Mechanical Engineering (MEEG)

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Department of Mechanical Engineering Website (http://mechanical-engineering.uark.edu)

The mechanical engineering program is designed to offer a high-quality course of instruction involving classroom, laboratory, and extracurricular activities that result in graduates who are qualified and prepared to meet the demands of a professional career in the present and future work place and be able to assume a responsible place of leadership in a complex technological society.

The mission of the department is three-fold:

1. Teaching — To provide a high-quality educational experience for undergraduate and graduate students that enables them to become leaders in their chosen professions.
2. Research — To create, explore, and develop innovations in engineering and science through undergraduate and graduate research.
3. Service — To provide beneficial service to the local, state, national, and international industries and communities via educational, technical, entrepreneurial, and professional activities.

The courses offered in mechanical engineering provide the student with a broad understanding of fundamental scientific principles that serve as a background for many fields of specialization. The undergraduate curriculum is designed to stress basic engineering principles and to assist in developing creative thinking. Emphasis is placed on the science and art of designing machines and systems, of converting energy into useful forms, and developing a basic understanding of engineering mechanics.

Completion of the degree requirements provides graduates with the following learning outcomes and ability to:

1. 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
2. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
3. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
4. Acquire and apply new knowledge as needed, using appropriate learning strategies.

The BSME Program Educational Objectives are to produce graduates who, within a few years of graduation, are expected to:

1. Contribute to the economic development of Arkansas and the world through the practice of Mechanical Engineering;
2. Meet or exceed the needs and expectations of mechanical engineering employers in industry, government, and private practice;
3. Engage in professional activities that promote the mechanical engineering profession and provide continuing self-development; and
4. Succeed in graduate study and research, if pursued.

Requirements for B.S. in Mechanical Engineering

Requirements for the B.S.M.E.: The Bachelor of Science in Mechanical Engineering curriculum includes, in addition to the required 18 hours of history, government, fine arts/humanities/social science elective courses, a total of 12 hours of technical and science electives. A student must select all electives with the approval of his or her adviser. The fine arts/humanities/social science electives must be selected from the University Core (http://catalog.uark.edu/undergraduatecatalog/academicregulations/universitycore) in the Academic Regulations chapter for university requirements for the program. It is expected that technical and science electives will be chosen to provide a coherent program within one or more areas of specialization or options available to mechanical engineers. Traditional areas of specialization are available in mechanical systems, materials, and energy systems. Other areas include pre-medical, management, and aerospace.

The first-year curriculum is essentially the same as prescribed for all engineering freshmen. Students entering the mechanical engineering program are required to take two, four hour laboratory based science electives. One of the four hour science electives must be PHYS 2074. The other four hour science elective must be chosen from one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 2003 &amp; ASTR 2001L</td>
<td>Survey of the Universe (ACTS Equivalency = PHSC 1204 Lecture) and Survey of the Universe Laboratory (ACTS Equivalency = PHSC 1204 Lab)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 1543 &amp; BIOL 1541L</td>
<td>Principles of Biology (ACTS Equivalency = BIOL 1014 Lecture) and Principles of Biology Laboratory (ACTS Equivalency = BIOL 1014 Lab)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 2213 &amp; BIOL 2211L</td>
<td>Human Physiology (ACTS Equivalency = BIOL 2414 Lecture) and Human Physiology Laboratory (ACTS Equivalency = BIOL 2414 Lab)</td>
<td>4</td>
</tr>
</tbody>
</table>
The humanities and social sciences electives are mandatory. Each student in the College of Engineering is required to complete 18 semester hours in the humanities and social sciences.

The courses taken must include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIST 2003</td>
<td>History of the American People to 1877 (ACTS Equivalency = HIST 2113)</td>
<td>3</td>
</tr>
<tr>
<td>or HIST 2033</td>
<td>History of the American People, 1877 to Present</td>
<td>3</td>
</tr>
<tr>
<td>or PLSC 2003</td>
<td>American National Government (ACTS Equivalency = PLSC 2003)</td>
<td>3</td>
</tr>
<tr>
<td>ECON 2143</td>
<td>Basic Economics: Theory and Practice (ACTS Equivalency = ECON 2103)</td>
<td>3</td>
</tr>
<tr>
<td>or ECON 2033</td>
<td>Principles of Macroeconomics (ACTS Equivalency = ECON 2103)</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 3103</td>
<td>Ethics and the Professions</td>
<td>3</td>
</tr>
</tbody>
</table>

The remaining three courses must be selected from an approved list. The humanities and social sciences chart from the University Core (http://catalog.uark.edu/undergraduatecatalog/academicregulations/universitycore/) page should be used as a guide for selecting these courses.

