ENGINEERING PHYSICS, B.S.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the Guide.

General Education

• Breadth—Humanities/Literature/Arts: 6 credits
• Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
• Breadth—Social Studies: 3 credits
• Communication Part A & Part B *
• Ethnic Studies *
• Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

SUMMARY OF REQUIREMENTS

The following curriculum applies to students who entered the program after fall 2018.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics and Statistics</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>Engineering Science</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Focus Area</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Technical Electives</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Communication Skills</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Liberal Studies</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Total Credits</td>
<td></td>
<td>130</td>
</tr>
</tbody>
</table>

MATH 221 or MATH 217 Calculus with Algebra and Trigonometry II
MATH 222 Calculus and Analytic Geometry 2

MATH 221 Calculus and Analytic Geometry I
or MATH 217
or MATH 275

MATH 234 Calculus—Functions of Several Variables
MATH 319 Techniques in Ordinary Differential Equations
MATH 321 Applied Mathematical Analysis
MATH 340 Elementary Matrix and Linear Algebra
or MATH 341 Linear Algebra
STAT 324 Introductory Statistics for Engineers
or STAT 311 Introduction to Theory and Methods of Mathematical Statistics I
or STAT/ MATH 431 Introduction to the Theory of Probability

SCIENCE

Select one of the following:
CHEM 109 Advanced General Chemistry
CHEM 103 and General Chemistry II
PHYSICS 202 General Physics
or PHYSICS 208 General Physics
PHYSICS 241 Introduction to Modern Physics
or PHYSICS 205 Modern Physics for Engineers
PHYSICS 322 Electromagnetic Fields
E P 271 Engineering Problem Solving I
or COMP SCI 200 Programming I
or COMP SCI 220 Data Science Programming I
or COMP SCI 310 Problem Solving Using Computers
M S & E 351 Materials Science—Structure and Property Relations in Solids
or CBE 440 Chemical Engineering Materials
N E 305 Fundamentals of Nuclear Engineering
or PHYSICS 531 Introduction to Quantum Mechanics

Comp Elective (select one)

Total Credits 25

ENGINEERING SCIENCE

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 224</td>
<td>Calculus—Functions of Several Variables</td>
<td>4</td>
</tr>
<tr>
<td>MATH 319</td>
<td>Techniques in Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 321</td>
<td>Applied Mathematical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MATH 340</td>
<td>Elementary Matrix and Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 341</td>
<td>Linear Algebra</td>
<td></td>
</tr>
<tr>
<td>STAT 324</td>
<td>Introductory Statistics for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 311</td>
<td>Introduction to Theory and Methods of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mathematical Statistics I</td>
<td></td>
</tr>
<tr>
<td>or STAT/</td>
<td>MATH 431 Introduction to the Theory of</td>
<td></td>
</tr>
<tr>
<td>MATH 431</td>
<td>Probability</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits 28-33

COMP SCI 300 Programming II
COMP SCI 412 Introduction to Numerical Methods (required for students in Scientific Computing Focus Area)
E P/E M A 471 Intermediate Problem Solving for Engineers
E P/E M A 476 Introduction to Scientific Computing for Engineering Physics

Total Credits 28-33
### Engineering Physics, B.S.

**PHYSICS 311**  
Mechanics  
3

or **E M A 202**  
Dynamics  
3

or **M E 240**  
Dynamics  
3

**E M A 303**  
Mechanics of Materials  
3

or **M E 306**  
Mechanics of Materials  
3

**E M A/M E 307**  
Mechanics of Materials Lab  
1

**M E 361**  
Thermodynamics  
3

or **M S & E 330**  
Thermodynamics of Materials  
3

**E C E 376**  
Electrical and Electronic Circuits  
3

or **PHYSICS 321**  
Electric Circuits and Electronics  
3

**M E 363**  
Fluid Dynamics  
3

**M E 364**  
Elementary Heat Transfer  
3

or **M S & E 331**  
Transport Phenomena in Materials  
3

**N E 231**  
Introduction to Nuclear Engineering  
1

**Total Credits**  
25

This requirement can also be satisfied with a different introductory engineering course

### FOCUS AREA

#### Research and Development/Senior Thesis

**Expectations for Research Projects**

Completion of the engineering physics degree program requires satisfactory completion of the **E P 468 Introduction to Engineering Research**, **E P 469 Research Proposal in Engineering Physics**, **E P 568 Research Practicum in Engineering Physics I**, and **E P 569 Research Practicum in Engineering Physics II** coursework sequence, which culminates in a senior research thesis. The research topic chosen by the student and agreed upon by the advisor should be on a topic connected to the chosen Focus Area. The research conducted should be such that the student participates in the creation of new knowledge, experiences the excitement of the research process, and makes a contribution so that it would be appropriate to include the student’s name on a scholarly publication if one results from the research.

