MECHANICAL ENGINEERING

Description
Mechanical engineering is a broad field of study that significantly impacts many technologies, including those that expand our energy resources and improve medical care. Mechanical engineers are concerned with all forms of energy conversion and transmission; the flow of fluids and heat; the development, design, manufacturing, and operation of machinery and equipment; material structure and properties; solid and applied mechanics; and transportation processes. The course of study is designed to give the student fundamental preparation to enter the fields of research, design, operation, production, sales, or management.

The mechanical engineering curriculum is structured so that students are well prepared in the fundamental areas of solid mechanics, thermal-fluid sciences, systems and design engineering, and materials engineering. Students can develop an emphasis area of study by concentrating elective courses in specific interdisciplinary areas such as aerospace engineering, automotive engineering, robotics, biomedical engineering, computational methods, manufacturing, nanotechnology and others, depending upon the technical courses available and the interest of the student. Additionally, broader general education requirements are covered through the Achievement-Centered Education (ACE) program (ace.unl.edu); the mechanical engineering curriculum requirements cover ACE areas [1-4,8,10], and students may work with their academic advisor to select courses covering areas [5-7,9].

Mission and Objectives
Mission Statement
The mission of the Department of Mechanical and Materials Engineering at the University of Nebraska is to impact society locally and globally through our educational programs, research, and service, developing knowledge and sharing our expertise in the best traditions of land-grant universities. We strive for excellence in teaching and learning at both the undergraduate and graduate levels; seek to develop novel educational opportunities; grow our public and private support for research and education; and expand our scholarship, outreach, and service.

Program Educational Objectives
Within a few years of graduation, our mechanical engineering graduates are expected to:

1. Have started successful careers based on their education or have completed a professional degree or a graduate degree in engineering or related field.
2. Have begun life-long learning and development in order to remain current in their knowledge and skills and to advance in their careers.
3. Have established a record of professionalism, leadership, respect, and integrity in working to serve humanity and use resources responsibly.

Admission
Admittance to Degree Program
Students are expected to meet minimum college entrance requirements. After being admitted to the college as pre-mechanical engineering students, students wishing to pursue a degree in mechanical engineering must further be admitted to the degree program. Students who have completed 43 credit hours applicable to their mechanical engineering degree are considered for formal admission to the mechanical engineering degree program. Typically, this occurs the semester the student is enrolled in MECH 200 Engineering Thermodynamics or MATL 360 Elements of Materials Science. Those exceeding 61 credit hours must receive formal admission to the mechanical engineering degree program if they are to continue to take mechanical engineering courses. Transfer students must have at least 12 credit hours of coursework from the University of Nebraska—Lincoln on record before an application will be considered.

The requirements for admission to the degree program are a major GPA of 2.7 (that is, not counting elective courses), completion of MECH 223 Engineering Statics, no more than four withdrawals and no more than three repeated courses. Those who are not admitted to the degree program the first time are advised of the outcome and are automatically reviewed again at the end of that semester. If after two reviews a student is not admitted to the degree program, the student is advised of other majors, in engineering or elsewhere, in which they may be likely to find success.

Other
Hands-on Opportunities
One major focus of the Department is to provide students with many hands-on opportunities, both within the curriculum (through formal laboratory courses) and through extracurricular activities. Brief descriptions of some of the laboratories in the department are given below.

The Materials Laboratory is designed to study the development of microstructures during processing and to correlate the properties of materials with the observed structures. Undergraduates utilize arc melting facilities for solidification processing and alloy formation, rolling mills for deformation processing, and a variety of furnaces for thermal treatments. Characterization facilities include x-ray diffractometry and optical microscopy, while property measurements are completed using hardness testing (including microhardness), tensile testing, and impact testing facilities. Other facilities associated with the materials laboratory include rapid solidification processing facilities and electron microscopy facilities.

The Measurements Laboratory is associated with the required MECH 380 Mechanical Engineering Measurements course, which includes two hours of lecture and two hours of laboratory work each week. The course covers the fundamentals of mechanical engineering measurements including data analysis (statistics, graphing, spectral analysis); signal conditioning and data readout; and the measurement of length/displacement, rate of rotation, stress/strain, temperature, pressure, fluid velocity, fluid flow rate, vibration/acceleration, and sound. The MECH 380 lab has four workbenches. Each workbench has a set of basic measurement equipment including a digital oscilloscope, an electronic counter, a digital multimeter, a DC power supply, a function generator, and a computer-based data acquisition system consisting of a personal computer with data acquisition software and interfaced analog-to-digital converter and digital counter cards. In addition, on a week-to-week basis, specialized equipment is brought out of the cabinets and set up for each of the nine (some one week, some two week) labs.

The Kinematics and Machine Design Laboratory is a teaching laboratory for undergraduate students. The laboratory consists of equipment and instruments for conducting experiments in kinematics and machine design. One piece of major equipment is the rapid prototyping machine, which accepts design specifications from a computer and forms a prototype of the design using plastic fused deposition. This machine provides the student with experience in design integration from concept to product. Accessories in this laboratory include desktop computers, a
wide-carriage printer, and other instruments. Kawasaki also donated a
tired robot that is now utilized in this laboratory.

The Thermal Fluids Laboratory involves design, execution, and
evaluation of physical experiments in the areas of thermodynamics, fluid mechanics, and heat transfer. There are three major, heavily-instrumented experiments:

1. A two stage air-compressor with intercooling.
2. A versatile air conditioning unit.
3. A Ford gasoline engine with a Superflow water brake
dynamometer, supported with a data acquisition system.

The course involves the design, execution, and evaluation of physical experiments in the areas of thermodynamics, fluid mechanics, and heat transfer. In addition, the facilities include "table top" instrumentation for viscosity measurement, measurement of pressure distribution on an airfoil, flow visualization, and head loss across a valve on which students conduct experiments.

The Mechatronics Laboratory is well-equipped for teaching courses in mechatronics, robotics, and controls. It is used primarily for MECH 457 Mechatronic Systems Design and MECH 450 Mechanical Engineering Control Systems Design, but is also used for other courses and by both undergraduate and graduate students working on research projects. The laboratory contains desktop computers, modular robots, digital oscilloscopes, function generators, computer controllers, soldering systems, and many other accessories.

The Department also has computational facilities available to students. The computer lab has a suite of personal computers with a full complement of computing resources available to students.

Research Laboratories. These laboratories, extensions of those described above, are equipped for research in the fields of fluid mechanics, heat transfer, thermodynamics, turbulence, flow visualization, measurements, turbomachinery and engine research, combustion, materials, mechanical design, dynamics, computational, solid and applied mechanics, biomedical engineering, and controls. Many of our undergraduate students gain valuable experience working on research projects under the guidance of professors. These are funded by research grants or the University's UCARE program.

Some of the extracurricular opportunities for students to gain hands-on engineering experience include SAE Baja, SAE Formula (both through Husker Motorsports), NASA microgravity, AIAA competitions, and others.

