particularly in micro/nanoscale systems. Emphasis is placed on energy storage and thermal transport by electrons, phonons, molecules, and photons. Topics include the Boltzmann equation modeling of thermal and electrical properties, size effects (classical and quantum-mechanical), carrier dispersion relations, Boltzmann equation modeling of thermal and electrical properties, size effects (classical and quantum-mechanical), and thermoelectric energy conversion. Graduate/Undergraduate Equivalency: MECH 484.

MECH 584 - DESIGN OF MECHATRONIC SYSTEMS
Short Title: DESIGN OF MECHATRONIC SYSTEMS
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: This course introduces concepts in statistical mechanics and non-equilibrium thermodynamics that are used to understand the behavior of thermal systems. Focus will be on understanding the physical mechanisms of heat transfer, particularly in micro/nanoscale systems. Emphasis is placed on energy storage and thermal transport by electrons, phonons, molecules, and photons. Topics include the Boltzmann equation modeling of thermal and electrical properties, size effects (classical and quantum-mechanical), carrier dispersion relations, Boltzmann equation modeling of thermal and electrical properties, size effects (classical and quantum-mechanical), and thermoelectric energy conversion. Graduate/Undergraduate Equivalency: MECH 484.

MECH 585 - AEROSPACE PROPULSION
Short Title: AEROSPACE PROPULSION
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: Additional work required. Graduate/Undergraduate Equivalency: MECH 488. Mutually Exclusive: Cannot register for MECH 588 if student has credit for MECH 488.

MECH 586 - MECHANICS AND KINEMATICS OF RESPIRATORY MUSCLE IN OBESITY
Short Title: RESPIRATORY MECH IN OBESITY
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: The course is designed to understand unique aspects of human and animal respiratory muscles. Focus will be on remodeling of diaphragm muscle and chest wall as a consequence of obesity. In particular, alteration in the kinematics and mechanics of the diaphragm in obese subjects will be evaluated.

MECH 588 - DESIGN OF MECHATRONIC SYSTEMS
Short Title: DESIGN OF MECHATRONIC SYSTEMS
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: Additional work required. Graduate/Undergraduate Equivalency: MECH 488. Mutually Exclusive: Cannot register for MECH 588 if student has credit for MECH 488.

MECH 590 - AEROSPACE PROPULSION
Short Title: AEROSPACE PROPULSION
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: Additional work required. Graduate/Undergraduate Equivalency: MECH 488. Mutually Exclusive: Cannot register for MECH 588 if student has credit for MECH 488.

MECH 591 - RESPIRATORY SYSTEM MECHANICS
Short Title: RESPIRATORY SYSTEM MECHANICS
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: Additional work required. Graduate/Undergraduate Equivalency: MECH 488. Mutually Exclusive: Cannot register for MECH 588 if student has credit for MECH 488.

MECH 592 - MICROSCOPIC THERMODYNAMICS AND TRANSPORT
Short Title: MICRO THERMO & TRANSPORT
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: Additional work required. Graduate/Undergraduate Equivalency: MECH 488. Mutually Exclusive: Cannot register for MECH 588 if student has credit for MECH 488.

MECH 593 - AEROSPACE PROPULSION
Short Title: AEROSPACE PROPULSION
Department: Mechanical Engineering
Course Level: Graduate
Restrictions: Enrollment is limited to Graduate level students.
Course Type: Lecture
Credit Hours: 3
Description: Additional work required. Graduate/Undergraduate Equivalency: MECH 488. Mutually Exclusive: Cannot register for MECH 588 if student has credit for MECH 488.
MECH 591 - GAS DYNAMICS  
Short Title: GAS DYNAMICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Prerequisite(s): MECH 371  
Description: Study of the fundamentals of compressible, one-dimensional gas flows with area change, normal shocks, friction, and heat addition. Includes oblique shocks, Prandtl-Meyer flows expansions, and numerical techniques.

MECH 592 - DESIGN FOR AEROSPACE ENVIRONMENTS  
Short Title: AEROSPACE ENVIRONMENTS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Graduate course on aerospace environments, including theoretical bases. Topics include key mission phases, orbital mechanics, the effects of the sun, plasma, particles and ionizing radiation, neutral atmosphere, contamination, micrometeoroid/orbital debris, thermal and aerothermal environments. Extraterrestrial environments are briefly discussed.

