ENGINEERING MECHANICS, BS

for the degree of Bachelor of Science in Engineering Mechanics

department website: http://mechse.illinois.edu/
department faculty: Mechanical Science & Engineering Faculty (https://mechse.illinois.edu/people)
overview of college admissions & requirements: The Grainger College of Engineering (https://grainger.illinois.edu/admissions)
college website: https://grainger.illinois.edu/

Engineering mechanics is a discipline devoted to the solution of engineering and mechanics problems through integrated application of mathematical, scientific, and engineering principles. Special emphasis is placed on the physical principles underlying modern engineering design.

In this program (accredited by the Engineering Accreditation Commission of ABET, www.abet.org), students in engineering mechanics develop a strong foundation in mathematics, physics, and chemistry. The program derives its strength from a rigorous curriculum composed of statics, dynamics, solid mechanics, fluid mechanics, and mechanics of materials courses. These topics form the basis of all engineering disciplines and have wide applicability in modern engineering. Special emphasis is placed on advanced dynamics, continuum mechanics, and the rapidly emerging field of computational mechanics. Laboratory experiments in fluid mechanics and mechanics of materials complement an integrated design sequence, which starts freshman year. Engineering design, communication, teamwork, and laboratory experiences are integrated throughout the entire curriculum. Students also have the opportunity for independent, creative work in a one-on-one or small group environment under the supervision of a faculty member.

Students in engineering mechanics also benefit from a built-in area of specialization in one of seven secondary fields within mechanics, such as biomechanics, experimental mechanics, mechanics of materials and more. Alternatively, students may fashion their own area of specialization with departmental approval. At the end of the curriculum, students take the capstone senior design course where the knowledge and skills they have learned are applied to projects submitted to the department by corporate or faculty sponsors, preparing Engineering Mechanics students for their next leap into industry or graduate school.

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Orientation and Professional Development

These courses introduce the opportunities and resources your college, department, and curriculum can offer you as you work to achieve your career goals. They also provide the skills to work effectively and successfully in the engineering profession.

Code | Title | Hours
---|---|---
ENG 100 | Engineering Orientation ¹ | 0
TAM 195 | Mechanics in the Modern World | 1
ME 290 | Seminar | 0
Total Hours | | 1

¹ External transfer students take ENG 300 instead.

Foundational Mathematics and Science

These courses stress the basic mathematical and scientific principles upon which the engineering discipline is based.

Code | Title | Hours
---|---|---
CHEM 102 | General Chemistry I | 3
CHEM 103 | General Chemistry Lab I | 1
CHEM 104 | General Chemistry II | 3
CHEM 105 | General Chemistry Lab II | 1
MATH 221 | Calculus I ¹ | 4
MATH 231 | Calculus II | 3
MATH 241 | Calculus III | 4
MATH 415 | Applied Linear Algebra | 3
MATH 441 | Differential Equations | 3
MATH 442 | Intro Partial Diff Equations | 3
PHYS 211 | University Physics: Mechanics | 4
PHYS 212 | University Physics: Elec & Mag | 4
PHYS 213 | Univ Physics: Thermal Physics | 2
PHYS 214 | Univ Physics: Quantum Physics | 2
Total Hours | | 40

¹ MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

Engineering Mechanics Technical Core

These courses stress fundamental concepts and basic laboratory techniques that comprise the common intellectual understanding of engineering mechanics.