#### Senior Thesis

A senior thesis, completed during enrollment in **E P 569 Research Practicum in Engineering Physics II** is required. The senior thesis is a written document reporting on a substantial piece of work. It should be written in the style of a graduate thesis. The faculty advisor, in consultation with a research mentor, determines the grade which the student receives for the thesis. A bound copy of the thesis must be submitted to the engineering physics department office.

On or before the Friday of finals week of the semester in which **E P 569 Research Practicum in Engineering Physics II** is taken, the senior thesis must be presented orally by the student to a committee of three professors in a publicly announced seminar. Interested faculty and students will be invited to attend.

### Research and Development Electives

**Code**  
**Title**  
**Credits**

**Required:**

- **E P 468**  
Introduction to Engineering Research  
1

- **E P 469**  
Research Proposal in Engineering Physics  
1

**Focus Area Electives**

**Nanoengineering**

**Code**  
**Title**  
**Credits**

<table>
<thead>
<tr>
<th>Required</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICS 551</strong></td>
<td>Solid State Physics</td>
</tr>
<tr>
<td><strong>At Least One of:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>E P/E M A 615</strong></td>
<td>Micro- and Nanoscale Mechanics</td>
</tr>
<tr>
<td><strong>M S &amp; E 553</strong></td>
<td>Nanomaterials &amp; Nanotechnology</td>
</tr>
<tr>
<td><strong>At Least One of:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>E M A 506</strong></td>
<td>Advanced Mechanics of Materials I</td>
</tr>
<tr>
<td><strong>E M A 622</strong></td>
<td>Mechanics of Continua</td>
</tr>
<tr>
<td><strong>E M A 519</strong></td>
<td>Fracture Mechanics</td>
</tr>
<tr>
<td><strong>At Least One of:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>M S &amp; E 448</strong></td>
<td>Crystallography and X-Ray Diffraction</td>
</tr>
<tr>
<td><strong>E M A 611</strong></td>
<td>Advanced Mechanical Testing of Materials</td>
</tr>
<tr>
<td><strong>M E 601</strong></td>
<td>Special Topics in Mechanical Engineering (Micro &amp; Nano Fabrication)</td>
</tr>
<tr>
<td><strong>N E 602</strong></td>
<td>Special Topics in Reactor Engineering (Vacuum Technology Lab)</td>
</tr>
<tr>
<td><strong>PHYSICS 623</strong></td>
<td>Electronic Aids to Measurement</td>
</tr>
<tr>
<td><strong>PHYSICS 625</strong></td>
<td>Applied Optics</td>
</tr>
<tr>
<td><strong>M S &amp; E 748</strong></td>
<td>Structural Analysis of Materials</td>
</tr>
</tbody>
</table>

**Open Electives:**

- **M S & E 333**  
Microprocessing of Materials  
3

- **E C E 335**  
Microelectronic Devices  
3

- **M S & E 434**  
Introduction to Thin-Film Deposition Processes  
3

- **M S & E 441**  
Deformation of Solids  
3

- **E C E 445**  
Semiconductor Physics and Devices  
3

- **M S & E 451**  
Introduction to Ceramic Materials  
3

- **E M A/M S & E 541**  
Heterogeneous and Multiphase Materials  
3

- **M S & E 560**  
Fundamentals of Atomistic Modeling  
3

- **M S & E 570**  
Properties of Solid Surfaces  
3

- **CHEM 630**  
Selected Topics in Analytical Chemistry  
1-3

- **M S & E 756**  
Structure and Properties of Advanced Electronic Materials  
3