MECH 593 - MECHANICAL ENGINEERING PROBLEMS  
Short Title: MECH ENGINEERING PROBLEMS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Independent Study  
Credit Hours: 3  
Restrictions: Enrollment is limited to students with a major in Mechanical Engineering. Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: An approved investigation or design project under the direction of a member of the staff. Open only to mechanical engineering majors. Repeatable for Credit.

MECH 594 - INTRODUCTION TO AERONAUTICS  
Short Title: INTRODUCTION TO AERONAUTICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Prerequisite(s): MECH 371  
Description: Development of theories for the prediction of aerodynamic forces and moments acting on airfoils, wings, and bodies. Includes their design applications.

MECH 595 - MODELING TISSUE MECHANICS  
Short Title: MODELING TISSUE MECHANICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Independent Study  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Independent study and seminar course which focuses on modeling the mechanical properties of biological tissues. Data from experiments will be used to refine the predictions of nonlinear mathematical computer models. Aimed at juniors, seniors, and graduate students. Laboratory work performed at Baylor College of Medicine, computer work at Rice University. Cross-list: BIOE 595.

MECH 596 - INTRODUCTION TO FLIGHT MECHANICS  
Short Title: INTRO TO FLIGHT MECHANICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Prerequisite(s): MECH 371 or CEVE 371  
Description: This course will examine the basic flight mechanics of aircraft and spacecraft. Simulation exercises will be conducted to illustrate the principles. Recommended Prerequisite(s): MECH 594

MECH 597 - NEUROMUSCULOSKELETAL MODELING AND SIMULATION  
Short Title: NEUROMUSCULOSKELETAL MODELING  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Introduction to computer modeling and simulation of the human neuromusculoskeletal system. Topics include measurement of human movement, 3D kinematic modeling, inverse and forward dynamic simulations, muscle and joint contact force estimation, and neural control modeling. Programming proficiency in Matlab required. Additional work required for Graduate course. Graduate/Undergraduate Equivalency: MECH 497. Mutually Exclusive: Cannot register for MECH 597 if student has credit for MECH 497.

MECH 598 - INTRODUCTION TO ROBOTICS  
Short Title: INTRODUCTION TO ROBOTICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter  
Course Type: Lecture/Laboratory  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
Description: Introduction to the kinematics, dynamics, and control of robot manipulators and to applications of artificial intelligence and computer vision in robotics. Additional work required for Graduate course. Cross-list: COMP 598, ELEC 598. Graduate/Undergraduate Equivalency: MECH 498. Mutually Exclusive: Cannot register for MECH 598 if student has credit for MECH 498.
MECH 599 - CURRENT TOPICS IN MECHANICAL ENGINEERING
Short Title: SPECIAL TOPICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Designed for senior and graduate level students. Lectures in areas of current interest in mechanical engineering. Topics may vary from term to term. Fall 2019, Section 001: This course focuses on numerical techniques for solving partial differential equations (PDEs) including the full incompressible Navier-Stokes equations. Several spatial-temporal discretization methods will be taught, primarily the finite difference method, but also moderate exposure to the finite volume method, and light exposure to the finite element method. Explicit and implicit approaches, in addition to methods to solve linear equations are employed to study fluid flows. A review of various finite difference methods which will be used to analyze elliptic, hyperbolic, and parabolic partial differential equations and the concepts of stability, consistency and convergence are taught to familiarize the students with general numerical PDE methods. Commercial computational fluid dynamics (CFD) software used in the field will be briefly introduced. Repeatable for Credit.

MECH 601 - SPECIAL TOPICS
Short Title: SPECIAL TOPICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 1-9
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Topics may vary. Please consult with the department for additional information. FA 2016, Section 001: Special Topics: Advanced Topics and Tools in Particle Flows & Tribology. Instructor Permission Required.

MECH 602 - SPECIAL TOPICS
Short Title: SPECIAL TOPICS
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 1-9
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Topics may vary. Please consult with the department for additional information.

MECH 606 - GRADUATE SEMINAR
Short Title: GRADUATE SEMINAR
Department: Mechanical Engineering
Grade Mode: Satisfactory/Unsatisfactory
Course Type: Seminar
Credit Hour: 1
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Repeatable for Credit.

MECH 611 - INDEPENDENT STUDY
Short Title: INDEPENDENT STUDY
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Independent Study
Credit Hours: 1-9
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Repeatable for Credit.

MECH 612 - INDEPENDENT STUDY
Short Title: INDEPENDENT STUDY
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Independent Study
Credit Hours: 1-9
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Repeatable for Credit.

