Undergraduate studies in mechanical engineering can lead to specialization in one or more of a diverse set of areas, including aerospace engineering, biomedical systems, computational fluid dynamics, computational mechanics, fluids-thermal science, mechanical design, mechanics, robotics, systems dynamics and controls.

The graduate program offers professional degrees in mechanical engineering, which permits specialization in the areas previously mentioned. Graduate students also may pursue research degrees. The graduate program, in its comprehensive educational and research activities, collaborates with other departments at Rice and other institutions in Houston, including those in the Texas Medical Center. Collaborations also are extended to universities in the United States, Europe, Japan, and South America. International collaborations include joint research activities and faculty and student visitor exchanges.

A coordinated MBA/MME degree program is available in conjunction with the Jesse H. Jones Graduate School of Business.

**Bachelor's Programs**

- Bachelor of Arts (BA) Degree with a Major in Mechanical Engineering ([ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-ba](ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-ba))
- Bachelor of Science in Mechanical Engineering (BSME) Degree ([ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-bsme](ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-bsme))

**Master's Programs**

- Master of Mechanical Engineering (MME) Degree ([ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-mme](ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-mme))
- Master of Science (MS) Degree in the field of Mechanical Engineering ([ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-ms](ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-ms))

**Doctoral Program**

- Doctor of Philosophy (PhD) Degree in the field of Mechanical Engineering ([ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-phd](ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/mechanical-engineering-phd))

**Coordinated Program**

- Master of Business Administration (MBA) Degree / Master of Mechanical Engineering (MME) Degree ([ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/business-administration- MBA-mechanical-engineering-mme](ga.rice.edu/programs-study/departments-programs/engineering/mechanical-engineering/business-administration-MBA-mechanical-engineering-MME))

**Chair**

Laura Schaefer

**Professors**

John E. Akin  
Yildiz Bayazitoglu  
B.J. Fregly  
Fathi Ghorbel  
C. Fred Higgs, III  
Andrew J. Meade  
Marcia K. O’Malley  
Pol D. Spanos  
Tayfun E. Tezduyar

**Assistant Professors**

Matthew Brake  
Pedram Hassanzadeh

**Professor Emeritus**

Chao-Cheng Wang

**Lecturers**

Leroy Chiao  
Matthew Elliott  
Eleazar Marquez

**Professors, Joint Appointments**

Lydia Kavraki  
Satish Nagarajaiah

**Associate Professors, Joint Appointments**

Ilincia Stanciulescu

**Adjunct Professors**

Sarmad Adnan  
Aladin Boriek  
James Dabney  
Thomas J. R. Hughes

**Adjunct Associate Professors**

Kenji Takizawa  
David Woffinden

For Rice University degree-granting programs:
To view the list of official course offerings, please see Rice’s Course Catalog ([https://courses.rice.edu/admweb/!SWKSCAT.cat?p_action=cata](https://courses.rice.edu/admweb/!SWKSCAT.cat?p_action=cata))
To view the most recent semester’s course schedule, please see Rice’s Course Schedule ([https://courses.rice.edu/admweb/!SWKSCAT.cat](https://courses.rice.edu/admweb/!SWKSCAT.cat))
### Mechanical Engineering (MECH)