College Requirements
College Admission
College Entrance Requirements
Students must have high school credit for (one unit is equal to one high school year):

1. Mathematics – 4 units: 2 of algebra, 1 of geometry, and 1 of precalculus and trigonometry
2. English – 4 units
3. Natural sciences – 3 units that must include 1 unit of physics and 1 unit of chemistry (chemistry requirement waived for students in construction management)
4. Foreign language – 2 units of a single foreign language
5. Social studies – 3 units

Students must have high school credit for (one unit is equal to one high school year):

1. Mathematics – 4 units: 2 of algebra, 1 of geometry, and 1 of precalculus and trigonometry
2. English – 4 units
3. Natural sciences – 3 units that must include 1 unit of physics and 1 unit of chemistry (chemistry requirement waived for students in construction management)
4. Foreign language – 2 units of a single foreign language
5. Social studies – 3 units

6. Students having a composite ACT score of 28 or greater (or equivalent SAT score) will be admitted to the College of Engineering even if they lack any one of the following: trigonometry, chemistry, or physics.
7. Students having an ACT score of 19 or less in English (or equivalent SAT score) must take ENGL 150 Writing and Inquiry or ENGL 151 Writing and Argument.

A total of 16 units is required for admission.

Students must have an ACT (enhanced) score of 24 or greater (or equivalent SAT). Students who lack entrance requirements may be admitted based on ACT scores, high school rank and credits, or may be admitted to pre-engineering status in the Exploratory and Pre-Professional Advising Center. Pre-engineering students are advised within the Exploratory and Pre-Professional Advising Center.

Students for whom English is not their language of nurture must meet the minimum English proficiency requirements of the University.

Students who lack entrance units may complete precollege training by Independent Study through the University of Nebraska–Lincoln Office of On-line and Distance Education, in summer courses, or as a part of their first or second semester course loads while in the Exploratory and Pre-Professional Advising Center or other Colleges at Nebraska.

Students should consult their advisor, their department chair, or Engineering Student Services if they have questions on current policies.

Other Admission Requirements
Students who transfer to the University of Nebraska–Lincoln from other accredited colleges or universities and wish to be admitted to the College of Engineering (COE) must meet COE freshman entrance requirements and have a minimum cumulative GPA of 2.5 and be calculus-ready. Students not meeting either of these requirements must enroll in the Explore Center or another University college until they meet COE admission requirements. Students transferring from UNQ, UNL, or UNK to the College of Engineering must be in good academic standing with their institution.

The COE accepts courses for transfer for which a C or better grade was received. Although the University of Nebraska–Lincoln accepts D grades from the University of Nebraska at Kearney and at Omaha, not all majors in the COE accept such low grades. Students must conform to the requirements of their intended major and, in any case, are strongly encouraged to repeat courses with a grade of C- or less.

All transfer students must adopt the curricular requirements of the undergraduate catalog current at the time of transfer to the COE—not that in use when they entered the University of Nebraska–Lincoln. Upon admission to Nebraska, students wishing to pursue degree programs in the COE will be classified and subject to the policies defined in the subsequent section.

Students who were previously admitted to COE and are returning to the College of Engineering must demonstrate a cumulative GPA of 2.5 in order to be readmitted to COE.

College Degree Requirements
Grade Rules
Grade Appeals
In the event of a dispute involving any college policies or grades, the student should appeal to his/her instructor and appropriate department
chair or school director (in that order). If a satisfactory solution is not achieved, the student may appeal his/her case through the College Academic Appeals Committee on his/her campus.

Catalog Rule

Students must fulfill the requirements stated in the catalog for the academic year in which they are first admitted at the University of Nebraska–Lincoln. In consultation with advisors, a student may choose to follow a subsequent catalog for any academic year in which they are admitted to and enrolled as a degree-seeking student at Nebraska in the College of Engineering. Students must complete all degree requirements from a single catalog year. The catalog which a student follows for degree requirements may not be more than 10 years old at the time of graduation.

Learning Outcomes

Graduates of the mechanical engineering program will have:

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

The above student outcomes have been approved by the ABET Engineering Area Delegation for use beginning with the 2019-20 academic year, and have been adopted by the faculty of the Department of Mechanical and Materials Engineering.

Major Requirements

Requirements for the Degree (Lincoln Campus)

First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 109A</td>
<td>General Chemistry I</td>
<td>4</td>
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<tr>
<td>&amp; CHEM 109L</td>
<td>and General Chemistry I Laboratory</td>
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</tr>
<tr>
<td>ENGR 10</td>
<td>Freshman Engineering Seminar</td>
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<tr>
<td>ENGR 100</td>
<td>Interpersonal Skills for Engineering Leaders</td>
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<tr>
<td>MATH 106</td>
<td>Calculus I</td>
<td>5</td>
</tr>
<tr>
<td>ACE Electives</td>
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</tbody>
</table>

Choose courses from not yet satisfied ACE outcomes 5, 6, 7, or 9

Credit Hours Subtotal: 15

Second Semester

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>CHEM 110A</td>
<td>General Chemistry II</td>
<td>4</td>
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<tr>
<td>&amp; CHEM 110L</td>
<td>and General Chemistry II Laboratory</td>
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</tr>
<tr>
<td>CSCE 155N</td>
<td>Computer Science I: Engineering and Science Focus</td>
<td>3</td>
</tr>
<tr>
<td>MATH 107</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 211</td>
<td>General Physics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>General Physics Laboratory I</td>
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Credit Hours Subtotal: 16

Third Semester

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<tbody>
<tr>
<td>BSEN 206 / COEN 206</td>
<td>Engineering Economics</td>
<td>3</td>
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<tr>
<td>ENGR 20</td>
<td>Sophomore Engineering Seminar</td>
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<tr>
<td>MATH 208</td>
<td>Calculus III</td>
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<tr>
<td>MECH 130</td>
<td>Introduction to CAD</td>
<td>3</td>
</tr>
<tr>
<td>MECH 223</td>
<td>Engineering Static</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>General Physics II</td>
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Credit Hours Subtotal: 17

Fourth Semester

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<tr>
<td>MATH 221</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATL 360</td>
<td>Elements of Materials Science</td>
<td>4</td>
</tr>
<tr>
<td>MECH 200</td>
<td>Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MECH 325</td>
<td>Mechanics of Elastic Bodies</td>
<td>3</td>
</tr>
<tr>
<td>MECH 373</td>
<td>Engineering Dynamics</td>
<td>3</td>
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Credit Hours Subtotal: 16

Fifth Semester

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<tr>
<td>ECEN 211</td>
<td>Elements of Electrical Engineering I</td>
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</tr>
<tr>
<td>ECEN 231</td>
<td>Electrical Engineering Laboratory</td>
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<tr>
<td>JGEN 200</td>
<td>Technical Communication I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 314</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MECH 342</td>
<td>Kinematics and Dynamics of Machinery</td>
<td>3</td>
</tr>
<tr>
<td>MECH 230</td>
<td>Introduction to Mechanical Engineering Design</td>
<td>3</td>
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Credit Hours Subtotal: 16

Sixth Semester

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<tr>
<td>MECH 310</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>MECH 321</td>
<td>Engineering Statistics and Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MECH 343</td>
<td>Elements of Machine Design 5</td>
<td>3</td>
</tr>
<tr>
<td>or MECH 300</td>
<td>Thermal Systems and Design</td>
<td></td>
</tr>
<tr>
<td>MECH 350</td>
<td>Introduction to Dynamics and Control of Engineering Systems</td>
<td>3</td>
</tr>
<tr>
<td>MECH 380</td>
<td>Mechanical Engineering Measurements</td>
<td>3</td>
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Credit Hours Subtotal: 15

Seventh Semester

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<tr>
<td>MECH 370</td>
<td>Manufacturing Methods and Processes</td>
<td>3</td>
</tr>
<tr>
<td>MECH 420</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>MECH 446</td>
<td>Mechanical Engineering Design 4</td>
<td>2</td>
</tr>
<tr>
<td>MECH 488</td>
<td>Kinematics and Machine Design Laboratory</td>
<td>2</td>
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</table>

Mechanical Engineering Technical Elective

Design and technical electives must be chosen from a list of approved 400-level mechanical engineering elective courses. Consult advisor for suggested choices.