### Mechanical Engineering Concentration Electives

The purpose of technical/science electives is to provide students with the opportunity to expand their education along lines of particular interest to them.

As part of the mechanical engineering curriculum, students are required to complete 12 hours of technical/science electives. These electives can be categorized into three groups: Mechanical Engineering Electives, Other Engineering Electives, and Science-Math Electives.

1. **Mechanical Engineering Electives.** All mechanical engineering courses at or above the 4000 level not already required in the BSME curriculum are acceptable. Special Project courses, MEEG 491V, are allowed as electives only after approval in advance by the department head.

2. **Other Engineering Electives.** The rules governing the selection of engineering electives are:

   Engineering or Computer Science/Computer Engineering courses at or above the 3000 level not already required in the BSME curriculum are allowed as technical-science electives. Courses with content remedial to required courses are not allowed, and courses considered redundant to required courses are not allowed.

3. **Science-Math Electives.** The approved list of science and math courses accepted as technical-science electives is available in the Mechanical Engineering department office.

### Mechanical Engineering B.S.M.E.

#### Eight-Semester Degree Program

The following section contains the list of courses required for the Bachelor of Science in Mechanical Engineering degree and a suggested sequence. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students interested in obtaining a sequencing schedule of courses may contact the Mechanical Engineering office.

Students wishing to follow the eight-semester degree plan should see the Eight-Semester Degree Policy (http://catalog.uark.edu/undergraduatecatalog/academicregulations/eightsemesterdegreecompletionpolicy/) in the Academic Regulations chapter for university requirements of the program.

Either the science elective in the second semester of Year 1 or the science elective in the first semester of Year 2 must include PHYS 2074. Other science electives should be chosen from an approved list. See the mechanical engineering office.

### First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ENGL 1013 Composition I (ACTS Equivalency = ENGL 1013)</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture)</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 2054 University Physics I (ACTS Equivalency = PHYS 2034)</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2554 Calculus I (ACTS Equivalency = MATH 2405)</td>
<td>4</td>
</tr>
<tr>
<td>GNEG 1111 Introduction to Engineering I</td>
<td>1</td>
</tr>
<tr>
<td>HIST 2003 History of the American People to 1877 (ACTS Equivalency = HIST 2113)</td>
<td>3</td>
</tr>
<tr>
<td>HIST 2033 History of the American People, 1877 to Present (ACTS Equivalency = HIST 2123)</td>
<td>3</td>
</tr>
<tr>
<td>GNEG 1121 Introduction to Engineering II</td>
<td>1</td>
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</tbody>
</table>

Select one of the following:

- HIST 2003 History of the American People to 1877 (ACTS Equivalency = HIST 2113)
- HIST 2033 History of the American People, 1877 to Present (ACTS Equivalency = HIST 2123)
- GNEG 1111 Introduction to Engineering I
- MATH 2564 Calculus II (ACTS Equivalency = MATH 2505)
- ENGL 1023 Composition II (ACTS Equivalency = ENGL 1023)

**Year Total:** 15

### Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>MEEG 2100</td>
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<tr>
<td>Science Elective (See Note Above)</td>
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</tbody>
</table>

**Year Total:** 15
Mechanical Engineering (MEEG)

MATH 2574 Calculus III (ACTS Equivalency = MATH 2603) 4
MEEG 2303 Introduction to Materials 3
MEEG 2003 Statics 3
MATH 2584 Elementary Differential Equations 4
MEEG 2013 Dynamics 3
MEEG 2403 Thermodynamics 3
MEEG 2703 Computer Methods in Mechanical Engineering 3
MEEG 2103 Introduction to Machine Analysis 3
Year Total: 14 16

Third Year

Spring Fall
MEEG 3013 Mechanics of Materials 3
MEEG 3113 Fundamentals of Vibrations 3
MEEG 3202L Mechanical Engineering Laboratory I 2
MEEG 3503 Mechanics of Fluids 3
ELEG 3903 Electric Circuits and Machines 3
ECON 2013 Principles of Macroeconomics (ACTS Equivalency = ECON 2103) 3
or ECON 2143 Basic Economics: Theory and Practice 3
MEEG 3212L Mechanical Engineering Laboratory II 2
MEEG 4413 Heat Transfer 3
MEEG 4104 4
ELEG 3933 Circuits & Electronics 3
Technical/Science Elective 3
PHIL 3103 Ethics and the Professions 3
Year Total: 17 18

Fourth Year

Fall Spring
MEEG 4132 Professional Engineering Practices 2
MEEG 4182 Creative Project Design I 2
MEEG 4202L Mechanical Engineering Laboratory III 2
MEEG 4483 Thermal Systems Analysis and Design 3
Technical/Science Elective 3
Fine Arts Elective (from University/State Core List) 3
MEEG 4192 Creative Project Design II 2
Two Technical/Science Elective 6
Two Social Science Elective (from University/State Core List) 6
Year Total: 15 14