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<tr>
<th>Course Code</th>
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<th>Short Title</th>
<th>Department</th>
<th>Grade Mode</th>
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<th>Course Level</th>
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<tr>
<td>MECH 200</td>
<td>CLASSICAL THERMODYNAMICS</td>
<td>CLASSICAL THERMODYNAMICS</td>
<td>Mechanical Engineering</td>
<td>Standard Letter, Audit, Pass/Fail, Satisfactory/ Unsatisfactory</td>
<td>Lecture</td>
<td>3</td>
<td>Graduate level students may not enroll.</td>
<td>Undergraduate Lower-Level</td>
<td>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.</td>
</tr>
<tr>
<td>MECH 211</td>
<td>ENGINEERING MECHANICS</td>
<td>ENGINEERING MECHANICS</td>
<td>Mechanical Engineering</td>
<td>Standard Letter, Audit, Pass/Fail, Satisfactory/ Unsatisfactory</td>
<td>Lecture</td>
<td>3</td>
<td>Graduate level students may not enroll.</td>
<td>Undergraduate Lower-Level</td>
<td>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.</td>
</tr>
<tr>
<td>MECH 308</td>
<td>SENIOR DESIGN JUNIOR OBSERVERS</td>
<td>SENIOR DESIGN JUNIOR OBSERVERS</td>
<td>Mechanical Engineering</td>
<td>Standard Letter, Audit, Pass/Fail, Satisfactory/ Unsatisfactory</td>
<td>Independent Study</td>
<td>1</td>
<td>Graduate level students may not enroll.</td>
<td>Undergraduate Upper-Level</td>
<td>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.</td>
</tr>
<tr>
<td>MECH 311</td>
<td>MECHANICS OF SOLIDS AND STRUCTURES</td>
<td>MECHANICS OF SOLIDS</td>
<td>Mechanical Engineering</td>
<td>Standard Letter, Audit, Pass/Fail, Satisfactory/ Unsatisfactory</td>
<td>Lecture</td>
<td>3</td>
<td>Graduate level students may not enroll.</td>
<td>Undergraduate Upper-Level</td>
<td>Analysis of stress and the deformation of solids with applications to beams, circular shafts, and columns. Open only to mechanical engineering and civil engineering majors. Required for mechanical engineering majors. Cross-list: CEVE 311.</td>
</tr>
</tbody>
</table>

### MECH 331 - JUNIOR LABORATORY I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Short Title</th>
<th>Department</th>
<th>Grade Mode</th>
<th>Course Type</th>
<th>Credit Hour</th>
<th>Restrictions</th>
<th>Course Level</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>MECH 332</td>
<td>JUNIOR LABORATORY II</td>
<td>JUNIOR LABORATORY II</td>
<td>Mechanical Engineering</td>
<td>Standard Letter, Audit, Pass/Fail, Satisfactory/ Unsatisfactory</td>
<td>Laboratory</td>
<td>1</td>
<td>Graduate level students may not enroll.</td>
<td>Undergraduate Upper-Level</td>
<td>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.</td>
</tr>
<tr>
<td>MECH 340</td>
<td>INDUSTRIAL PROCESS LAB</td>
<td>INDUSTRIAL PROCESS LAB</td>
<td>Mechanical Engineering</td>
<td>Standard Letter, Audit, Pass/Fail, Satisfactory/ Unsatisfactory</td>
<td>Laboratory</td>
<td>1</td>
<td>Enrollment is limited to students with a major in Mechanical Engineering. Graduate level students may not enroll.</td>
<td>Undergraduate Upper-Level</td>
<td>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.</td>
</tr>
</tbody>
</table>
MECH 343 - MODELING OF DYNAMIC SYSTEMS
Short Title: MODELING OF DYNAMIC SYSTEMS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 4
Restrictions: Graduate level students may not enroll.
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 371 - FLUID MECHANICS I
Short Title: FLUID MECHANICS I
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 200 and (MECH 211 or CEVE 211) 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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 211 or CEVE 211) and (MECH 311 or CEVE 311)
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, Audit, Pass/Fail, Transfer Courses, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
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 INSTRUMENT&MESURE TECHN
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
Course Level: Undergraduate Upper-Level
Prerequisite(s): ELEC 381
Description: Review of basic sensors, measurement principles and analog electronics using operational amplifiers. Includes design problems using operational amplifier circuits (e.g. instrumentation and isolation amplifiers, comparators, timer circuits). Introduction to development of virtual instruments (VIs) using LabView. Discussion of micro and macro-biopotential electrodes, cell cytometry, the measurement of blood pressure, blood flow, and heart sounds, temperature, and the principles of electrical safety (e.g. micro and macro-shock hazards in the clinical environment). Includes discussion of pulmonary instrumentation and medical applications of ultrasound. Two lab exercises and a term project required.

MECH 400 - ADVANCED MECHANICS OF MATERIALS
Short Title: ADV MECHANICS OF MATERIALS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
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: Credit cannot be earned for MECH 400 and MECH 500.

MECH 401 - MECHANICAL DESIGN APPLICATIONS
Short Title: MECHANICAL DESIGN APPLICATIONS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
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: Credit cannot be earned for MECH 403 and MECH 503.

