Engineering Physics (EPHY)

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, energy 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 Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 51 &amp; MATH 52</td>
<td>Linear Algebra, Multivariable Calculus, and Modern Applications and Integral Calculus of Several Variables</td>
<td>10</td>
</tr>
<tr>
<td>CME 100 &amp; CME 104</td>
<td>Vector Calculus for Engineers and Linear Algebra and Partial Differential Equations for Engineers</td>
<td></td>
</tr>
<tr>
<td>MATH 53</td>
<td>Ordinary Differential Equations with Linear Algebra</td>
<td>5</td>
</tr>
<tr>
<td>or CME 102</td>
<td>Ordinary Differential Equations for Engineers</td>
<td></td>
</tr>
<tr>
<td>MATH 131P</td>
<td>Partial Differential Equations (or MATH 173 or MATH 220 or PHYSICS 111)</td>
<td>3</td>
</tr>
</tbody>
</table>

Science

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 41</td>
<td>Mechanics (or PHYSICS 61)</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 42</td>
<td>Classical Mechanics Laboratory (or PHYSICS 62)</td>
<td>1</td>
</tr>
<tr>
<td>PHYSICS 43</td>
<td>Electricity and Magnetism (or PHYSICS 63)</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 67</td>
<td>Introduction to Laboratory Physics ²</td>
<td>2</td>
</tr>
<tr>
<td>PHYSICS 45</td>
<td>Light and Heat (or PHYSICS 65)</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 46</td>
<td>Light and Heat Laboratory (or PHYSICS 67)</td>
<td>1</td>
</tr>
<tr>
<td>PHYSICS 70</td>
<td>Foundations of Modern Physics (if taking the 40 series)</td>
<td>4</td>
</tr>
</tbody>
</table>

Technology in Society

One course required; course must be on the School of Engineering Approved List, Fig 4-3 in the UGHB, the year it is taken. See Basic Requirement 4.

Engineering Fundamentals

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two courses minimum (CS 106A or X recommended)</td>
<td>6-10</td>
<td></td>
</tr>
</tbody>
</table>

Engineering Physics Depth (core)

Advanced Mathematics:
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 261</td>
<td>The Fourier Transform and Its Applications</td>
<td>3-5</td>
</tr>
<tr>
<td>PHYSICS 112</td>
<td>Mathematical Methods for Physics</td>
<td></td>
</tr>
</tbody>
</table>

Electronics Lab

Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 40A &amp; ENGR 40B</td>
<td>Introductory Electronics and Introductory Electronics Part II (ENGR 40A alone is not allowed)</td>
<td>3-5</td>
</tr>
<tr>
<td>EE 101B</td>
<td>Circuits II</td>
<td>4</td>
</tr>
<tr>
<td>EE 122A</td>
<td>Laboratory Electronics</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 105</td>
<td>Intermediate Physics Laboratory I: Analog Electronics</td>
<td>4</td>
</tr>
<tr>
<td>APPPHY 207</td>
<td>Laboratory Electronics</td>
<td>4</td>
</tr>
</tbody>
</table>

Writing of Original Research for Engineers (for students pursuing an independent research project)
MATSCI 164 | Electronic and Photonic Materials and Devices Laboratory (Okay for Materials Science and Renewable Energy specialties)
PHYSICS 107 | Intermediate Physics Laboratory II: Experimental Techniques and Data Analysis (for Photonics or other specialty)

Quantum Mechanics
Select one of the following sequences:
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
or ME 346A | Introduction to Statistical Mechanics

Design Course
Select one of the following:
AA 236A | Spacecraft Design
CS 108 | Object-Oriented Systems Design
EE 103 | 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. Select three courses from one specialty area:

Aerospace Physics:
AA 203 | Introduction to Optimal Control and Dynamic Optimization
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
Any MATSCI courses numbered 151 to 199 (except 159Q) or PHYSICS 172

Electromechanical System Design:
ME 80 | Mechanics of Materials
ME 112 | Mechanical Systems Design
ME 210 or EE 118 | Introduction to Mechatronics

Energy Systems:
ME 131A | Heat Transfer
ME 131B | Fluid Mechanics: Compressible Flow and Turbomachinery
ME 140 | Advanced Thermal Systems

Renewable Energy:
CEE 176B | 100% Clean, Renewable Energy and Storage for Everything
EE 153 | Power Electronics
EE 155 | Green Electronics
EE 293A
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

Biophysics:
APPPHYS 205 | Introduction to Biophysics
BIO 132 | Advanced Imaging Lab in Biophysics
BIOE 41
BIOE 42 | Physical Imaging Lab
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

EE 169 | Introduction to Bioimaging
or EE 369A | Medical Imaging Systems I

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 300
CS 103 | Mathematical Foundations of Computing
CS 154 | Introduction to Automata and Complexity Theory
CS 161 | Design and Analysis of Algorithms
CS 205A
CS 205B
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

Quantum Science & Engineering
APPPHYS 203 | Atoms, Fields and Photons
APPPHYS 225 | Probability and Quantum Mechanics
APPPHYS 383

CS 254 | Computational Complexity
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 230 | Graduate Quantum Mechanics I
PHYSICS 231 | Graduate Quantum Mechanics II
PHYSICS 282 | Introduction to Modern Atomic Physics and Quantum Optics

Total Units: 93-119

1 PHYSICS 67 Introduction to Laboratory Physics (2 units), recommended in place of PHYSICS 44 Electricity and Magnetism Lab
The Engineering Fundamental courses are to be selected from the Basic Requirements 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.

Although not required, PHYSICS 59 (Frontiers in Physics Research, 1 unit) and PHYSICS 91SI (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 October 15 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
   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 October 15 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 199(W) or in departmental courses such as AA 190 or ME 191(H).
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 one signed, single-sided copy 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.

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