Total Units in Sequence: 124

B.S. in Mechanical Engineering with Aerospace Concentration

Requirements for the B.S.M.E.: The Bachelor of Science in Mechanical Engineering curriculum includes, in addition to the required 18 hours of history, government, fine arts/humanities/social science elective courses, a total of 12 hours of technical and science electives. A student must select all electives with the approval of his or her adviser. The fine arts/humanities/social science electives must be selected from the University Core (http://catalog.uark.edu/undergradutecatalog/academicregulations/universitycore/) in the Academic Regulations chapter for university requirements for the program. It is expected that technical and science electives will be chosen to provide a coherent program within one or more areas of specialization or options available to mechanical engineers. Traditional areas of specialization are available in mechanical systems, materials, and energy systems. Other areas include pre-medical, management, and aerospace.

The first-year curriculum is essentially the same as prescribed for all engineering freshmen. Students entering the mechanical engineering program are required to take two, four hour laboratory based science electives. One of the four hour science electives must be PHYS 2074. The other four hour science elective must be chosen from one of the following:

- ASTR 2003 & ASTR 2001L Survey of the Universe (ACTS Equivalency = PHSC 1204 Lecture and Survey of the Universe Laboratory (ACTS Equivalency = PHSC 1204 Lab) 4
- BIOL 1543 & BIOL 1541L Principles of Biology (ACTS Equivalency = BIOL 1014 Lecture and Principles of Biology Laboratory (ACTS Equivalency = BIOL 1014 Lab) 4
- BIOL 2213 & BIOL 2211L Human Physiology (ACTS Equivalency = BIOL 2414 Lecture and Human Physiology Laboratory (ACTS Equivalency = BIOL 2414 Lab) 4
- CHEM 1103 & CHEM 1101L University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture and University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab) 4
- GEOS 1113 & GEOS 1111L Physical Geology (ACTS Equivalency = GEOL 1114 Lecture and Physical Geology Laboratory (ACTS Equivalency = GEOL 1114 Lab) 4
- PHYS 2094 University Physics III 4
- PHYS 3544 Optics 4
- PHYS 3603 & PHYS 360VL Introduction to Modern Physics and Modern Physics Laboratory 4

Fine Arts/Humanities/Social Science Electives

Students must follow the University Core curriculum in selecting their history, government, fine arts, humanities, and social science electives. Each student in the College of Engineering is required to complete 18 semester hours in the humanities and social sciences.

The courses taken must include:

- HIST 2003 History of the American People to 1877 (ACTS Equivalency = HIST 2113) 3
or HIST 2013 History of the American People, 1877 to Present (ACTS Equivalency = HIST 2123)
- ECON 2143 Basic Economics: Theory and Practice 3
Mechanical Engineering (MEEG) or ECON 2013  Principles of Macroeconomics (ACTS Equivalency = ECON 2103)

PHIL 3103  Ethics and the Professions  3

The remaining three courses must be selected from an approved list. The humanities and social sciences chart from the University Core (http://catalog.uark.edu/undergraduatecatalog/academicregulations/universitycore/) page should be used as a guide for selecting these courses.

Requirements for Aerospace Concentration: The Aerospace Concentration in Mechanical Engineering provides students an opportunity to concentrate on engineering and scientific issues associated with aircraft, spacecraft, and space exploration. The Aerospace Concentration consists of the 112-credit hour Mechanical Engineering B.S. core and 12 hours of specified elective courses.

Choose at least two of the following courses:

- MEEG 4503  Introduction to Flight
- MEEG 4523  Astronautics
- MEEG 4433  Aerospace Propulsion
- MEEG 5503  Advanced Fluid Dynamics I
- MEEG 5533  Fundamentals of Aerodynamics

Choose an additional 6 hours from any of the above courses not yet taken or any following technical elective:

- MEEG 4903H  Honors Mechanical Engineering Research
- MEEG 491V  Special Topics in Mechanical Engineering
- MEEG 492V  Individual Study in Mechanical Engineering
- MEEG 5473  Radiation Heat Transfer
- ASTR 4033  Astrophysics I: Stars and Planetary Systems
- ASTR 4043  Astrophysics II: Galaxies and the Large-Scale Universe
- GEOS 3213  Principles of Remote Sensing
- SPAC 5033  Astrophysics I: Stars and Planetary Systems