MECH 404 - MECHANICAL DESIGN PROJECT
Short Title: MECHANICAL DESIGN PROJECT
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 1-4
Restrictions: Graduate level students may not enroll.
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture/Laboratory
Credit Hours: 4
Restrictions: Graduate level students may not enroll.
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 408 - CAPSTONE DESIGN PROJECT II
Short Title: CAPSTONE DESIGN PROJECT II
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
Course Level: Undergraduate Upper-Level

MECH 411 - DYNAMICS AND CONTROL OF MECHANICAL SYSTEMS
Short Title: DYNAMICS & CONTROL OF MECH SYS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
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: Credit cannot be earned for MECH 411 and MECH 501.

MECH 412 - VIBRATIONS
Short Title: VIBRATIONS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
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: Credit cannot be earned for MECH 412 and MECH 502.
MECH 417 - FINITE ELEMENT ANALYSIS  
**Short Title:** FINITE ELEMENT ANALYSIS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Graduate level students may not enroll.  
**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: Credit cannot be earned for MECH 417 and MECH 517.  

MECH 420 - FUNDAMENTALS OF CONTROL SYSTEMS  
**Short Title:** FUNDAMENTALS OF CONTROL SYST  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Graduate level students may not enroll.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** MECH 343 or (ELEC 242 and ELEC 244) or (CAAM 335 or MATH 355)  
**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: Credit cannot be earned for MECH 420 and MECH 620.  

MECH 427 - COMPUTATIONAL STRUCTURAL MECHANICS AND FEM  
**Short Title:** COMPUTATIONAL STR MECH & FEM  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**Course Type:** Lecture  
**Credit Hours:** 3  
**Restrictions:** Graduate level students may not enroll.  
**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.  

MECH 431 - SENIOR LABORATORY I  
**Short Title:** SENIOR LABORATORY I  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**Course Type:** Laboratory  
**Credit Hour:** 1  
**Restrictions:** Graduate level students may not enroll.  
**Course Level:** Undergraduate Upper-Level  
**Description:** Laboratory instruction in heat transfer and thermodynamics. Students work in groups doing experiments with emphasis on applied thermodynamics. Required for mechanical engineering majors in B.S. program. See online registration for sections. Department Permission Required.  

MECH 435 - INTRODUCTION TO ENERGY-EFFICIENT MECHATRONICS  
**Short Title:** INTRO TO MECHATRONICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**Course Type:** Lecture/Laboratory  
**Credit Hours:** 3  
**Restrictions:** Graduate level students may not enroll.  
**Course Level:** Undergraduate Upper-Level  
**Prerequisite(s):** ELEC 242 or ELEC 243  
**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: Credit cannot be earned for MECH 435 and MECH 535.  

MECH 450 - ALGORITHMIC ROBOTICS  
**Short Title:** ALGORITHMIC ROBOTICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**Course Type:** Lecture  
**Credit Hours:** 4  
**Restrictions:** Graduate level students may not enroll.  
**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 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 450, ELEC 450. Graduate/Undergraduate Equivalency: MECH 550. Mutually Exclusive: Credit cannot be earned for MECH 450 and MECH 550.
MECH 454 - COMPUTATIONAL FLUID MECHANICS  
Short Title: COMPUTATIONAL FLUID MECHANICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Graduate level students may not enroll.  
Course Level: Undergraduate Upper-Level  
Prerequisite(s): MECH 371 (may be taken concurrently) or CHBE 401 (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. Cross-list: BIOE 454, CEVE 454. Graduate/Undergraduate Equivalency: MECH 554. Mutually Exclusive: Credit cannot be earned for MECH 454 and 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, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Graduate level students may not enroll.  
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: Credit cannot be earned for MECH 456 and MECH 556.

MECH 472 - THERMAL SYSTEMS DESIGN  
Short Title: THERMAL DESIGN  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Graduate level students may not enroll.  
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.

MECH 473 - ADVANCED FLUID MECHANICS I  
Short Title: ADVANCED FLUID MECHANICS I  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Graduate level students may not enroll.  
Course Level: Undergraduate Upper-Level  
Description: Governing equations for inviscid and viscous flows. Constitutive laws, simple non-Newtonian flows, and surface tension. Derivation and applications of the equations representing the conservation of mass and momentum. Various forms of the Bernoulli equation. Introductory concepts of computational fluid mechanics. Graduate/Undergraduate Equivalency: MECH 573. Mutually Exclusive: Credit cannot be earned for MECH 473 and MECH 573.