ACE Elective 2
Choose one course from not yet satisfied ACE outcomes 5, 6, 7, or 9

Credit Hours Subtotal: 16

**Eighth Semester**

<table>
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<th>Course</th>
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<tbody>
<tr>
<td>ENGR 400</td>
<td>Professional Ethics and Social Responsibilities</td>
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<tr>
<td>MECH 447</td>
<td>Mechanical Engineering Design II</td>
<td>2</td>
</tr>
<tr>
<td>MECH 487</td>
<td>Thermal Fluids Laboratory</td>
<td>2</td>
</tr>
<tr>
<td><strong>Mechanical Engineering Design Elective</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design and technical electives must be chosen from a list of approved 400-level mechanical engineering elective courses. Consult advisor for suggested choices.</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Senior Elective**

Senior electives may be either another mechanical engineering technical elective, another mechanical engineering design elective, or, with prior written approval of your advisor, a 300 or higher level engineering, science, or math course.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td><strong>ACE Electives</strong></td>
<td></td>
<td>6</td>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical Engineering Design Elective</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design and technical electives must be chosen from a list of approved 400-level mechanical engineering elective courses. Consult advisor for suggested choices.</td>
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<td></td>
</tr>
</tbody>
</table>

Choose courses from not yet satisfied ACE outcomes 5, 6, 7, or 9

Credit Hours Subtotal: 17

Total Credit Hours 128

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1. Or, instead, COMM 210, COMM 283, or COMM 286 may be taken in the Third Semester.
2. ENGR 200 is recommended for ACE 6 or ACE 9 credit.
3. Or, instead, PHYS 222 (1 cr) may be taken in the Third Semester.
4. The capstone design sequence must be taken in the order shown in the curriculum and should be taken in the last full academic year (fall-spring) of the program (i.e., MECH 446 in the fall and MECH 447 in the spring).
5. If both courses are taken, one may count as the senior elective.

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**MATL 260 Elements of Materials Science**

**Prerequisites:** CHEM 109 or CHEM 109A and 109L or CHEM 111; PHYS 212; MECH 223 or parallel.

**Description:** Relation of atomic, molecular, and crystal structure to the physical, mechanical, and chemical properties of metals, alloys, polymers, and ceramics.

**Credit Hours:** 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded

**Prerequisite for:** MATL 262

**MATL 262 Materials Laboratory I**

**Prerequisites:** MATL 260 or parallel.

**Description:** Engineering behavior of materials with emphasis on macroscopic properties; relationship between these properties, processing history, composition and microstructure. Introduction to the use of metallographic tools used in interpretation.

**Credit Hours:** 1

Max credits per semester: 1

Max credits per degree: 1

Grading Option: Graded

**MATL 360 Elements of Materials Science**

**Prerequisites:** CHEM 109 or CHEM 109A and 109L or CHEM 111; PHYS 212; MECH 223 or parallel.

**Description:** Relation of atomic, molecular and crystal structure to the physical, mechanical and chemical properties of metals, alloys, polymers and ceramics. Experience in investigation of properties of engineering materials.

**Credit Hours:** 4

Max credits per semester: 4

Max credits per degree: 4

Grading Option: Graded

**Prerequisite for:** MECH 343; MECH 370

**MATL 460 Mechanical Aspects of Materials**

**Crosslisted with:** MATL 860

**Prerequisites:** MECH 325 and MATL 360, or equivalent.

**Description:** Emphasizes those principles at the atomistic or molecular level that relate mechanical properties and behavior of different classes of materials to their structure and environment.

**Credit Hours:** 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded

**Prerequisite for:** MATL 875; MATL 960; MATL 962

**MATL 461 Materials Laboratory II**

**Crosslisted with:** MATL 861

**Prerequisites:** MATL 360.

**Description:** Application of scientific principles in the laboratory to the analysis of materials problems and selection of engineering materials.

**Credit Hours:** 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded

**MATL 462 X-ray Diffraction**

**Crosslisted with:** MATL 862

**Prerequisites:** PHYS 212.

**Description:** Principles of crystallography. Production and properties of X-rays. Interaction of X-rays with atoms and the nature of diffraction (direction and the intensities of diffracted beams). Diffraction patterns and intensity measurements.

**Credit Hours:** 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded

**MATL 465 Applied Physical Metallurgy and Design**

**Crosslisted with:** MATL 865

**Prerequisites:** MATL 360 or equivalent.

**Description:** Principles of alloying; alloy selection; modification of the physical properties of structural alloys by thermal, mechanical, and chemical treatment; solidification and joining phenomena.

**Credit Hours:** 3

Max credits per semester: 3

Max credits per degree: 3

Grading Option: Graded
MATL 466 Materials Selection for Mechanical Design  
**Crosslisted with:** MATL 866  
**Prerequisites:** MATL 360 and MECH 325.  
**Description:** Rational selection procedure for the most suitable materials for each particular mechanical design. Introduction of materials selection charts and the concept of materials performance indices. Case studies in mechanical design, taking materials selections, shape and process into account. Projects on materials selection at the design concept and the design embodiment stages.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MATL 467 Principles of Powder Metallurgy  
**Crosslisted with:** MATL 867  
**Prerequisites:** MECH 200; MECH 325; MATL 360 or equivalent.  
**Description:** Basic principles of powder metallurgy, with emphasis on methods of producing metal powders, determination of their characteristics; the mechanics of powder compaction; sintering methods and effects; and engineering applications.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MATL 468 Failure Analysis: Prevention and Control  
**Crosslisted with:** MATL 868  
**Prerequisites:** MECH 325; MATL 360 or equivalent.  
**Description:** Metallurgical tools for analysis of failures; types and modes of failures; sources of design and manufacturing defects. Case histories utilized to illustrate modes of failures and principles and practices for analysis. Design concepts and remedial design emphasized with these case studies. Several projects involving case analyses and design by students included.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MATL 469 Physical Materials Systems  
**Crosslisted with:** MATL 869  
**Prerequisites:** PHYS 212 and MATL 360.  
**Description:** Development of the principles controlling the formation of the structure of engineering materials. Phase diagrams, diffusion, interfaces and microstructures, solidification and diffusional transformation and diffusionless transformations.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MATL 470 Thermodynamics of Alloys  
**Crosslisted with:** MATL 870  
**Prerequisites:** MATL 360 and MECH 200, or equivalent; MATH 208 or parallel.  
**Description:** Materials thermodynamics of closed systems, introduction to liquid and solid solution alloys, relationship to gas phase, application to binary systems.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded  
**Prerequisite for:** MATL 875; MATL 960; MATL 970; MATL 972