B.S.M.E. with Aerospace Concentration

Eight-Semester Plan

First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 1013 Composition I (ACTS Equivalency = ENGL 1013)</td>
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<td></td>
</tr>
<tr>
<td>CHEM 1103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHYS 2054 University Physics I (ACTS Equivalency = PHYS 2034)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MATH 2554 Calculus I (ACTS Equivalency = MATH 2405)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>GNEG 1111 Introduction to Engineering I</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Select one of the following:

- HIST 2003 History of the American People to 1877 (ACTS Equivalency = HIST 2113)
- HIST 2013 History of the American People, 1877 to Present (ACTS Equivalency = HIST 2123)
- GNEG 1121 Introduction to Engineering II

Year Total: 15  15

Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 2574 Calculus III (ACTS Equivalency = MATH 2603)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>PHYS 2074 University Physics II (ACTS Equivalency = PHYS 2044 Lecture)</td>
<td>4</td>
<td></td>
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<tr>
<td>MEEG 2003 Statics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEEG 2101 Computer-aided Design</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MEEG 2303 Introduction to Materials</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH 2584 Elementary Differential Equations</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MEEG 2013 Dynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEEG 2103 Introduction to Machine Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEEG 2403 Thermodynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEEG 2703 Computer Methods in Mechanical Engineering</td>
<td>3</td>
<td></td>
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</table>

Year Total: 15  16

Third Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>ELEG 3903 Electric Circuits and Machines</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ECON 2013 Principles of Macroeconomics (ACTS Equivalency = ECON 2103) or ECON 2143 Basic Economics: Theory and Practice</td>
<td>3</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Units</td>
</tr>
<tr>
<td>-------------</td>
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<td>-------</td>
</tr>
<tr>
<td>MEEG 3013</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 3113</td>
<td>Fundamentals of Vibrations</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 3202L</td>
<td>Mechanical Engineering Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>MEEG 3503</td>
<td>Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>ELEG 3933</td>
<td>Circuits &amp; Electronics</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 3103</td>
<td>Ethics and the Professions</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 3212L</td>
<td>Mechanical Engineering Laboratory II</td>
<td>2</td>
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<tr>
<td>MEEG 4103</td>
<td>Machine Element Design</td>
<td>3</td>
</tr>
<tr>
<td>MEEG 4413</td>
<td>Heat Transfer</td>
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<tr>
<td>Aerospace Technical Science Elective</td>
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**Year Total:** 17

### Fourth Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>MEEG 4182</td>
<td>Creative Project Design I</td>
<td>2</td>
</tr>
<tr>
<td>MEEG 4132</td>
<td>Professional Engineering Practices</td>
<td>2</td>
</tr>
<tr>
<td>MEEG 4202L</td>
<td>Mechanical Engineering Laboratory III</td>
<td>2</td>
</tr>
<tr>
<td>MEEG 4483</td>
<td>Thermal Systems Analysis and Design</td>
<td>3</td>
</tr>
<tr>
<td>Fine Arts Elective (from University Core List)</td>
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<td>3</td>
</tr>
<tr>
<td>Aerospace Technical Science Elective</td>
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<td>3</td>
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<tr>
<td>MEEG 4192</td>
<td>Creative Project Design II</td>
<td>2</td>
</tr>
<tr>
<td>Social Science Elective (from University Core List)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Social Science Elective (from University Core List)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Technical Science Elective</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Technical Science Elective</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

**Year Total:** 15

**Total Units in Sequence:** 124

**Courses**

**MEEG 2003. Statics. 3 Hours.**
Equilibrium and analysis of force systems in a plane and in space; analysis of structures, friction, centroids, moments of inertia, and virtual work method. Methods of analysis are emphasized. Corequisite: Drill component. Prerequisite: MATH 2574 or MATH 2574C. Prerequisite: PHYS 2054. (Typically offered: Fall, Spring and Summer)

**MEEG 2003H. Honors Statics. 3 Hours.**
Equilibrium and analysis of force systems in a plane and in space; analysis of structures, friction, centroids, moments of inertia, and virtual work method. Methods of analysis are emphasized. Corequisite: Drill component. Prerequisite: MATH 2574 or MATH 2574C. Prerequisite: PHYS 2054 and honors standing. (Typically offered: Fall, Spring and Summer)

**MEEG 2010. Computer-aided Design. 1 Hour.**
The concept and application of solid-modeling, based on SolidWorks Computer-Aided Design (CAD) software suite, are introduced in this course. They include sketches, parts modeling, assembly of parts, and drawing documentation. Prerequisite: GNEG 1103 or GNEG 1121H or GNEG 1103. (Typically offered: Fall and Spring)