Code | Title | Hours
---|---|---
CS 101 | Intro Computing: Engrg & Sci | 3
ECE 205 | Electrical and Electronic Circuits | 3
ME 170 | Computer-Aided Design | 3
ME 200 | Thermodynamics | 3
ME 470 | Senior Design Project | 3
TAM 211 | Statics | 3
TAM 212 | Introductory Dynamics | 3
TAM 251 | Introductory Solid Mechanics | 3
TAM 252 | Solid Mechanics Design | 1
TAM 270 | Design for Manufacturability | 3
TAM 324 | Behavior of Materials | 4

Information listed in this catalog is current as of 08/2019
Secondary Field Option Electives

This component of the curriculum enables the student to specialize further by electing a secondary field, a coherent group of technical courses in mechanics and closely related subjects. The current secondary fields are:

- Biomechanics
- Computational Mechanics
- Engineering Science and Applied Mathematics
- Experimental Mechanics
- Fluid Mechanics
- Mechanics of Materials
- Solid Mechanics

Each secondary field generally specifies two required courses and two additional courses from a list of approved elective courses. For each of the secondary fields, the required and approved elective courses specified for each are listed below. To add flexibility to the program and to accommodate particular interests, the student may petition to substitute appropriate courses, including 500-level courses if the student has the adequate preparation, for any of the secondary field elective courses. Without petition, a student may select any one course listed as required in one of the secondary field options to satisfy elective course credits in a chosen secondary field.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAM 335</td>
<td>Introductory Fluid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>TAM 412</td>
<td>Intermediate Dynamics</td>
<td>4</td>
</tr>
<tr>
<td>TAM 445</td>
<td>Continuum Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>TAM 470</td>
<td>Computational Mechanics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Hours</strong></td>
<td><strong>47</strong></td>
</tr>
</tbody>
</table>

**Secondary Field electives selected from departmentally approved courses for Secondary Field Options.**

### Biomechanics

**Required Courses**
- MCB 150  Molec & Cellular Basis of Life  4
- MCB 151  Molec & Cellular Laboratory  1
- TAM 461  Cellular Biomechanics  4

**Approved Courses**
- ECE 473  Fund of Engrg Acoustics  3 or 4
- ECE 380  Biomedical Imaging  3
- ME 481  Whole-Body Musculoskel Biomech  3 or 4
- ME 482  Musculoskel Tissue Mechanics  3 or 4
- ME 483  Mechanobiology  4
- BIOP 401  Introduction to Biophysics  3
- TAM 499  Senior Thesis  3

### Computational Mechanics

**Required Courses**
- CS 357  Numerical Methods I  3
- ME 471  Finite Element Analysis  3 or 4

**Approved Courses**
- CS 450  Numerical Analysis  3 or 4
- CS 457  Numerical Methods II  3
- ME 412  Numerical Thermo-Fluid Mechs  2 to 4
- TAM 499  Senior Thesis  3

### Engineering Science and Applied Mathematics

**Required Courses**
- MATH 446  Applied Complex Variables  3 or 4
- MATH 448  Complex Variables (Or Any 400 level MATH course, excluding MATH 415, MATH 441, and MATH 442)  3 or 4

**Approved Courses**
- AE 353  Aerospace Control Systems  3
- AE 402  Orbital Mechanics  3 or 4
- CEE 491  Decision and Risk Analysis  3 or 4
- CEE 329  Fields and Waves I  3
- CEE 330  Power Ckts & Electromechanics  3
- ECE 473  Fund of Engrg Acoustics  3 or 4
- MATH 423  Differential Geometry  3 or 4
- MATH 447  Real Variables  3 or 4
- MATH 482  Linear Programming  3 or 4
- MATH 484  Nonlinear Programming  3 or 4
- MATH 489  Dynamics & Differential Eqns  3 or 4
- MATH 490  Advanced Topics in Mathematics  1 to 4
- PHYS 402  Light  3 or 4
- STAT 400  Statistics and Probability I  4
- STAT 410  Statistics and Probability II  3 or 4
- TAM 499  Senior Thesis  3

### Fluid Mechanics

**Required Courses**
- TAM 435  Intermediate Fluid Mechanics  4
- ME 410  Intermediate Gas Dynamics  3 or 4

**Approved Courses**
- AE 412  Viscous Flow & Heat Transfer  4
- CEE 445  Air Quality Modeling  4
- CEE 451  Environmental Fluid Mechanics  3
- CEE 453  Urban Hydrology and Hydraulics  4
- ECE 473  Fund of Engrg Acoustics  3 or 4
- ME 412  Numerical Thermo-Fluid Mechs  2 to 4
- TAM 499  Senior Thesis  3