MATL 471 Electron Microscopy of Materials  
**Crosslisted with:** MATL 871  
**Prerequisites:** PHYS 212.  
**Description:** Introduction to electron beam instruments. Electron interactions with materials. Basic aspects of electron diffraction, image formation and spectrum generation by materials. Acquisition and analysis of images, diffraction patterns and spectral data. Resolution and sensitivity limits of electron probe methods. Practical experience in the use of electron microscopes for characterization of materials.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MATL 472 Kinetics of Alloys  
**Crosslisted with:** MATL 872  
**Prerequisites:** MATL 360 or equivalent; MATH 221/MATH 821.  
**Description:** Kinetics of gas-liquid-solid reactions in alloy systems; analysis of diffusion models applicable to such systems.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MATL 473 Corrosion  
**Crosslisted with:** MATL 873  
**Prerequisites:** CHEM 109 or CHEM 109A and 109L or equivalent.  
**Description:** Fundamentals of corrosion engineering, underlying principles, corrosion control, and materials selection and environmental control.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MATL 474 Extractive Metallurgy  
**Crosslisted with:** MATL 874  
**Prerequisites:** MATL 360 and MECH 200 or equivalent.  
**Description:** Unit operations and processes utilized in production of ferrous, nonferrous, and refractory metals. Examples of production techniques for metal bearing ores, scrap metals, and domestic waste. Control of impurity and alloy content and their relationship to physical properties.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MATL 477 Organic and Inorganic Electronic Materials and Devices  
**Crosslisted with:** MATL 877  
**Prerequisites:** Permission  
**Description:** The course introduces the optical and electronic processes in inorganic and organic molecules and polymers that govern the behavior of practical organic electronic and optoelectronic devices.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded
MATL 492 Special Topics
Crosslisted with: MATL 892
Description: Special topics in materials engineering and related areas.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 24
Grading Option: Graded

MECH 100 Introduction to Mechanical Engineering
Description: Overview of mechanical engineering, introduction to problem
layout, and development of basic skills required to solve mechanical
engineering problems. Collection, manipulation and presentation of
engineering data.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded

MECH 130 Introduction to CAD
Description: Principles and accepted practices of geometric design.
Computer generation of 2D and 3D models for mechanical systems.
Introduction to engineering design practices such as specifications,
dimensioning, and tolerances.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 230; MECH 342; MECH 381

MECH 200 Engineering Thermodynamics
Prerequisites: MECH 223.
Description: First and Second Laws of Thermodynamics, properties of
gases and vapors, and cycles. Sources of energy and its conversion to
work.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: AGEN 344, BSEN 344; AREN 310; AREN 404; MECH 300;
MECH 330; MECH 446; MECH 487

MECH 200H Honors: Engineering Thermodynamics
Prerequisites: Good standing in the University Honors Program or by
permission; PHYS 212; MECH 223.
Description: First and Second Laws of Thermodynamics, properties of
gases and vapors, and cycles. Sources of energy and its conversion to
work. Honors students will be expected to study beyond the students in
the normal sections and do a special project.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: AGEN 344, BSEN 344; AREN 310; AREN 404; MECH 300;
MECH 330; MECH 446; MECH 487

MECH 220 Statics
Prerequisites: MATH 106.
Description: Fundamental concepts, equilibrium of forces systems,
analysis of simple frames and trusses. Centroid and moments of inertia
and friction.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 324

MECH 223 Engineering Statics
Prerequisites: MATH 107 (grade of C or better), PHYS 211 (grade of C or
better)
Description: Action of forces on engineering structures and machines.
Force systems, static equilibrium of frames and machines. Friction,
center of gravity, moment of inertia, vector algebra.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: AGEN 324, BSEN 324; CIVE 310; CIVE 310H; CIVE 361; MATL 260; MATL 360; MECH 200; MECH 200H; MECH 324; MECH 325; MECH 325H; MECH 373; MECH 373H

MECH 223H Honors: Engineering Statics
Prerequisites: Good standing in the University Honors Program or by
permission; MATH 107 and PHYS 211.
Description: Bodies in equilibrium. Vector algebra, equivalent force
systems, distributed loads, and center of gravity. Analysis of trusses,
frames, and machines. Friction, wedges, crews, and belts. Area moments
of inertia.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: AGEN 324, BSEN 324; CIVE 310; CIVE 310H; CIVE 361; MATL 260; MATL 360; MECH 200; MECH 200H; MECH 324; MECH 325; MECH 325H; MECH 373; MECH 373H

MECH 230 Introduction to Mechanical Engineering Design
Prerequisites: MECH 130, MECH 325
Description: Introduction to formalized engineering design processes
and methodology, selection of common mechanical components, and
practice of teamwork and problem solving in the context of mechanical
engineering.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 446
MECH 250 Mechanics I
Prerequisites: PHYS 211.
Notes: Parallel: MATH 208. For electrical engineering majors.
Description: Force actions in static coplanar systems with applications to engineering structures and machines. Resultants, moments, couples, equivalent force systems, vector algebra. Static equilibrium conditions and equations.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Prerequisite for: MECH 351

MECH 300 Thermal Systems and Design
Prerequisites: MECH 200, CSCE 155N
Description: Applications of control-volume analysis (mass, energy, and momentum), both transient and steady; mixtures of gases and vapors; introduction to combustion; thermodynamic relations and establishment of data banks of thermal properties; applications of computer-aided engineering to processes and cycles; methodologies and case studies for thermal systems design; execution of small-scaled design projects.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 310 Fluid Mechanics
Prerequisites: MECH 373; MATH 221
Notes: Parallel: MECH 200, or BSEN 244 or by permission for non-ME students.
Description: Fluid statics, equations of continuity, momentum, and energy dimensional analysis and dynamic similitude. Applications to: flow meters; fluid pumps and turbines; viscous flow and lubrication; flow in closed conduits and open channels. Two-dimensional potential flow.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 311 Fluid Mechanics Laboratory
Prerequisites: MECH/CIVE 310 or parallel.
Description: Fluid mechanics experiments and demonstrations. Conservation principles; determination of fluid properties, velocity, pressure, and flow measurements; pipe flow; open channel flow; and instrumentation techniques.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Grading Option: Graded