MECH 620 - FUNDAMENTALS OF CONTROL SYSTEMS
Short Title: FUNDAMENTALS OF CONTROL SYST
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Linear systems and the fundamental principles of classical feedback control, state variable analysis of linear dynamic systems, stability of linear control systems, time-domain analysis and control of linear systems, root-locus analysis and design and pole-zero synthesis, frequency domain techniques for the analysis and design of control systems. Required for mechanical engineering majors in B.S. program. Additional work required for MECH 620. Cannot be taken if MECH 420 or ELEC 436 was previously taken. Instructor Permission Required. Graduate/Undergraduate Equivalency: MECH 420. Mutually Exclusive: Cannot register for MECH 620 if student has credit for MECH 420.

MECH 621 - M.M.E. RESEARCH PROJECT I
Short Title: M.M.E. RESEARCH PROJECT I
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Research
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This is the first part of the M.M.E. research project course. The faculty advisor, taking into account the background and research interests of the student as well as the research interests of the faculty advisor, will determine the contents. Course requirements will include a final report. Instructor Permission Required.

MECH 622 - M.M.E. RESEARCH PROJECT II
Short Title: M.M.E. RESEARCH PROJECT II
Department: Mechanical Engineering
Grade Mode: Standard Letter
Course Type: Research
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: This is the second part of the M.M.E. research project and continuation of MECH 621. Course requirements will include a final report.
MECH 654 - ADVANCED COMPUTATIONAL MECHANICS  
**Short Title:** ADV COMPUTATIONAL MECHANICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Prerequisite(s):** BIOE 554 or CEVE 554 or MECH 554 or CEVE 454 or MECH 454 or BIOE 454  

MECH 665 - ANALYSIS OF VIBRATIONS IN NONLINEAR SYSTEMS  
**Short Title:** NONLINEAR VIBRATIONS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Prerequisite(s):** MECH 502  
**Description:** Nonlinear vibrations are studied in structural and mechanical systems. Methods for the qualitative and quantitative analysis of these systems are applied. The classification and stability of equilibrium and periodic solutions are discussed for continuous time systems and discrete maps. Floquet theory and Poincare maps are used to study periodic behavior.

MECH 667 - NONLINEAR DYNAMIC BEHAVIOR IN MECHANIC SYSTEMS AND STRUCTURES  
**Short Title:** NONLINEAR DYNAMICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Prerequisite(s):** MECH 502  
**Description:** Various types of nonlinear dynamic behavior are studied in mechanical systems and structures. The course will focus mainly on quasi-periodic and chaotic behavior but will also include periodic behavior. Modeling and analysis methods will be discussed for both discrete and continuous time systems including Lyapunov exponents and pseudo-state space. Recommended Prerequisite(s): MECH 665

MECH 667 - SPECIAL TOPICS  
**Short Title:** SPECIAL TOPICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Internship/Practicum, Lecture, Seminar, Laboratory  
**Credit Hours:** 1-4  
**Restrictions:** Enrollment is limited to Graduate or Visiting Graduate level students.  
**Course Level:** Graduate  
**Description:** Topics and credit hours vary each semester. Contact department for current semester’s topic(s). Repeatable for Credit.

MECH 677 - SPECIAL TOPICS  
**Short Title:** SPECIAL TOPICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** Nonlinear random vibrations, Statistical Linearization, ARMA filters modeling, Monte Carlo Simulation, Wiener-Volterra series, time-variant structural reliability, and Stochastic Finite Elements are presented from a perspective of usefulness to aerospace, civil, marine, and mechanical applications. Cross-list: CEVE 678.

MECH 683 - RADIATIVE HEAT TRANSFER I  
**Short Title:** RADIATION HEAT TRSF I  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** Rigorous study of the transfer of heat by radiant exchange in the absence of absorbing media.

MECH 691 - INTRODUCTION TO HYPERSONIC AERODYNAMICS  
**Short Title:** INTRO TO HYPERSONICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Enrollment is limited to Graduate level students.  
**Course Level:** Graduate  
**Description:** Recommended Prerequisite(s): MECH 591.
MECH 800 - RESEARCH AND THESIS

Short Title: RESEARCH AND THESIS

Department: Mechanical Engineering

Grade Mode: Satisfactory/Unsatisfactory

Course Type: Research

Credit Hours: 1-12

Restrictions: Enrollment is limited to students with a major in Mechanical Engineering. Enrollment is limited to Graduate level students.

Course Level: Graduate

Description: Repeatable for Credit.