### Mechanics of Materials

**Required Courses**
- TAM 424  Mechanics of Structural Metals  3 or 4
- TAM 427  Mechanics of Polymers  3
- TAM 428  Mechanics of Composites  3

**Approved Courses**
- CEE 310  Transportation Engineering  3

Information listed in this catalog is current as of 08/2019
MSE 401 Thermodynamics of Materials 3
MSE 489 Matl Select for Sustainability 3 or 4
NPRE 431 Materials in Nuclear Engrg 3
TAM 499 Senior Thesis 3

Solid Mechanics

Required Courses
TAM 424 Mechanics of Structural Metals 3 or 4
TAM 451 Intermediate Solid Mechanics 4

Approved Courses
CEE 360 Structural Engineering 3
CEE 460 Steel Structures I 3
CEE 461 Reinforced Concrete I 3
CS 357 Numerical Methods I 3
ECE 473 Fund of Engrg Acoustics 3 or 4
TAM 499 Senior Thesis 3

Liberal Education

The liberal education courses (https://wiki.cites.illinois.edu/wiki/display/ugadvise/Liberal+Education+Electives?src=search) develop students’ understanding of human culture and society, build skills of inquiry and critical thinking, and lay a foundation for civic engagement and lifelong learning.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electives from the campus General Education Social and Behavioral Sciences list.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Electives from the campus General Education Humanities and the Arts list.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Electives either from a list approved by the college, or from the campus General Education lists for Social and Behavioral Sciences or Humanities and the Arts.</td>
<td>6</td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

Students entering after the Spring 2018 semester must also complete the campus cultural studies requirement by completing (i) one western/comparative culture(s) course, (ii) one non-western course and (iii) one U.S. minority culture(s) course from the General Education cultural studies lists. Students entering prior to the Spring 2018 semester will need to complete requirements (i) and either (ii) or (iii). Most students select liberal education courses that simultaneously satisfy these cultural studies requirements. Courses from the western, non-western and U.S. minority culture(s) lists that fall into free electives or other categories may also be used satisfy the cultural studies requirements.

Composition

These courses teach fundamentals of expository writing.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHET 105</td>
<td>Writing and Research</td>
<td>4</td>
</tr>
<tr>
<td>Advanced Composition (satisfied by completing TAM 324 and ME 470 in the Engineering Mechanics Technical Core)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Hours</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Free Electives

These unrestricted electives, subject to certain exceptions as noted at the College of Engineering Advising Website (https://wiki.cites.illinois.edu/wiki/display/ugadvise/Degree+Requirements/#DegreeRequirements-FreeElectives), give the student the opportunity to explore any intellectual area of unique interest. This freedom plays a critical role in helping students to define research specialties or to complete minors.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free electives. Additional unrestricted course work, subject to certain exceptions as noted at the College of Engineering Advising Website, so that there are at least 128 credit hours earned toward the degree.</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

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Suggested Sequence

The schedule that follows is illustrative, showing the typical sequence in which courses would be taken by a student with no college course credit already earned and who intends to graduate in four years. Each individual's case may vary, but the position of required named courses is generally indicative of the order in which they should be taken.