MECH 318 Applied Linear Algebra and Computational Methods
Prerequisites: MATH 208; MATH 221 or parallel; CSCE 155N or equivalent.
Notes: This course is a substitute for MATH 314 for mechanical engineering students.
Description: Application-based linear algebra concepts and introduction to numerical computations using Matlab. Topics include: linear systems and numerical solvers; eigenvalue and eigenvector computations; methods for root finding and curve fitting; norms and convergence of numerical methods; numerical integration, differentiation, and initial-value ODE problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 321 Engineering Statistics and Data Analysis
Prerequisites: MATH 208
Description: An applications-oriented course for formulating and solving engineering statistical problems. Includes Descriptive statistics, probability distributions, variability, sampling, confidence intervals, tests of significance, basics of statistical process control, and design of experiments.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 324 Strength of Materials
Prerequisites: MECH 220 or MECH 223.
Notes: For students in architecture and construction management.
Description: Stress and strain analysis in elastic materials. Use of properties of materials in the analysis and design of welded and riveted connections, statically determinate and indeterminate flexure members, columns. Combined stresses, axial, eccentric and torsional loading. Observations of laboratory tests for axially loaded specimens. Introduction to shear and moment diagrams.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 325 Mechanics of Elastic Bodies
Prerequisites: MECH 223, MATH 208
Description: Concept of stress and strain considering axial, torsional, and bending forces. Shear and moments. Introduction to combined stresses and column theory.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: AGEN 443; CIVE 334; CIVE 341; CIVE 378; MECH 230; MECH 330; MECH 343; MECH 370; MECH 910
MECH 325H Honors: Mechanics of Elastic Bodies
Prerequisites: Good standing in the University Honors Program or by permission; MECH 223 or 223H; MATH 208.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: AGEN 443; CIVE 334; CIVE 378; MECH 230; MECH 330; MECH 343; MECH 370

MECH 330 Mechanical Engineering Analysis
Prerequisites: MATH 221; CSCE 155N; MECH 325; MECH 373; MECH 200.
Description: Conceptual modeling of mechanical engineering systems. Analytical exploration of engineering behavior of conceptual models. Case studies drawn from mechanical engineering problems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 350

MECH 342 Kinematics and Dynamics of Machinery
Prerequisites: MECH 130 and MECH 373
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 343; MECH 488

MECH 343 Elements of Machine Design
Prerequisites: MECH 325; MECH 342 or parallel; MATL 360; MECH 321 or STAT 380 or parallel.
Description: Design of machine elements under different conditions of loading. Design work includes a project of broader scope (done primarily out of class) requiring a breadth of knowledge. Failure theories for static and dynamic loading of bolts, springs, bearings, and shafts.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 350 Introduction to Dynamics and Control of Engineering Systems
Prerequisites: MECH 373; ECEN 211; CSCE 155N or AGEN/BSEN 212A; MATH 314 or parallel.
Description: Unified treatment of the dynamics and control of engineering systems. Emphasis on physical aspects, formulation of mathematical models, application of various mathematical methods, and interpretation of results in terms of the synthesis and analysis of real systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 446

MECH 351 Mechanics II
Prerequisites: MECH 250.
Notes: For electrical engineering majors.
Description: Application of Newton's laws to engineering problems involving coplanar kinematics and kinetics of particles. Work, energy, impulse, and momentum. Conservative systems. Periodic motion.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded

MECH 370 Manufacturing Methods and Processes
Prerequisites: MATL 360; and MECH 325.
Description: Introduction to traditional and modern manufacturing processes and methods to include: foundry; forming processes; welding; metal removal theory and practices; modern manufacturing systems and automation; and economics of process selection.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 373 Engineering Dynamics
Prerequisites: MECH 223, MATH 208.
Description: Force action related to displacement, velocity, and acceleration of rigid bodies. Kinematics of plane motion, kinetics of translation and rotation. Mass moment of inertia, vibration, work, energy and power, impulse and momentum.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: BSEN 410; MECH 310; MECH 330; MECH 342; MECH 350

MECH 373H Honors: Engineering Dynamics
Prerequisites: Good standing in the University Honors Program or by permission; MECH 223 or 223H; MATH 208.
Description: Motion of particles and rigid bodies under the action of forces and moments. Kinematics of plane motion: displacement, velocity, and acceleration. Kinetics of translation and rotation; work, energy and power; impulse, momentum and impact. Introduction to vibration analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 310; MECH 330; MECH 342; MECH 350

MECH 380 Mechanical Engineering Measurements
Prerequisites: ECEN 231; JGEN 200 or JGEN 300; MECH 321 or STAT 380 or parallel; MECH 350 and MECH 310, or parallel.
Description: Theory, statistics, applications and design of mechanical engineering experiments.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR
Prerequisite for: MECH 487; MECH 488
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Max credits per semester</th>
<th>Max credits per degree</th>
<th>Grading Option</th>
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</thead>
<tbody>
<tr>
<td>MECH 381</td>
<td>Elements of Computer-Aided Design</td>
<td>MATH 221; MECH 130 or CSCE 155N</td>
<td>Principles and techniques currently used for computer-aided design (CAD). Applications of interactive graphics devices for drafting, design, and analysis. Modelling and analogy of engineering systems. Elementary finite element, Bode, and numerical analyses. CAD case studies and term project.</td>
<td>3</td>
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<td>Graded</td>
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<tr>
<td>MECH 399</td>
<td>Undergraduate Research and Thesis</td>
<td>Permission</td>
<td>Engineering design or laboratory investigation that an undergraduate is qualified to undertake.</td>
<td>1-5</td>
<td>1</td>
<td>6</td>
<td>Graded</td>
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<tr>
<td>MECH 403</td>
<td>Internal Combustion Engines</td>
<td>MECH 300 or equivalent</td>
<td>Basic cycle analysis and engine types, fundamental thermodynamics and operating characteristics of various engines are analyzed, combustion processes for spark and compression-ignition engines, fuels, testing procedures, and lubrication systems are evaluated. Emphasis on the thermodynamic evaluation of the performance and understanding the basic operation of various engine types.</td>
<td>3</td>
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<tr>
<td>MECH 405</td>
<td>Turbomachinery</td>
<td>MECH 300 and MECH 310/CIVE 310</td>
<td>Thermodynamic analysis and design of axial and radial flow turbines, compressors, and pumps. Fundamentals of the operating characteristics and performance parameters of turbomachines will be evaluated. Cavitation and blade element theory.</td>
<td>3</td>
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<tr>
<td>MECH 406</td>
<td>Air Conditioning Systems Design</td>
<td>MECH 300 or equivalent</td>
<td>Application of thermodynamic and fluid dynamic principles to the design of air conditioning systems. Comprehensive design project is an integral part of the course.</td>
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<tr>
<td>MECH 407</td>
<td>Power Plant Systems Design</td>
<td>MECH 300 or equivalent</td>
<td>Application of thermodynamic and fluid dynamic principles to the design of Power Plants. Comprehensive design project an integral part of the course.</td>
<td>3</td>
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<td>Graded</td>
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<tr>
<td>MECH 408</td>
<td>Heat Exchanger Design</td>
<td>MECH 300 or equivalent</td>
<td>Design methodology for various heat exchangers employed in mechanical engineering. Introduction to computer-aided design as applied to heat exchangers. Practical exercises in actual design tasks.</td>
<td>3</td>
<td>3</td>
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<td>Graded</td>
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<tr>
<td>MECH 413</td>
<td>Aerodynamics</td>
<td>MECH 200 and MECH 310/CIVE 310</td>
<td>Subsonic and supersonic air flow theory, dynamics of flight, performance parameters, rotor analysis, and special topics.</td>
<td>3</td>
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<td>Graded</td>
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<tr>
<td>MECH 414</td>
<td>Compressible Flow</td>
<td>MECH 300 and MECH 310/CIVE 310</td>
<td>Analysis of the flow of compressible fluids by means of the momentum equation, continuity equation, and the laws of thermodynamics and some application of thermodynamic laws to incompressible fluids.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>Graded</td>
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</tbody>
</table>
MECH 415 Two-Phase Flow
Crosslisted with: MECH 815
Prerequisites: MECH/CIVE 310; MECH 380 or parallel.
Description: Transport phenomena of homogeneous and heterogeneous types of mixtures such as solid-liquid, liquid-liquid, and liquid-gas. Properties of components and mixtures. Flow induced vibrations and parameter distributions. Optimization and design problems in multiphase systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 416 Engineering Acoustics
Crosslisted with: MECH 816
Prerequisites: MECH 310 and MATH 221/MATH 821.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 420 Heat Transfer
Crosslisted with: MECH 820
Prerequisites: MECH 310
Description: Heat transfer by conduction, convection, and radiation. Correlation of theory with experimental data and engineering design.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: AREN 810; MECH 404, MECH 804; MECH 487; MECH 922; MECH 923; MECH 924