**Plasma Science and Engineering**

**Code**  
**Title**  
**Credits**

**Required:**

- **N E/E C E/PHYSICS 525**  
Introduction to Plasmas  
3

**Focus Area Electives**

**Nanoengineering**

**Code**  
**Title**  
**Credits**

<table>
<thead>
<tr>
<th>Required</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PHYSICS 551</strong></td>
<td>Solid State Physics</td>
</tr>
<tr>
<td><strong>At Least One of:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>E P/E M A 615</strong></td>
<td>Micro- and Nanoscale Mechanics</td>
</tr>
<tr>
<td><strong>M S &amp; E 553</strong></td>
<td>Nanomaterials &amp; Nanotechnology</td>
</tr>
<tr>
<td><strong>At Least One of:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>E M A 506</strong></td>
<td>Advanced Mechanics of Materials I</td>
</tr>
<tr>
<td><strong>E M A 622</strong></td>
<td>Mechanics of Continua</td>
</tr>
<tr>
<td><strong>E M A 519</strong></td>
<td>Fracture Mechanics</td>
</tr>
<tr>
<td><strong>At Least One of:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>M S &amp; E 448</strong></td>
<td>Crystallography and X-Ray Diffraction</td>
</tr>
<tr>
<td><strong>E M A 611</strong></td>
<td>Advanced Mechanical Testing of Materials</td>
</tr>
<tr>
<td><strong>M E 601</strong></td>
<td>Special Topics in Mechanical Engineering (Micro &amp; Nano Fabrication)</td>
</tr>
<tr>
<td><strong>N E 602</strong></td>
<td>Special Topics in Reactor Engineering (Vacuum Technology Lab)</td>
</tr>
<tr>
<td><strong>PHYSICS 623</strong></td>
<td>Electronic Aids to Measurement</td>
</tr>
<tr>
<td><strong>PHYSICS 625</strong></td>
<td>Applied Optics</td>
</tr>
<tr>
<td><strong>M S &amp; E 748</strong></td>
<td>Structural Analysis of Materials</td>
</tr>
</tbody>
</table>

**Open Electives:**

- **M S & E 333**  
Microprocessing of Materials  
3

- **E C E 335**  
Microelectronic Devices  
3

- **M S & E 434**  
Introduction to Thin-Film Deposition Processes  
3

- **M S & E 441**  
Deformation of Solids  
3

- **E C E 445**  
Semiconductor Physics and Devices  
3

- **M S & E 451**  
Introduction to Ceramic Materials  
3

- **E M A/M S & E 541**  
Heterogeneous and Multiphase Materials  
3

- **M S & E 560**  
Fundamentals of Atomistic Modeling  
3

- **M S & E 570**  
Properties of Solid Surfaces  
3

- **CHEM 630**  
Selected Topics in Analytical Chemistry  
1-3

- **M S & E 756**  
Structure and Properties of Advanced Electronic Materials  
3
At Least One of:
- N E C E/PHYSICS 527 Plasma Confinement and Heating 3
- N E C E 528 Plasma Processing and Technology 3

At Least One of:
- N E 526 Laboratory Course in Plasmas 3

Open Electives:
- N E 408 Ionizing Radiation 3
- N E 536 Feasibility St of Power from Controlled Thermonuclear Fusion 3

Any plasma-related special topics course in NE
- PHYSICS 415 Thermal Physics 3
- PHYSICS 623 Electronic Aids to Measurement 4
- PHYSICS 625 Applied Optics 4
- N E C E/PHYSICS 724 Waves and Instabilities in Plasmas 3
- N E C E/PHYSICS 725 Plasma Kinetic Theory and Radiation Processes 3
- N E C E/PHYSICS 726 Plasma Magnetohydrodynamics 3

**Scientific Computing**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Focus Area Total Credits:</strong></td>
<td><strong>14</strong></td>
</tr>
<tr>
<td>At Least One of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N E/MED PHYS 506</td>
<td>Monte Carlo Radiation Transport</td>
<td>3</td>
</tr>
<tr>
<td>M E 573</td>
<td>Computational Fluid Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>E M A 605</td>
<td>Introduction to Finite Elements</td>
<td>3</td>
</tr>
<tr>
<td>E C E 742</td>
<td>Computational Methods in Electromagnetics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>At Least One of:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students must take at least two credits of laboratory experience in the Physical or Biological Sciences beyond the required chemistry and mechanics of materials courses</td>
<td></td>
</tr>
</tbody>
</table>