**MEEG 2013. Dynamics. 3 Hours.**
Kinematics and kinetics of particle and of rigid bodies; work and energy; impulse and momentum, and special topics. Corequisite: Drill component. Prerequisite: MEEG 2003 and MATH 2574. (Typically offered: Fall, Spring and Summer)

**MEEG 2101. Introduction to Machine Analysis. 3 Hours.**
Introduction to kinematics and kinetics of mechanisms, static and dynamic forces, gears and cam design and analysis. Recitation three hours per week and drill one hour per week. Corequisite: Drill component. Prerequisite: PHYS 2054 and MEEG 2101. (Typically offered: Fall and Spring)

**MEEG 2300. Introduction to Materials. 3 Hours.**
A study of chemical, physical, and electrical properties of materials using fundamental atomistic approach. The materials of interest are: metals, polymers, ceramics, and composites. The interactive relationship between structure, properties, and processing of materials will be emphasized. For various engineering applications. Corequisite: Drill component. Prerequisite: MATH 2554, PHYS 2054 and CHEM 1103. (Typically offered: Fall and Spring)
MEEG 2403. Thermodynamics. 3 Hours.
A study of the 1st and 2nd laws of thermodynamics. Availability of energy, properties of liquids, gases, and vapors; nonflow and flow processes. Recitation 3 hours, drill 2 hours per week. Corequisite: Drill component. Prerequisite: PHYS 2054 and MATH 2564. (Typically offered: Fall, Spring and Summer)

MEEG 2703. Computer Methods in Mechanical Engineering. 3 Hours.
Use of computers and programming for solving engineering problems. Basic numerical methods including errors, equation solution, matrices, optimization, regression, integration, and differential equations. Corequisite: Drill component. Pre- or Corequisite: MATH 2584. (Typically offered: Spring and Summer)

MEEG 3013. Mechanics of Materials. 3 Hours.
Stress and deformation of members in tension, compression, torsion, and bending, and the design of these members. Columns, statically indeterminate beams, and simple connections. Corequisite: Drill component. Prerequisite: MEEG 2003. (Typically offered: Fall, Spring and Summer)

MEEG 3013H. Honors Mechanics of Materials. 3 Hours.
Stress and deformation of members in tension, compression, torsion, and bending, and the design of these members. Columns, statically indeterminate beams, and simple connections. Corequisite: Drill component. Prerequisite: MEEG 2003 and honors standing. (Typically offered: Fall, Spring and Summer)

This course is equivalent to MEEG 3013.

MEEG 3113. Fundamentals of Vibrations. 3 Hours.
Time and frequency domain mathematical techniques for linear system vibrations are reviewed. Undamped system and viscously damped systems are analyzed. Equations of motion of single and multiple degrees-of-freedom systems are studied. Vibration of multi-degrees-of-freedom systems are analyzed using modal analysis and modal summation methods. Eigenvalue problems as related vibrations are studied. Corequisite: Drill component. Prerequisite: MEEG 2103, MATH 2584 or MATH 2584C, MEEG 2703, and MEEG 2013. (Typically offered: Fall and Spring)

MEEG 3202L. Mechanical Engineering Laboratory I. 2 Hours.
Introduction to measurement, uncertainty, data acquisition, and instrumentation with an emphasis in materials and manufacturing. Corequisite: Drill component. Pre- or Corequisite: MEEG 3013 and ELEG 3903. Prerequisite: MEEG 2303 and PHYS 2074. (Typically offered: Fall and Spring)

MEEG 3212L. Mechanical Engineering Laboratory II. 2 Hours.
Design and implementation of measurements, fabrication processes, data acquisition, and data analysis with emphasis in mechanical and fluid systems. Corequisite: Drill component. Prerequisite: MEEG 3202L, MEEG 3503 and MEEG 3113. (Typically offered: Fall and Spring)

MEEG 3223. Introduction to Mechatronics. 3 Hours.
This course is an introduction to design and control the mechatronic system, which requires integration of the mechanical and electrical knowledge within a unified framework. The topics covered in this course include basic electronics, diodes, transistors, power amplifiers, digital logic, operation amplifier, motor design, encoder, and programming in Arduino. Prerequisite: MEEG 3202L. (Typically offered: Spring)

MEEG 3503. Mechanics of Fluids. 3 Hours.
A study of fluids including fluid properties, pressure, and flow fields utilizing conservation of mass, energy, and momentum principles. Prerequisite: MEEG 2403 or CHEG 2313. Pre- or Corequisite: MATH 2584. (Typically offered: Fall and Summer)