First Year

First Semester

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAM 195</td>
<td>Mechanics in the Modern World</td>
<td>1</td>
</tr>
<tr>
<td>MATH 221</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 102</td>
<td>General Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 103</td>
<td>General Chemistry Lab I</td>
<td>1</td>
</tr>
<tr>
<td>ENG 170</td>
<td>Engineering Orientation</td>
<td>0</td>
</tr>
<tr>
<td>RHET 105</td>
<td>Writing and Research</td>
<td>4-3</td>
</tr>
<tr>
<td>or ME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student liberal education elective³</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total Semester Hours</td>
<td>16-15</td>
<td></td>
</tr>
</tbody>
</table>

Second Semester

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 211</td>
<td>University Physics: Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>MATH 231</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 104</td>
<td>General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 105</td>
<td>General Chemistry Lab II</td>
<td>1</td>
</tr>
<tr>
<td>ME 170</td>
<td>Computer-Aided Design</td>
<td>3-4</td>
</tr>
<tr>
<td>or RHET 105</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student liberal education elective³</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total Semester Hours</td>
<td>17-18</td>
<td></td>
</tr>
</tbody>
</table>

Second Year

First Semester

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 212</td>
<td>University Physics: Elec Mag</td>
<td>4</td>
</tr>
<tr>
<td>MATH 241</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>CS 101</td>
<td>Intro Computing: Engrg Sci</td>
<td>3</td>
</tr>
<tr>
<td>TAM 211</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>ME 290</td>
<td>Seminar</td>
<td>0</td>
</tr>
<tr>
<td>Student liberal education elective³</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total Semester Hours</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

Second Semester

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 213</td>
<td>Univ Phys: Thermal Physics</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 214</td>
<td>Univ Phys: Quantum Physics</td>
<td>2</td>
</tr>
<tr>
<td>TAM 212</td>
<td>Introductory Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>TAM 251</td>
<td>Introductory Solid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>TAM 252</td>
<td>Solid Mechanics Design</td>
<td>1</td>
</tr>
</tbody>
</table>
ECE 205  Electrical and Electronic Circuits  3
Liberal education elective\(^3\)  3

Semester Hours  17

**Third Year**

**First Semester**

ME 200  Thermodynamics  3
MATH 415  Applied Linear Algebra  3
ME 270  Design for Manufacturability  3
TAM 335  Introductory Fluid Mechanics  3
Free Elective  3

Semester Hours  15

**Second Semester**

TAM 324  Behavior of Materials  4
MATH 441  Differential Equations  3 or 4
TAM 412  Intermediate Dynamics  4
TAM 445  Continuum Mechanics  4

Semester Hours  15-16

**Fourth Year**

**First Semester**

ME 470 or Secondary Field Elective\(^4\)  4
SECONDARY FIELD ELECTIVE\(^4\)  3
MATH 442  Intro Partial Diff Equations  3 or 4
TAM 470  Computational Mechanics  3
Secondary field elective\(^4\)  3
Liberal education elective\(^3\)  3

Semester Hours  15-16

**Second Semester**

ME 470 or Secondary Field Elective\(^4\)  3
SECONDARY FIELD ELECTIVE\(^4\)  3
Secondary field elective\(^4\)  6
Liberal education elective\(^3\)  3
Free elective  3

Semester Hours  15

Total Hours:  127-129

\(^1\) MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

\(^2\) RHET 105 may be taken in the first or second semester of the first year as authorized. The alternative is ME 170.

\(^3\) Liberal education electives (https://wiki.illinois.edu/wiki/display/ugadvise/Degree+Requirements/#DegreeRequirements-LiberalEducationElectives) must include 6 hours of social & behavioral sciences and 6 hours of humanities & the arts course work from the campus General Education lists. The remaining 6 hours may be selected from a list maintained by the college, or additional course work from the campus General Education lists for social & behavioral sciences or humanities & the arts. Students must also complete the campus cultural studies requirement by completing (i) one western/comparative culture(s) course, (ii) one non-western culture(s) course, and (iii) one U.S. Minority Culture(s) course from the General Education cultural studies lists. Most students select liberal education courses that simultaneously satisfy these cultural studies requirements. Courses from the western, non-western, and U.S. Minority lists that fall into free electives or other categories may also be used satisfy the cultural studies requirements.

\(^4\) Selected from departmentally approved lists of Secondary Field Electives (http://mechanical.illinois.edu/undergraduate/bs-engineering-mechanics/#EMSecondaryFields).