Open Electives:
- E P/E M A 476 Introduction to Scientific Computing for Engineering Physics 3
- COMP SCI 300 Programming II 3
- COMP SCI/ MATH 513 Numerical Linear Algebra 3
- COMP SCI/ MATH 514 Numerical Analysis 3
- COMP SCI/I SY E/MATH/STAT 525 Linear Optimization 3
- COMP SCI/E C E/ M E 532 Matrix Methods in Machine Learning 3
- COMP SCI/E C E/ M E 539 Introduction to Artificial Neural Networks 3
- COMP SCI 540 Introduction to Artificial Intelligence 3
- COMP SCI/ E C E 561 Probability and Information Theory in Machine Learning 3
- COMP SCI 577 Introduction to Algorithms 4
- COMP SCI/ MATH 714 Methods of Computational Mathematics I 3

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>TECHNICAL ELECTIVE</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Select 6 credits from:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Co-op (no more than 3 credits)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Courses numbered 300+ in the CoE except for E P D/ INTEREGR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Courses numbered 300+ in MATH, PHYSICS, COMP SCI, STAT (except STAT 301), ASTRON, MED PHYS, and CHEM departments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students may also propose any class that they feel will benefit their education path with pre-requisite of two physics or calculus classes. For these courses the advisor will review the request and if approved, recommend a DARS substitution.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>COMMUNICATION SKILLS</strong></td>
<td></td>
</tr>
<tr>
<td>ENGL 100</td>
<td>Introduction to College Composition</td>
<td>3</td>
</tr>
<tr>
<td>or COM ARTS 100</td>
<td>Introduction to Speech Composition</td>
<td></td>
</tr>
<tr>
<td>or LSC 100</td>
<td>Science and Storytelling</td>
<td></td>
</tr>
<tr>
<td>or ESL 118</td>
<td>Academic Writing II</td>
<td></td>
</tr>
<tr>
<td>E P D 275</td>
<td>Technical Presentations</td>
<td>2</td>
</tr>
<tr>
<td>INTEREGR 397</td>
<td>Engineering Communication</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Credits</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>LIBERAL STUDIES</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complete Requirements (<a href="http://guide.wisc.edu/undergraduate/engineering/#requirementstext">http://guide.wisc.edu/undergraduate/engineering/#requirementstext</a>)</td>
<td></td>
</tr>
</tbody>
</table>
Students must take 16 credits that carry H, S, L, or Z breadth designators. These credits must fulfill the following subrequirements:

1. A minimum of two courses from the same subject area (https://registrar.wisc.edu/subjectareas/) (the description before the course number). At least one of these two courses must be designated as above the elementary level (I, A, or D) in the course listing.

2. A minimum of 6 credits designated as humanities (H, L, or Z in the course listing), and an additional minimum of 3 credits designated as social science (S or Z in the course listing). Foreign language courses count as H credits. Retroactive credits for language courses may not be used to meet the Liberal Studies credit requirement (they can be used for subrequirement 1 above).

3. At least 3 credits in courses designated as ethnic studies (lower case ‘e’ in the course listing). These courses may help satisfy subrequirements 1 and 2 above, but they only count once toward the total required. Note: Some courses may have "e" designation but not have H, S, L, or Z designation; these courses do not count toward the Liberal Studies requirement.

**TOTAL CREDITS: 130–132**

For information on credit load, adding or dropping courses, course substitutions, pass/fail, auditing courses, dean’s honor list, repeating courses, probation, and graduation, see the College of Engineering Official Regulations (http://guide.wisc.edu/undergraduate/engineering/#policiesandregulationstext).

**UNIVERSITY DEGREE REQUIREMENTS**

<table>
<thead>
<tr>
<th>Total Degree</th>
<th>To receive a bachelor’s degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residency</td>
<td>Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. “In residence” means on the UW–Madison campus with an undergraduate degree classification. “In residence” credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.</td>
</tr>
<tr>
<td>Quality of Work</td>
<td>Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.</td>
</tr>
</tbody>
</table>