ENGINEERING PHYSICS UNDERGRADUATE MAJOR

Engineering Physics (EPHYS)

Completion of the undergraduate program in Engineering Physics leads to the conferral of the Bachelor of Science in Engineering. The subplan “Engineering Physics” appears on the transcript and on the diploma.

Mission of the Undergraduate Program in Engineering Physics

The mission of the undergraduate program in Engineering Physics is to provide students with a strong foundation in physics and mathematics, together with engineering and problem-solving skills. All majors take high-level math and physics courses as well as engineering courses. This background prepares them to tackle complex problems in multidisciplinary areas that are at the forefront of 21st-century technology such as aerospace physics, biophysics, computational science, quantum science & engineering, materials science, nanotechnology, electromechanical systems, renewable energy, and any other engineering field that requires a solid background in physics. Because the program emphasizes science, mathematics, and engineering, students are well prepared to pursue graduate work in engineering, physics, or applied physics.

Requirements

Mathematics

Select one of the following sequences:

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 51 &amp; MATH 52</td>
<td>10</td>
</tr>
<tr>
<td>CME 100 &amp; CME 104</td>
<td>5</td>
</tr>
<tr>
<td>MATH 131P</td>
<td>3</td>
</tr>
</tbody>
</table>

Science

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>PHYSICS 41 mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 42 Classical Mechanics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>PHYSICS 43 Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 45 Light and Heat</td>
<td>2</td>
</tr>
<tr>
<td>PHYSICS 46 Light and Heat Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 70 Foundations of Modern Physics</td>
<td>1</td>
</tr>
</tbody>
</table>

Technology in Society

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATSCI 161 Energy Materials Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>MATSCI 164 Electronic and Photonic Materials and Devices Laboratory</td>
<td>4</td>
</tr>
</tbody>
</table>

Engineering Fundamentals

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ENGR 40A Introductory Electronics and Introductory Electronics Part II</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 101B Circuits II</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 105 Intermediate Physics Laboratory I: Analog Electronics</td>
<td>1</td>
</tr>
<tr>
<td>APPPHYS 207 Laboratory Electronics</td>
<td>4</td>
</tr>
</tbody>
</table>

Writing in the Major (WIM)

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 190 Directed Research and Writing in Aero/</td>
<td>5</td>
</tr>
<tr>
<td>CS 181W Computers, Ethics, and Public Policy (for Computational Science specialty or other specialty with prereqs)</td>
<td>5</td>
</tr>
<tr>
<td>CS 182W Ethics, Public Policy, and Technological Change (for Computational Science specialty or other specialty with prereqs)</td>
<td>5</td>
</tr>
<tr>
<td>EE 134 Introduction to Photonics (for Photonics specialty only. Not offered 2019-20)</td>
<td>5</td>
</tr>
<tr>
<td>MATSCI 161 Energy Materials Laboratory (for Materials Science and Renewable Energy specialties)</td>
<td>5</td>
</tr>
<tr>
<td>MATSCI 164 Electronic and Photonic Materials and Devices Laboratory (for Materials Science and Renewable Energy specialties)</td>
<td>5</td>
</tr>
<tr>
<td>PHYSICS 107 Intermediate Physics Laboratory II: Experimental Techniques and Data Analysis (for Quantum Science &amp; Engineering or other specialty)</td>
<td>5</td>
</tr>
</tbody>
</table>

Electronics Lab

Select one of the following:

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 40A Introductory Electronics and Introductory Electronics Part II</td>
<td>3</td>
</tr>
<tr>
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<td>4</td>
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<tr>
<td>PHYSICS 105 Intermediate Physics Laboratory I: Analog Electronics</td>
<td>1</td>
</tr>
<tr>
<td>APPPHYS 207 Laboratory Electronics</td>
<td>4</td>
</tr>
</tbody>
</table>

Quantum Mechanics

Select one of the following sequences:

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 109 Introduction to Probability for Computer Scientists</td>
<td>3</td>
</tr>
<tr>
<td>CME 106 Introduction to Probability and Statistics for Engineers</td>
<td>4</td>
</tr>
<tr>
<td>Also qualified are EE 263, any Math or Statistics course numbered 100 or above, and any CME course numbered 200 or above, except CME 206.</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Mechanics:</td>
<td>4</td>
</tr>
<tr>
<td>CME 108 Introduction to Scientific Computing</td>
<td>3</td>
</tr>
<tr>
<td>CME 205/ME 300C Engineering</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 113 Computational Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

Advanced Mathematics:

<table>
<thead>
<tr>
<th>Course(s)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 261 The Fourier Transform and Its Applications</td>
<td>3</td>
</tr>
<tr>
<td>PHYSICS 112 Mathematical Methods for Physics</td>
<td>5</td>
</tr>
</tbody>
</table>

Stanford Bulletin 2018-19
EE 222 & EE 223  
Applied Quantum Mechanics I and Applied Quantum Mechanics II

PHYSICS 130 & PHYSICS 131  
Quantum Mechanics I and Quantum Mechanics II

Thermodynamics and Statistical Mechanics

PHYSICS 170 & PHYSICS 171  
Thermodynamics, Kinetic Theory, and Statistical Mechanics I and Thermodynamics, Kinetic Theory, and Statistical Mechanics II 3-8

or ME 346A  
Introduction to Statistical Mechanics

Design Course

Select one of the following: 3-4

AA 236A  
Spacecraft Design
CS 108  
Object-Oriented Systems Design
EE 133  
Analog Communications Design Laboratory
ME 203  
Design and Manufacturing
ME 210  
Introduction to Mechatronics
PHYSICS 108  
Advanced Physics Laboratory: Project

Specialty Tracks

See Undergraduate Engineering Handbook for important details. 9-12

Select three courses from one specialty area:

Aerospace Physics:

AA 203  
Optimal and Learning-based Control
AA 244A  
Introduction to Plasma Physics and Engineering
AA 251  
Introduction to the Space Environment
AA 279A  
Space Mechanics
ME 161  
Dynamic Systems, Vibrations and Control

Biophysics:

APPPHYS 205  
Introduction to Biophysics
BIO 132  
Advanced Imaging Lab in Biophysics
BIOE 42  
Physical Biology
BIOE 44  
Fundamentals for Engineering Biology Lab
BIOE 101  
Systems Biology
BIOE 103  
Systems Physiology and Design
BIOE 123  
Biomedical System Prototyping Lab
BIOE 211  
Biophysics of Multi-cellular Systems and Amorphous Computing
BIOE 214  
Representations and Algorithms for Computational Molecular Biology

Computational Science:

CME 212  
Advanced Software Development for Scientists and Engineers
CME 215A  
Advanced Computational Fluid Dynamics
CME 215B  
Advanced Computational Fluid Dynamics
Any CME course with course number greater than 300 and less than 390

CS 103  
Mathematical Foundations of Computing
CS 154  
Introduction to Automata and Complexity Theory
CS 161  
Design and Analysis of Algorithms
CS 205L  
Continuous Mathematical Methods with an Emphasis on Machine Learning
CS 221  
Artificial Intelligence: Principles and Techniques
CS 228  
Probabilistic Graphical Models: Principles and Techniques
CS 229  
Machine Learning
STATS 202  
Data Mining and Analysis

STATS 213  
Introduction to Graphical Models

Electromechanical System Design:

ME 104  
Mechanical Systems Design (formerly ME 112)
ME 80  
Mechanics of Materials
ME 210  
Introduction to Mechatronics
or EE 118  
Introduction to Mechatronics

Materials Science:

Any MATSCI courses numbered 151 to 199 (except 159Q) or PHYSICS 172

Quantum Science & Engineering

APPPHYS 203  
Atoms, Fields and Photons
APPPHYS 225  
Probability and Quantum Mechanics
CS 254  
Computational Complexity
CS 269Q  
Elements of Quantum Computer Programming
EE 234  
Photonics Laboratory
EE 236C  
Lasers
EE 243  
Semiconductor Optoelectronic Devices
EE 340  
Optical Micro- and Nano-Cavities
PHYSICS 134  
Advanced Topics in Quantum Mechanics
PHYSICS 182  
Quantum Gases
PHYSICS 230  
Graduate Quantum Mechanics I
PHYSICS 231  
Graduate Quantum Mechanics II