MEEG 4003. Intermediate Dynamics. 3 Hours.
Review of central-force motion of spacecraft, use of rotating reference frames, Coriolis acceleration. Kinematics of rigid bodies in 3-D space: velocities and accelerations in different moving reference frames, addition theorem of angular accelerations. Kinetics of rigid bodies in 3-D space: eigenvalues and eigenvectors of inertia matrices, momentum and kinetic energy of a rigid body in 3-D motion, Euler's equations of motion; precession, nutation, and spin of a gyroscope; forced steady precession, torque free steady precession, space cone, and body cone. Prerequisite: MEEG 2013. (Typically offered: Irregular)

MEEG 4023. Composite Materials: Analysis and Design. 3 Hours.
A study of fibrous composite materials with emphasis on mechanical behavior, synthesis, and application. Topics include macro- and micromechanical analysis lamina, lamina theory, failure analysis in design, and manufacturing techniques. Prerequisite: MEEG 3013. (Typically offered: Irregular)

MEEG 4103. Machine Design. 3 Hours.
This course introduces the static failure theories and fatigue failure theories, and how each of the theories can be applied in practical engineering problems in supporting the selection and design of machine elements. This course also introduces key design concepts, design principles, design process, and design guidelines for four commonly-used machine elements: spring, gear, bearing and shaft. Pre- or Corequisite: MEEG 3113. Prerequisite: MEEG 3013. (Typically offered: Fall, Spring and Summer)

MEEG 4103H. Honors Machine Design. 3 Hours.
This course introduces the static failure theories and fatigue failure theories, and how each of the theories can be applied in practical engineering problems in supporting the selection and design of machine elements. This course also introduces key design concepts, design principles, design process, and design guidelines for four commonly-used machine elements: spring, gear, bearing and shaft. Advanced project required of honors students. Advanced project required. (Typically offered: Fall, Spring and Summer)

This course is equivalent to MEEG 4103.

MEEG 4123. Finite Element Methods I. 3 Hours.
Introduction to the use of the finite element method in mechanical engineering analysis and design. Use of commercial software to solve thermal and mechanical problems. Pre- or Corequisite: MEEG 3013 and MEEG 4413. (Typically offered: Irregular)

MEEG 4132. Professional Engineering Practices. 2 Hours.
Design proposal preparation, design codes, professional ethics, engineering economics, and the role of the engineer in society. Pre- or Corequisite: MEEG 4103 or MEEG 4483. (Typically offered: Fall and Spring)

MEEG 4143. Design for Safety. 3 Hours.
This course provides an overview of safety engineering and a framework from which the students can evaluate and develop mechanical and thermal systems from a safety perspective. Pre- or Corequisite: MEEG 4413. Prerequisite: MEEG 3013. (Typically offered: Irregular)

MEEG 4153. Fundamentals of Mechanical Design. 3 Hours.
This class is designed to provide engineering students with a head start in industry as design engineers or working in an engineering related function. The course contents cover machine design and analysis experiences as related to working in industry and performing consulting work. Major topics include the design process, design procedures, fasteners, general design and numerous consulting experiences. A concept design exercise and two special design projects will be assigned to the students as homework. Prerequisite: MEEG 4103. (Typically offered: Fall)
MEEG 4173. Model-Based Systems Design and Analysis. 3 Hours.
This course provides students with an introduction into the two main approaches to understanding and designing complex engineered systems. First, the course covers the unique technical challenges of systems engineering and design of systems. Second, the course covers concepts, methods and tools related to 'model-based systems design.' This course formalizes the information content of complex systems. The third portion of the course will focus on modeling the complex behavior of the system. This is often described as dynamical systems modeling. Students will utilize the methods and tools presented in class to model a complex engineered system of their choice (with instructor approval). The classes will alternate between presenting modeling methods to the students and students demonstrating their system to the class utilizing those methods. Students may not receive credit for both MEEG 4173 and MEEG 5173. Prerequisite: MEEG 4103 or Instructor consent. (Typically offered: Spring Even Years)

MEEG 4182. Creative Project Design I. 2 Hours.
Students will select a capstone design project, and each student group will prepare a formal written proposal on their project for presentation to a panel of judges. This group project will be carried to completion in MEEG 4192. Corequisite: MEEG 4483. Prerequisite: MEEG 4103. (Typically offered: Fall and Spring)

MEEG 4192. Creative Project Design II. 2 Hours.
Student groups will present their final capstone design proposal to a faculty panel and then carry out their project to completion. Each student group will make timely progress reports, complete their design project, and present their final report to a panel of judges. Prerequisite: MEEG 4182. (Typically offered: Fall and Spring)

MEEG 4202L. Mechanical Engineering Laboratory III. 2 Hours.
Application of measurement techniques to mechanical engineering problems which emphasize mechanical and thermal systems. Corequisite: Drill component. Pre- or corequisite: MEEG 4483. Prerequisite: MEEG 3212L and MEEG 4103. (Typically offered: Fall, Spring and Summer)