MECH 421 Elements of Nuclear Engineering
Crosslisted with: MECH 821, ENGR 421
Prerequisites: ENGR 300 or ENGR 301 or ENGR 310; MATH 208/MATH 208H; and PHYS 212/PHYS 212H
Description: Survey of nuclear engineering concepts and applications. Nuclear reactions, radioactivity, radiation interaction with matter, reactor physics, risk and dose assessment, applications in medicine, industry, agriculture, and research.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: ENGR 410; ENGR 420

MECH 422 Industrial Quality Control
Crosslisted with: MECH 822
Prerequisites: MECH 321 or STAT 380
Description: Statistical process control and quality assurance techniques in manufacturing. Control charts, acceptance sampling, and analyses and design of quality control systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 424 Laser Material Processing with Compressible Flow Perspective
Crosslisted with: MECH 824
Prerequisites: Permission.
Description: Fundamentals of laser material processing. Laser material interactions from the compressible flow perspective. Analytical, semi-analytical, and numerical approaches.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 425 Solar Energy Engineering
Crosslisted with: MECH 825
Prerequisites: MECH 420 or permission.
Description: Conversion of solar energy into more useful forms with emphasis on environmental heating and cooling applications. Includes solar energy availability, solar collectors and design, solar systems and their simulation and solar economics.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 426 Heat Transfer at Nanoscales and in Ultrashort Time Domains
Crosslisted with: MECH 826
Prerequisites: MECH 420
Description: Heat transfer in nanoscale and nanostructured materials. Heat transfer in ultrafast laser materials processing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 428 Analysis of Thermal Data
Crosslisted with: MECH 828
Prerequisites: MECH 420 or parallel.
Description: Indirect measurement of thermal properties and heat flux are explored with various methods, and optimization, with examples drawn from engineering practice.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Offered: FALL/SPR

MECH 431 Computational Heat Transfer and Fluid Flow
Crosslisted with: MECH 831
Prerequisites: MECH 310; MATH 314; MECH 420 or parallel.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 932
MECH 434 Facility Planning and Design  
**Notes:** introductory knowledge of ergonomics  
**Description:** Design, analysis and layout of facilities: queuing, material handling systems, material flow analysis, systematic layout planning and design of warehouse facilities.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MECH 436 Introduction to Continuum Biomechanics  
**Crosslisted with:** MECH 836  
**Prerequisites:** Senior or graduate student standing  
**Notes:** Linear Algebra (MATH 314) and Mechanics of Elastic Bodies (MECH 325) are recommended.  
**Description:** An introduction to continuum biomechanics with an emphasis on soft tissues. Case studies covering diverse applications of biomechanics in biology and medicine, including in the areas of mechanobiology, medical devices, and tissue engineering. Continuum mechanics concepts include kinematics, kinetics, balance laws, and constitutive relations. Includes some programming in MATLAB.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MECH 437 Biomedical Device Design  
**Crosslisted with:** MECH 837  
**Prerequisites:** MECH 223, MECH 373  
**Notes:** basic understanding of solid mechanics  
**Description:** Design of devices intended for use in biomedical environments. Introduction to modeling of the bio-environment, biomaterials, and material selection. Overview of design methodologies and strategies used in biomedical device design from a material properties perspective. Introduction to federal regulation and other pertinent issues.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MECH 438 Mechanics of Biomaterials  
**Crosslisted with:** MECH 838  
**Prerequisites:** MECH 325 or AGEN/BSEN 324 or parallel  
**Description:** Theory, application, simulation, and design of biomaterials that apply mechanical principles to solving medical problems (case studies in artery, brain, bone, etc.). Tentative Topics include Mechanical characterization of biomaterials; Bio-manufacturing a tissue; Function-structure relationship; Design and analysis of medical implants; Active response of biomaterials: growth and remodeling mechanism; Cellular behavior and measurements, etc.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MECH 439 Biomaterial Surface Patterning  
**Crosslisted with:** MECH 839  
**Description:** Biomaterials, biocompatibility, and biomaterial surface characteristics (chemistry, surface energy, topography, wettability, etc.). Protein adsorption on biomaterials. Microscale and nanoscale chemical patterning; anisotropic and isotropic micro/nanotopography; cell sensing and response to patterned substrates.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MECH 442 Intermediate Kinematics  
**Crosslisted with:** MECH 842  
**Prerequisites:** MECH 342.  
**Description:** Analytical cam design. Geometry of constrained plane motion and application to the design of mechanisms. Analysis and synthesis of pin-jointed linkage mechanisms.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded  
**Prerequisite for:** MECH 943

MECH 444 Intermediate Dynamics of Machinery  
**Crosslisted with:** MECH 844  
**Prerequisites:** MECH 342 and MECH 350.  
**Description:** Fundamentals of vibration, vibration and impact in machines, balance of rotors, flexible rotor dynamics and instabilities, parametric vibration, advanced dynamics and design of cam mechanisms, and dynamics of flywheel.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded

MECH 445 Mechanical Engineering Design Concepts  
**Crosslisted with:** MECH 845  
**Prerequisites:** MECH 200, MECH 342, MECH 350, and MECH 310/CIVE 310.  
**Description:** Development of design concepts. Introduction to synthesis techniques and mathematical analysis methods. Applications of these techniques to mechanical engineering design projects.  
**Credit Hours:** 3  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Graded  
**Prerequisite for:** MECH 945
MECH 446 Mechanical Engineering Design I
Prerequisites: BSEN 206, MECH 200, MECH 230, MECH 310, MECH 350, professional admission to Mechanical Engineering BS program
Notes: This course should be taken in the fall semester of the final full academic year, followed immediately by MECH 447 in the spring semester.
Description: The first of two courses in the capstone sequence. Practical application of the engineering design process in a team project focused on a mechanical engineering problem, including design reviews and reports.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
Offered: FALL
Prerequisite for: MECH 447
ACE: ACE 10 Integrated Product