Renewable Energy:

CEE 176B  
100% Clean, Renewable Energy and Storage for Everything
EE 153  
Power Electronics
EE 155  
Green Electronics
EE 293B  
Fundamentals of Energy Processes
MATSCI 156  
Solar Cells, Fuel Cells, and Batteries: Materials for the Energy Solution
MATSCI 302  
Solar Cells
MATSCI 316  
Nanoscale Science, Engineering, and Technology
ME 260  
Fuel Cell Science and Technology
EE 169  
Introduction to Bioimaging
or EE 369A  
Medical Imaging Systems I

Total Units  
93-119

1  
PHYSICS 67 Introduction to Laboratory Physics (2 units), recommended in place of PHYSICS 44 Electricity and Magnetism Lab

2  
The Engineering Fundamental courses are to be selected from the Basic Requirements 3 list. Fundamentals courses acceptable for the core program may also be used to satisfy the fundamentals requirement as long as 45 unduplicated units of Engineering are taken.

3  
Although not required, PHYSICS 59 (https://explorecourses.stanford.edu/search?view=catalog&filter-coursestatus-Active=on&page=0&catalog=&academicYear=&q=physics59&collapse=) (Frontiers in Physics Research, 1 unit) and PHYSICS 91SI (https://explorecourses.stanford.edu/search?view=catalog&filter-coursestatus-Active=on&page=0&catalog=&academicYear=&q=physics91si&collapse=) (Practical Computing for Scientists, 2 units) are highly recommended.
A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.

For additional information and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).

**Honors Program**

The School of Engineering offers a program leading to a Bachelor of Science in Engineering: Engineering Physics with Honors.

**Honors Criteria**

1. Minimum overall GPA of 3.5.
2. Independent research conducted at an advanced level with a faculty research adviser and documented in an honors thesis. The honors candidate must identify a faculty member who will serve as his or her honors research adviser and a second reader who will be asked to read the thesis and give feedback before endorsing the thesis. One of the two must be a member of the Academic Council and in the School of Engineering.

**Application:** The deadline to apply is November 1 in Autumn Quarter of the senior year. The application documents should be submitted to the Student Services Officer. Applications are reviewed by a subcommittee of the faculty advisers for Engineering Physics majors. Applicants and thesis advisers receive written notification when the application is approved. An application consists of three items:

1. One-page description of the research topic
2. The Honors Application form is available on Engineering Physics (https://ughb.stanford.edu/majors-minors/major-programs/engineering-physics-program) page of the Undergraduate handbook. It must be signed by honors thesis adviser.
3. Unofficial Stanford transcript

**Requirements and Timeline for Honors in Engineering Physics:**

1. Declare the honors program in Axess (ENGR-BSH, Subplan: Engineering Physics)
2. Obtain application form from the student services officer.
3. Apply to honors program by November 1 in the Autumn Quarter of the senior year.
4. Maintain an overall GPA of at least 3.5.
5. Optional: Under direction of the thesis adviser, students may enroll for research units in ENGR 199W Writing of Original Research for Engineers or in departmental courses such as AA 190 Directed Research and Writing in Aero/Astro or ME 191H Honors Research.
6. Submit a completed thesis draft to the research adviser and second reader by April 15.
7. Present the thesis work in an oral presentation or poster session in an appropriate forum (e.g., an event that showcases undergraduate research and is organized by the department of the adviser, the school of the adviser, or the University).
8. Incorporate feedback, which the adviser and second reader should provide by April 30, and obtain final endorsement signatures from the thesis adviser and second reader by May 15.
9. Submit a pdf of the thesis, including the signature page signed by both readers, to the student services officer by May 15. Students are sent email instructions on how to archive a permanent electronic copy in Terman Engineering library.