MEEG 4213. Control of Mechanical Systems. 3 Hours.
Mathematical modeling for feedback control of dynamic mechanical systems with design techniques using LaPlace transforms, state variables, root locus, frequency analysis, and criteria for performance and stability. Prerequisite: MEEG 3113. (Typically offered: Irregular)

MEEG 4233. Microprocessors in Mechanical Engineering I: Electromechanical Systems. 3 Hours.
Microcomputer architectural, programming, and interfacing. Smart product design (microprocessor-based design). Control of DC and stepper motors and interfacing to sensors. Applications to robotics and real-time control. Mobile robot project. Digital and analog electronics are reviewed where required. Prerequisite: ELEG 3903. (Typically offered: Irregular)

MEEG 4253. Introduction to Robotics. 3 Hours.
This course serves as an introduction to robotics. The course covers the historical development of robotics as a field, and as mechatronic systems, the importance of integrating sensors, actuators and end-effectors. Topics covered in this course will include but not limited to the following: mathematical modeling of robots, rigid motions and homogeneous transformation, forward/inverse kinematics, and velocity kinematics. Prerequisite: MEEG 2703, MEEG 3113 and instructor consent. (Typically offered: Fall)

MEEG 4303. Materials Laboratory. 3 Hours.
A study of properties, uses, testing, and heat treatment of basic engineering materials and related analytical techniques. Corequisite: Lab component. Prerequisite: MEEG 2303. (Typically offered: Irregular)

MEEG 4313. Introduction to Tribology. 3 Hours.
A study of science and technology of interacting surfaces in relative motion. Topics include solid surface characterization, contact between solid surfaces, adhesion, friction, wear, lubrication, micro/nanotribology, friction and wear screening test methods, and tribological components and applications. Prerequisite: MEEG 3013 and MEEG 3503 or graduate standing. (Typically offered: Irregular)

MEEG 4323L. Nanotechnology Laboratory. 3 Hours.
Provides students with hands-on experience in several major areas of nanotechnology, including nanoscale imaging, synthesis of nanomaterials, nanostructure assembly and manipulation, device and system integration, and performance evaluation. Students can earn credit for only one of the following courses: MEEG 4323L, BENG 4753L, BMEG 4103L, CHEM 4153L, PHYS 4793L. Corequisite: Drill component, junior standing and instructor consent. Prerequisite: MATH 2564 and PHYS 2074. (Typically offered: Fall)
This course is cross-listed with CHEM 4153L, PHYS 4793L.

MEEG 4323M. Honors Nanotechnology Laboratory. 3 Hours.
Provides students with hands-on experience in several major areas of nanotechnology, including nanoscale imaging, synthesis of nanomaterials, nanostructure assembly and manipulation, device and system integration, and performance evaluation. Students can earn credit for only one of the following courses: MEEG 4323L, BENG 4753L, BMEG 4103L, CHEM 4153L, PHYS 4793L. Corequisite: Drill component, junior standing and instructor consent. Prerequisite: MATH 2564 and PHYS 2074. (Typically offered: Fall)

MEEG 4333. Hybrid Electric Vehicles. 3 Hours.
This course is intended to provide an introduction to basics of hybrid and pure electrical vehicles (mainly passenger cars), covering history, architecture, constituents, working mechanisms, and key technologies. The course focuses on fundamental concepts of different hybrid electrical vehicles (HEVs) and their technical features and highlights the successes of the state-of-the-art pure electrical vehicles (EVs). In addition, this course will introduce various battery technologies used for electrical vehicles, covering traditional batteries, lithium-ion batteries, and batteries beyond lithium-ions. It is appropriate for engineering and natural science students interested in obtaining basic knowledge of hybrid and pure electrical vehicles to prepare for a career in developing alternate energy sources. Prerequisite: ELEG 3903 or BENG 3113, and senior standing. (Typically offered: Spring)

MEEG 4413. Heat Transfer. 3 Hours.
Basic thermal energy transport processes; conduction, convection, and radiation; and the mathematical analysis of systems involving these processes in both steady and time-dependent cases. Prerequisite: MEEG 3503. (Typically offered: Spring and Summer)

MEEG 4423. Power Generation. 3 Hours.
Study of design and operational aspects of steam, gas, and combined cycle power plants. Brief study of Nuclear and Alternative energy systems. Prerequisite: MEEG 3503. (Typically offered: Irregular)

MEEG 4433. Aerospace Propulsion. 3 Hours.
Principles, operation, and characteristics of gas turbine and rocket engines. Brief study of novel spacecraft propulsion systems. Prerequisite: MEEG 3503. (Typically offered: Irregular)