MECH 474 - ADVANCED COMPUTATIONAL MECHANICS  
Short Title: ADV COMPUTATIONAL MECHANICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Graduate level students may not enroll.  
Course Level: Undergraduate Upper-Level  
Prerequisite(s): BIOE 454 or CEVE 454 or MECH 454 or BIOE 554 or CEVE 554 or MECH 554  
Description: Undergraduate version of MECH 654. The required semester-end report and presentation will be on the introductory topics of the course. Graduate/Undergraduate Equivalency: MECH 654. Mutually Exclusive: Credit cannot be earned for MECH 474 and MECH 654.

MECH 481 - HEAT TRANSFER  
Short Title: HEAT TRANSFER  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Graduate level students may not enroll.  
Course Level: Undergraduate Upper-Level  
Prerequisite(s): (MECH 200 and MECH 371)  
Description: 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.
MECH 488 - DESIGN OF MECHATRONIC SYSTEMS
Short Title: DESIGN OF MECHATRONIC SYSTEMS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MECH 343 or ELEC 241 or ELEC 243
Description: Analog electronic design for purposes of controlling electromechanical systems, including electromechanical sensors and actuators, analog electronic design of filters, state space and classical controllers, and transistor-based servo amplifiers and high voltage amplifiers. Implementation of digital controllers. Significant laboratory component with design and fabrication of circuits to control electromechanical systems. Graduate/Undergraduate Equivalency: MECH 588. Recommended Prerequisite(s): MECH 211 and ELEC 436 or MECH 420. Mutually Exclusive: Credit cannot be earned for MECH 488 and MECH 588.

MECH 490 - MECHANICAL ENGINEERING RESEARCH PROJECTS
Short Title: MECH ENG RESEARCH PROJECTS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Research
Credit Hours: 1-4
Restrictions: Graduate level students may not enroll.
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 498 - INTRODUCTION TO ROBOTICS
Short Title: INTRODUCTION TO ROBOTICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
Course Level: Undergraduate Upper-Level
Prerequisite(s): MATH 354 or MATH 355 or CAAM 335
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 analysis 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: Credit cannot be earned for MECH 498 and MECH 598.

MECH 499 - CURRENT TOPICS
Short Title: CURRENT TOPICS
Department: Mechanical Engineering
Grade Mode: Satisfactory/Unsatisfactory, Audit, Pass/Fail, Standard Letter
Course Type: Lecture
Credit Hours: 3
Restrictions: Graduate level students may not enroll.
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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: Credit cannot be earned for MECH 500 and MECH 400.

MECH 501 - DYNAMICS AND CONTROL OF MECHANICAL SYSTEMS
Short Title: DYNAMICS & CONTROL OF MECH SYS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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: Credit cannot be earned for MECH 501 and MECH 411.

MECH 502 - VIBRATIONS
Short Title: VIBRATIONS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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: Credit cannot be earned for MECH 502 and MECH 412.
MECH 503 - COMPUTER AIDED DESIGN  
Short Title: COMPUTER AIDED DESIGN  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
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: Credit cannot be earned for MECH 503 and MECH 403.

MECH 505 - NUMERICAL METHODS FOR ENGINEERS  
Short Title: NUMERICAL METHODS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  

MECH 510 - ELASTO DYNAMICS  
Short Title: ELASTO DYNAMICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  

MECH 517 - FINITE ELEMENT ANALYSIS  
Short Title: FINITE ELEMENT ANALYSIS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
Course Type: Lecture/Laboratory  
Credit Hours: 3  
Restrictions: Enrollment is limited to Graduate level students.  
Course Level: Graduate  
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 result equations are discussed. Cross-list: CEVE 519.
MECH 520 - NONLINEAR FINITE ELEMENT ANALYSIS
Short Title: NONLINEAR FEM
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate

MECH 523 - PROBABILISTIC STRUCTURAL DYNAMICS
Short Title: PROB STRUCTURAL DYNAMICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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.