MECH 447 Mechanical Engineering Design II
Prerequisites: MECH 446, professional admission to Mechanical Engineering BS program
Description: Definition, scope, analysis, synthesis, and the design for the solution of a comprehensive engineering problem in any major area of mechanical engineering.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded
ACE: ACE 10 Integrated Product

MECH 448 Advanced Mechanics of Materials
Crosslisted with: MECH 848
Prerequisites: MECH 373, MECH 325.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 915; MECH 930; MECH 933; MECH 935; MECH 937; MECH 938; MECH 940; MECH 941; MECH 952

MECH 449 Advanced Dynamics
Crosslisted with: MECH 849
Prerequisites: MECH 373 and MATH 221/821.
Description: Particle Dynamics using Newton’s laws, energy principles, momentum principles. Rigid body dynamics using Euler’s equations and Lagrange’s equations. Variable mass systems. Gyroscopic motion.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 915; MECH 935

MECH 450 Mechanical Engineering Control Systems Design
Crosslisted with: MECH 850
Prerequisites: MECH 350.
Description: Applications of control systems analysis and synthesis for mechanical engineering equipment. Control systems for pneumatic, hydraulic, kinematic, electromechanical, and thermal systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 451 Introduction to Finite Element Analysis
Prerequisites: Open to College of Engineering Students only.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 452 Experimental Stress Analysis I
Crosslisted with: MECH 852
Prerequisites: MECH 325.
Description: Investigation of the basic theories and techniques associated with the analysis of stress using mechanical strain gages, electric strain gages, brittle lacquer, photoelasticity, and membrane analogy.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 952

MECH 453 Robotics: Kinematics and Design
Crosslisted with: MECH 853
Prerequisites: MECH 350.
Description: Robotics synthesize some aspects of human function by the use of mechanisms, sensors, actuators, and computers.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 454 Introduction to Continuum Modeling
Crosslisted with: MECH 854
Prerequisites: MATH 221/821, MECH 325 and MECH 373
Description: Basic concepts of continuum modeling. Development of models and solutions to various mechanical, thermal and electrical systems. Thermo-mechanical and electro-mechanical coupling effects. Differential equations, dimensional methods and similarity.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
MECH 455 Vehicle Dynamics
Crosslisted with: MECH 855
Prerequisites: MECH 343 and MECH 350.
Description: Introduction to basic mechanics governing automotive vehicle dynamic acceleration, braking, ride, handling and stability. Analytical methods, including computer simulation, in vehicle dynamics. The different components and subsystems of a vehicle that influence vehicle dynamic performance.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 456 Dynamics of Internal Combustion Engines
Crosslisted with: MECH 856
Prerequisites: MECH 342 and MECH 343.
Description: Basics of design of the internal combustion engines. Design of various engine parts such as pistons, connecting rods, valve trains, crankshafts, and the vibration dampers. Dynamics of the engine. The vibration of the crankshaft assembly and the valve train. Balancing of the engines.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 457 Mechatronic Systems Design
Crosslisted with: MECH 857
Prerequisites: ECEN 231; MECH 350 or parallel.
Notes: Lab sessions allow for constructing mechatronic systems. Lab time arranged. A comprehensive design project included.
Description: Theory, application, simulation, and design of systems that integrate mechanical, computer, and electronic components.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 958

MECH 458 Digital Control of Mechanical Systems
Crosslisted with: MECH 858
Prerequisites: MECH 450
Description: Introduction to digital measurement and control of mechanical systems. Applications of analysis and synthesis of discrete time systems.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 470 Theory and Practice of Materials Processing
Crosslisted with: MECH 870
Prerequisites: MECH 370
Description: Theory, practice and application of conventional machining, forming and non-traditional machining processes with emphasis on tool life, dynamics of machine tools and adaptive control.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: MECH 970

MECH 472 Additive Manufacturing
Crosslisted with: MECH 872
Prerequisites: MECH 370 or parallel
Description: Hands-on exposure to several aspects of Additive Manufacturing (AM): (1) design and experimentation; (2) process optimization; and (3) materials testing. Coverage of a variety of AM technologies, their advantages and limitations, and how to design for AM. Discussion of both polymer and metal technologies, and exploration of recent applications of AM across multiple industries.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 474 Manufacturing Systems I
Crosslisted with: MECH 874
Prerequisites: Open to College of Engineering Students only.
Description: Principles of automated production lines; analysis of transfer lines; group technology; flexible manufacturing systems; and just-in-time; and optimization strategies for discrete parts manufacturing.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 475 Introduction to Mechanical Vibrations
Crosslisted with: MECH 875
Prerequisites: MECH 373 and MATH 221
Description: Review of rigid body dynamics; equations of motion, free vibration, damping; linear response of one, two, and multi-degree of freedom systems; forced vibrations, harmonic, periodic, impulse, and general responses; resonance and vibration isolation; rotating imbalance; Fourier transforms, digitization and analysis of experimental data.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option
Prerequisite for: MECH 975

MECH 476 Manufacturing Information Systems
Crosslisted with: MECH 876
Prerequisites: Senior standing; CSCE 155A, CSCE 155E, CSCE 155H, CSCE 155N, or CSCE 155T or equivalent
Description: An exploration of information systems and their impact in a manufacturing environment. Software, hardware, database systems, enterprise resource planning, networking, and the Internet.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
MECH 480 Numerical Methods in Engineering
Crosslisted with: MECH 880
Prerequisites: MATH 221/MATH 821; CSCE 155N.
Notes: Linear Algebra recommended. Credit towards the degree cannot be earned in both CSCE/MATH 440/840 and MECH 480/880.
Description: Numerical algorithms and their convergence properties in: solving nonlinear equations; direct and iterative schemes for linear systems of equations; eigenvalue problems; polynomial and spline interpolation; curve fitting; numerical integration and differentiation; initial and boundary values problems for Ordinary Differential Equations (ODEs) and systems of ODEs with applications to engineering; finite difference methods for partial differential equations (potential problems, heat-equation, wave-equation).
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded
Prerequisite for: CHME 496, CHME 896; MECH 851; MECH 888

MECH 483 Engineering Analysis with Finite Elements
Crosslisted with: MECH 883
Prerequisites: MECH 310; MECH 343; MECH 350; MECH 420 or parallel
Description: Analysis of engineering systems using finite elements; critical and challenging task performed during the design process for many engineering systems. Four very distinct domains are studied: Structural stress analysis, heat transfer, fluid flow, and modal analysis.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded with Option

MECH 487 Thermal Fluids Laboratory
Prerequisites: MECH 200 and MECH 380; MECH 420/820 or parallel.
Description: Design, execution, and evaluation of physical experiments in the areas of thermodynamics, fluid mechanics, and heat transfer.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded with Option

MECH 488 Kinematics and Machine Design Laboratory
Prerequisites: MECH 342; MECH 380 or parallel.
Description: Design projects and physical experiments in the area of machine design and kinematics.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Grading Option: Graded

MECH 491 Special Topics in Engineering Mechanics
Crosslisted with: MECH 891
Prerequisites: Permission.
Description: Treatment of special topics in engineering mechanics by experimental, computational and/or theoretical methods. Topics vary from term to term.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded

MECH 492 Special Topics
Crosslisted with: MECH 892
Description: Special topics in mechanical engineering and related areas.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 24
Grading Option: Graded

MECH 494 Independent Study
Crosslisted with: MECH 894
Prerequisites: Permission
Description: Faculty-supervised independent study.
Credit Hours: 1-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 24
Grading Option: Graded

MECH 498 Research
Crosslisted with: MECH 898
Description: Faculty-supervised research.
Credit Hours: 0-6
Min credits per semester: 1
Max credits per semester: 6
Max credits per degree: 6
Grading Option: Graded

MECH 499H Honors Thesis
Prerequisites: Senior standing in mechanical engineering; admission to the University Honors Program.
Description: Honors thesis research project meeting the requirements of the University Honors Program. Independent research project executed under the guidance of a member of the faculty of the Department of Mechanical Engineering which contributes to the advancement of knowledge in the field. Culminates in the presentation of an honors thesis to the department and college.
Credit Hours: 1-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Grading Option: Graded

MECH 896, CHME 896; MECH 851; MECH 888

PLEASE NOTE
This document represents a sample 4-year plan for degree completion with this major. Actual course selection and sequence may vary and should be discussed individually with your college or department academic advisor. Advisors also can help you plan other experiences to enrich your undergraduate education such as internships, education abroad, undergraduate research, learning communities, and service learning and community-based learning.

Career Information
The following represents a sample of the internships, jobs and graduate school programs that current students and recent graduates have reported.

Jobs of Recent Graduates
- Weapon Systems Operation & Sustainment Team, The Boeing Company - Huntsville AL
- Production Engineer, Kawasaki Motors - Lincoln NE
- Aerospace Engineer, NASA - Houston TX
- Power Supply Engineer, Lincoln Electric System - Lincoln NE
• Operations Management Training Program, Union Pacific - Kansas City KS
• Airframe Engineer, Textron Aviation - Wichita KS
• Mechanical Engineer, Schlumberger - Houston TX
• Design Engineer - Airframe, Cessna Aircraft Company - Wichita KS
• Field Engineer, Kiewit - Englewood CO
• Nuclear Officer, United States Navy - Washington DC
• Engineering Leadership Program - Entry Level Engineer, National Instruments - Austin TX
• Operations Advanced Development Program, Schneider Electric - Lincoln NE
• Assistant Mechanical Engineer, Burns and McDonnell - Kansas City MO
• Infotainment Design Engineer, Honda Research & Development - Columbus OH
• Research & Development Engineer, Stark Industries - Manhattan NY
• Consulting Engineer, Black & Veatch - Kansas City MO
• Project Engineer, Hexagon Lincoln - Lincoln NE
• Mechanical Engineer, Advanced Aircraft Company - Lincoln NE
• Machine Design Engineer, Vishay Dale Electronics Inc. - Columbus NE
• Seating Engineer, Tesla Motors Inc. - Palo Alto CA
• Design Engineer, Molex Inc. - Lincoln NE
• Assistant Mechanical Engineer, Burns and McDonnell - Kansas City MO
• Nuclear Engineer, Omaha Public Power District - Blair NE
• Product Engineering Development Program, John Deere - Coffeyville KS
• Mechanical Engineer 1, Honeywell - Kansas City MO

Internships

• Mechanical Engineering Co-op, NASA - Langley Research Center - Hampton VA
• Locomotive Intern, BSNF Railway - Fort Worth TX
• Manufacturing Engineer Intern, John Deere - Springfield MO
• Mechanical Engineering Co-op, Omaha Public Power District - Omaha NE
• Propulsion Engineer Intern, Textron Aviation - Wichita KS
• Mechanical Engineering Intern, HDR - Omaha NE
• Mechanical Engineering Intern, LI-COR Biosciences - Lincoln NE
• Mechanical Design Engineer Intern, Valmont Irrigation - Valley NE
• Mechanical Engineering Intern, Schneider Electric - Lincoln NE
• Mechanical Engineering Co-op, Nebraska Public Power District - Cooper Nuclear Station - Brownville NE
• Research Intern, NASA Jet Propulsion Lab - Pasadena CA
• Mechanical Engineering Co-op, UTC Aerospace - York NE
• Product Support Technician Intern, Lindsay Manufacturing - Lindsay NE
• Mechanical Intern, Union Pacific Railroad - De Soto MO
• Commercialization Analyst Intern, NU Tech Ventures - Lincoln NE
• Research Intern I - Maize Trait Commercialization, DuPont Pioneer - York NE
• Printing Mechanical Technician Intern, Sandhills Publishing - Lincoln NE
• Mechanical Engineering Co-op, GE Global Research - Niskayuna NY
• Robotics Engineering Intern, Lockheed Martin Space Systems - Littleton CO
• Intern Test Engineer, CNH Industrial - New Holland PA
• Product Engineering Intern, Molex - Lincoln NE
• Rotorcraft Aeromechanics LXI, NASA Ames Research Center - Mountain View CA
• BCA Mechanical/Structural Intern, Boeing - Everett WA
• Ceramic Research & Development and 3D Printer Maintenance, Tethon 3D - Omaha NE
• Production Engineering Intern, Kawasaki Motors Manufacturing - Lincoln NE

Graduate & Professional Schools

• Aerospace Engineering, M.S., University of Nebraska-Lincoln - Lincoln NE
• Aeronautics & Astronautics, Ph.D., Stanford University - Stanford CA
• Mechanical Engineering, Ph.D., University of Nebraska Medical Center - Omaha NE
• Robotics, Ph.D., Carnegie Mellon University - Pittsburgh PA
• Mechanical Engineering, M.S., Georgia Institute of Technology - Atlanta GA
• Biomedical Engineering, M.S., University of Nebraska-Lincoln - Lincoln NE
• Mechanical Engineering, M.S., University of California-Berkeley - Berkeley CA
• Aerospace Engineering, Ph.D., University of Texas at Austin - Austin TX
• Master of Business Administration, University of Nebraska-Lincoln - Lincoln NE
• Doctor of Medicine, University of Nebraska Medical Center - Omaha NE
• Mechanical Engineering, M.S., Texas A&M University - College Station TX
• Computational Methods, Ph.D., University of Nebraska-Lincoln - Lincoln NE
• Mechanical Engineering, M.S., University of Utah - Salt Lake City UT
• Mechanical Engineering, Ph.D., Colorado School of Mines - Golden CO
• Mechanical Engineering, Ph.D., University of Washington - Seattle WA
• Material Science and Engineering, Ph.D., University of Illinois Urbana-Champaign - Champaign IL
• Medical Engineering, Ph.D., University of California at Santa Barbara - Santa Barbara CA
• Materials Science and Engineering, Ph.D., Iowa State University - Ames IA
• Aeronautics and Astronautics, Ph.D., Purdue University - West Lafayette IN
• Financial Mathematics, M.S., Rutgers University - Piscataway NJ
• Mechanical Engineering, M.S., University of Illinois Urbana-Champaign - Urbana IL
• Mechanical Engineering, Ph.D., State University of New York - Binghamton NY
• Mechanical Engineering, M.S., Stanford University - Stanford CA
• Aerospace Engineering, M.S.E., University of Michigan - Ann Arbor MI