MEEG 4453. Industrial Waste and Energy Management. 3 Hours.
Applications of thermodynamics, heat transfer, fluid mechanics, and electric machinery to the analysis of waste streams and energy consumption for industrial facilities. Current techniques and technologies for waste minimization and energy conservation including energy-consuming systems and processes, utility rate analysis, economic analysis and auditing are taught. Prerequisite: MEEG 4413. (Typically offered: Irregular)
MEEG 4473. Indoor Environmental Control. 3 Hours.
Gives student a thorough understanding of the fundamental theory of air conditioning design for commercial buildings, including calculating heating and cooling loads along with the proper selection and sizing of air conditioning equipment. Prerequisite: MEEG 4413. (Typically offered: Irregular)

MEEG 4483. Thermal Systems Analysis and Design. 3 Hours.
Analysis design and optimization of thermal systems and components with examples from such areas as power generation, refrigeration, and propulsion. Availability loss characteristics of energy systems and availability conservation methods. Prerequisite: MEEG 4413. (Typically offered: Fall and Summer)

MEEG 4483H. Honors Thermal Systems Analysis and Design. 3 Hours.
Analysis design and optimization of thermal systems and components with examples from such areas as power generation, refrigeration, and propulsion. Availability loss characteristics of energy systems and availability conservation methods. Additional topics, with an additional design project and /or more rigorous approach to design projects for honors course. Advanced project required. Prerequisite: MEEG 4413 (Typically offered: Fall and Summer)
This course is equivalent to MEEG 4483.

MEEG 4493. Internal Combustion Engines. 3 Hours.
Study of the design of internal combustion engines, including emissions and performance issues. Pre- or Corequisite: MEEG 3503. (Typically offered: Irregular)

MEEG 4503. Introduction to Flight. 3 Hours.
The course will provide understanding in basic aerodynamics, airfoil design and characteristics, and flight control surfaces. Prerequisite: MATH 2584, MEEG 3503. (Typically offered: Fall)

MEEG 4503H. Honors Introduction to Flight. 3 Hours.
The course will provide understanding in basic aerodynamics, airfoil design and characteristics, and flight control surfaces. Prerequisite: MATH 2584 and MEEG 3503. (Typically offered: Fall)
This course is equivalent to MEEG 4503.

MEEG 4523. Astronautics. 3 Hours.
Study of spacecraft design and operations. Prerequisite: MEEG 2013 and MEEG 2403 or consent of instructor. (Typically offered: Irregular)

MEEG 4633. Additive Manufacturing. 3 Hours.
This course provides an overview of developing opportunities and critical challenges of additive manufacturing (AM, also known as 3-D printing). It covers existing and emerging additive manufacturing processes in the context of product design, materials selection and processing, and industrial and consumer applications. Students will learn to take advantage of the new capabilities of additive manufacturing technologies (e.g., design freedom) for existing and new applications and the implementation of their designs in a laboratory through project-based learning. Students may not receive credit for both MEEG 4633 and MEEG 5633. Prerequisite: MEEG 2101, MEEG 2303, MEEG 3013, and MEEG 3503 or instructor consent. (Typically offered: Spring)

MEEG 4703. Mathematical Methods in Engineering. 3 Hours.
Determinants, matrices, inverse of a matrix, simultaneous equations, eigenvalues, eigenvectors, coordinate transformations for matrices, diagonalization, square roots of a matrix, cryptography, and method of least squares. Vector algebra and calculus, Green's theorem, Stokes' theorem, and Gauss' divergence theorem. Index notation, epsilon-delta identity, and Cartesian tensors. Curvilinear coordinates, base vectors, and covariant and contravariant tensors. Applications to mechanics. Prerequisite: MATH 2574. (Typically offered: Irregular)

MEEG 4903H. Honors Mechanical Engineering Research. 3 Hours.
Independent research for mechanical engineering honors students. Prerequisite: Honors standing and instructor consent. (Typically offered: Fall and Spring)

MEEG 491V. Special Topics in Mechanical Engineering. 1-6 Hour.
Consideration of current mechanical engineering topics not covered in other courses. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

MEEG 491VH. Honors Special Topics in Mechanical Engineering. 1-6 Hour.
Consideration of current mechanical engineering topics not covered in other courses. Prerequisite: Honors standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

MEEG 492V. Individual Study in Mechanical Engineering. 1-3 Hour.
Individual study and research on a topic of mutually agreeable interest to the student and a faculty member. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer)

MEEG 492VH. Honors Individual Study in Mechanical Engineering. 1-3 Hour.
Individual study and research on a topic of mutually agreeable interest to the student and a faculty member. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer)
This course is equivalent to MEEG 492V.