MECH 535 - INTRODUCTION TO ENERGY-EFFICIENT MECHATRONICS
Short Title: INTRO TO MECHATRONICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture/Laboratory
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): MECH 412
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: Credit cannot be earned for MECH 535 and MECH 435.

MECH 537 - DESIGN AND CONTROL OF COMPUTER NETWORKS
Short Title: COMMUNICATION NETWORKS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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 550 - ALGORITHMIC ROBOTICS  
Short Title: ALGORITHMIC ROBOTICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
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: Credit cannot be earned for MECH 550 and MECH 450.  

MECH 554 - COMPUTATIONAL FLUID MECHANICS  
Short Title: COMPUTATIONAL FLUID MECHANICS  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
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)  
Description: Additional work required. Cross-list: BIOE 554, CEVE 554. Graduate/Undergraduate Equivalency: MECH 454. Mutually Exclusive: Credit cannot be earned for MECH 554 and MECH 454.  

MECH 555 - COMPUTATIONAL FLUID-STRUCTURE INTERACTION  
Short Title: COMPUTATIONAL FSI  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
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 ENGI PRACTICES  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
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: Credit cannot be earned for MECH 556 and MECH 456.  

MECH 572 - AEROSPACE SYSTEMS ENGINEERING  
Short Title: AEROSPACE SYSTEMS ENGINEERING  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
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: Credit cannot be earned for MECH 573 and MECH 473.  

MECH 575 - INTRODUCTION TO HYDRODYNAMIC STABILITY  
Short Title: INTRO HYDRODYNAMIC STABILITY  
Department: Mechanical Engineering  
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment limited to Graduate level students.
Course Level: Graduate
Description: Introduction to structural dynamic systems. Linear SDOF and MDOF discrete systems, undamped and damped systems, free and forced vibration, dynamic response to periodic and arbitrary excitations, numerical evaluation of dynamic response, response spectrum and modal analysis. Additional topics for graduate version 576: Linear systems theory, transform methods, state space methods, feedback control, observers and identification. Applications using MATLAB. Demonstrations and laboratory examples. Students will be required to do more advanced assignments and a project. Cross-list: MECH 546.

Restrictions: (CEVE 521 or CIVI 521 or MECH 522) and (CEVE 527 or CIVI 527).

MECH 580 - MECHANICS AND KINEMATICS OF RESPIRATORY MUSCLE IN OBESITY
Short Title: RESPIRATORY MECH IN OBESITY
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment limited to Graduate level students.
Course Level: Graduate
Description: The course is designed to understand unique aspects of remodeling the respiratory system mechanics in obesity. 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 TRANSFER METHODOLOGIES AND DESIGN
Short Title: MICRO & NANO HEAT TRANSFER
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment limited to students with a class of Graduate or Senior. Enrollment is limited to students with a major in Mechanical Engineering or Materials Science & NanoEng. Enrollment is limited to Graduate level students.
Course Level: Graduate
Prerequisite(s): MECH 481

MECH 582 - CONVECTIVE HEAT TRANSFER
Short Title: CONVECTIVE HEAT TRANSFER
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment limited to Graduate level students.
Course Level: Graduate
Description: Rigorous study of the transfer of heat by free and forced convection. Not offered every year.

MECH 586 - RESPIRATORY SYSTEM MECHANICS
Short Title: RESPIRATORY SYSTEM MECHANICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment limited to Graduate level students.
Course Level: Graduate
Description: Mechanics of ventilation, respiratory muscle mechanics, rib cage mechanics, mechanical coupling between the respiratory muscles and the rib cage, and inferences on mechanics from respiratory muscle anatomy. The class will meet in the Pulmonary Division at Baylor College of Medicine in the Texas Medical Center. Cross-list: BIOE 586.

MECH 588 - DESIGN OF MECHATRONIC SYSTEMS
Short Title: DESIGN OF MECHATRONIC SYSTEMS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment limited to Graduate level students.
Course Level: Graduate
Description: Additional work required. Graduate/Undergraduate Equivalency: MECH 488. Mutually Exclusive: Credit cannot be earned for MECH 588 and MECH 488.

