ENGINEERING PHYSICS
UNDERGRADUATE MAJOR

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

Science

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

Technology in Society

One course required; 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

Two courses minimum (CS 106A or AX or X recommended) 2 6-10

Engineering Physics Depth (core)

Advanced Mathematics:

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

Electronics Lab

Select one of the following:

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 109 Introduction to Probability for Computer Scientists</td>
</tr>
<tr>
<td>CME 106 Introduction to Probability and Statistics for Engineers</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>
</tr>
</tbody>
</table>

Advanced Mechanics:

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 242A Classical Dynamics (or ME 333 or PHYSICS 110) 3</td>
</tr>
<tr>
<td>Intermediate Electricity and Magnetism 6-8</td>
</tr>
</tbody>
</table>

Select one of the following sequences:

<table>
<thead>
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<tbody>
<tr>
<td>PHYSICS 120 Intermediate Electricity and Magnetism I</td>
</tr>
<tr>
<td>PHYSICS 121 Intermediate Electricity and Magnetism II</td>
</tr>
<tr>
<td>EE 142 &amp; EE 242 Engineering Electromagnetics and Electromagnetic Waves</td>
</tr>
</tbody>
</table>

Numerical Methods

Select one of the following:

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>CME 108 Introduction to Scientific Computing 3-4</td>
</tr>
<tr>
<td>CME 206/ME 300C Introduction to Numerical Methods for Engineering</td>
</tr>
<tr>
<td>PHYSICS 113 Computational Physics</td>
</tr>
</tbody>
</table>

Writing in the Major (WIM)

Select one of the following:

<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>AA 190 Directed Research and Writing in Aero/Astro (for Aerospace specialty only) 4-5</td>
</tr>
<tr>
<td>ENGR 199W Writing of Original Research for Engineers (for students pursuing an independent research project)</td>
</tr>
<tr>
<td>BIE 131 Ethics in Bioengineering (for Biophysics specialty only)</td>
</tr>
<tr>
<td>CS 181W Computers, Ethics, and Public Policy (for Computational Science specialty or other specialty with prereqs)</td>
</tr>
<tr>
<td>CS 182W Ethics, Public Policy, and Technological Change (for Computational Science specialty or other specialty with prereqs)</td>
</tr>
<tr>
<td>EE 134 Introduction to Photonics (for Photonics specialty only. Not offered 2019-20)</td>
</tr>
<tr>
<td>MATSCI 161 Energy Materials Laboratory (for Materials Science and Renewable Energy specialties)</td>
</tr>
<tr>
<td>MATSCI 164 Electronic and Photonic Materials and Devices Laboratory (for Materials Science and Renewable Energy specialties)</td>
</tr>
<tr>
<td>PHYSICS 107 Intermediate Physics Laboratory II: Experimental Techniques and Data Analysis (for Quantum Science &amp; Engineering or other specialty)</td>
</tr>
</tbody>
</table>
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 133  
Analog Communications Design Laboratory  

ME 203  
Design and Manufacturing  

ME 210  
Introduction to Mechatronics  

PHYSICS 108  
Advanced Physics Laboratory: Project  

Speciality Tracks  
See Undergraduate Engineering Handbook for important details.  
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:  

APPHPHYS 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  

APPHPHYS 203  
Atoms, Fields and Photons  

APPHPHYS 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.