MECH 591 - GAS DYNAMICS
Short Title: GAS DYNAMICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment 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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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 599 - CURRENT TOPICS IN MECHANICAL ENGINEERING
Short Title: SPECIAL TOPICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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. Spring 2018: Section 001- "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". Section 002- This course will cover recent topics in neuroengineering, with a focus on human-machine interface systems for individuals with neurological impairment, bioinspired and wearable sensing and robotic systems for diagnostic, assistive, and therapeutic applications, and neurorehabilitation. Intended for graduate students with a background and interest in neuroengineering, robotics, control systems, signal processing, and biomechanics. This course will include a significant technical communications component (oral and written) covering the research pipeline process, and will require experimental work via project. Repeatable for Credit.

MECH 690 - DESIGN FOR AEROSPACE ENVIRONMENTS
Short Title: AEROSPACE ENVIRONMENTS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Independent Study
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 693 - MECHANICAL ENGINEERING PROBLEMS
Short Title: MECH ENGINEERING PROBLEMS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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 694 - INTRODUCTION TO AERONAUTICS
Short Title: INTRODUCTION TO AERONAUTICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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 695 - MODELING TISSUE MECHANICS
Short Title: MODELING TISSUE MECHANICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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 696 - INTRODUCTION TO FLIGHT MECHANICS
Short Title: INTRO TO FLIGHT MECHANICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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 699 - CURRENT TOPICS IN MECHANICAL ENGINEERING
Short Title: SPECIAL TOPICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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. Spring 2018: Section 001- "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". Section 002- This course will cover recent topics in neuroengineering, with a focus on human-machine interface systems for individuals with neurological impairment, bioinspired and wearable sensing and robotic systems for diagnostic, assistive, and therapeutic applications, and neurorehabilitation. Intended for graduate students with a background and interest in neuroengineering, robotics, control systems, signal processing, and biomechanics. This course will include a significant technical communications component (oral and written) covering the research pipeline process, and will require experimental work via project. Repeatable for Credit.
MECH 601 - SPECIAL TOPICS  
**Short Title:** SPECIAL TOPICS  
**Department:** Mechanical Engineering  
**Grade Mode:** Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**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, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**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, Audit, Pass/Fail, Standard Letter  
**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, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**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, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**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, Audit, Pass/Fail, Satisfactory/Unsatisfactory  
**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: Credit cannot be earned for MECH 620 and 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, Audit, Pass/Fail, Transfer Courses, Satisfactory/Unsatisfactory  
**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, Audit, Pass/Fail, Transfer Courses, Satisfactory/Unsatisfactory  
**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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
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 678 - ADVANCED STOCHASTIC MECHANICS
Short Title: ADV STOCHASTIC MECHANICS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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 679 - APPLIED MONTE CARLO ANALYSIS
Short Title: APPLIED MONTE CARLO ANALYSIS
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
Course Type: Lecture
Credit Hours: 3
Restrictions: Enrollment is limited to Graduate level students.
Course Level: Graduate
Description: Probability density and power spectrum based simulation concepts and procedures are discussed. Scalar and vectorial simulation are addressed. Spectral decomposition and digital filter algorithms are presented. Applications from aerospace, earthquake, marine, and wind engineering, and from other applied science disciplines are included. Cross-list: CEVE 679.

MECH 683 - RADIATIVE HEAT TRANSFER I
Short Title: RADIATION HEAT TRSF I
Department: Mechanical Engineering
Grade Mode: Standard Letter, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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, Audit, Pass/Fail, Satisfactory/Unsatisfactory
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, Audit, Pass/Fail, Standard Letter
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.

Description and Code Legend
Note: Internally, the university uses the following descriptions, codes, and abbreviations for this academic program. The following is a quick reference:

Course Catalog/Schedule
• Course offerings/subject code: MECH

Department Description and Code
• Mechanical Engineering: MECH

Undergraduate Degree Descriptions and Codes
• Bachelor of Arts degree: BA
• Bachelor of Science degree: BSME

Undergraduate Major Description and Code
• Major in Mechanical Engineering (attached to both the BA and BSME Degrees): MECH

Graduate Degree Descriptions and Codes
• Master of Mechanical Engineering degree: MME
• Master of Science degree: MS
• Doctor of Philosophy degree: PhD

Graduate Degree Program Description and Code
• Degree Program in Mechanical Engineering: MECH