ENGINEERING PHYSICS
UNDERGRADUATE MAJOR

COVID-19-Related Degree Requirement Changes
The Engineering Physics program counts all courses taken in academic year 2020-21 with a grade of 'CR' (credit) or 'S' (satisfactory) towards satisfaction of undergraduate degree requirements that otherwise require a letter grade.

Students who take Physics 61 and 63 in the Fall and Winter quarters may take either Physics 65 in Summer 2021 or EE 65 in Spring 2021 to complete the requirement of an introductory physics sequence for the Engineering Physics 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

<table>
<thead>
<tr>
<th>Mathematics Units</th>
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<tbody>
<tr>
<td>Select one of the following sequences: 10</td>
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<tr>
<td>MATH 51 &amp; MATH 52 Linear Algebra, Multivariable Calculus, and Modern Applications and Integral Calculus of Several Variables</td>
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<tr>
<td>CME 100 &amp; CME 104 Vector Calculus for Engineers and Linear Algebra and Partial Differential Equations for Engineers</td>
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<tr>
<td>MATH 53 Ordinary Differential Equations with Linear Algebra 5</td>
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<tr>
<td>or CME 102 Ordinary Differential Equations for Engineers</td>
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<tr>
<td>MATH 131P Partial Differential Equations (or MATH 204 or MATH 173 or MATH 220 or PHYSICS 111) 3</td>
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<table>
<thead>
<tr>
<th>Science</th>
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</thead>
<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 1 2</td>
</tr>
<tr>
<td>PHYSICS 65 Light and Heat (or PHYSICS 65 or EE 65 in 2020-21) 4</td>
</tr>
<tr>
<td>PHYSICS 46 Light and Heat Laboratory (or PHYSICS 67) 1</td>
</tr>
</tbody>
</table>

| PHYSICS 70 Foundations of Modern Physics (if taking the 40 series) 4 |

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
Two courses minimum (CS 106A or B recommended; PHYSICS 105 allowed) 2

Engineering Physics Depth (core)
Advanced Mathematics:
One advanced math elective such as 3-5

EE 261 The Fourier Transform and Its Applications
PHYSICS 112 Mathematical Methods for Physics
CS 109 Introduction to Probability for Computer Scientists
CME 106 Introduction to Probability and Statistics for Engineers

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.

Advanced Mechanics: 3-4

AA 242A Classical Dynamics (or ME 333 or PHYSICS 110)

Intermediate Electricity and Magnetism 6-8

Select one of the following sequences:

PHYSICS 105 Foundations of Modern Physics (if taking the 40 series) 4

Intermediate Electricity and Magnetism I
Intermediate Electricity and Magnetism II

Select one of the following sequences:

PHYSICS 120 Intermediate Electricity and Magnetism I
PHYSICS 121 Intermediate Electricity and Magnetism II

EE 142 EE 242 Engineering Electromagnetics and Electromagnetic Waves

Numerical Methods
Select one of the following: 3-4

CME 108 Introduction to Scientific Computing
CME 206/ME 300C Introduction to Numerical Methods for Engineering
PHYSICS 113 Computational Physics

Electronics Lab
Select one of the following: 3-5

EE 101A Circuits I
EE 101B Circuits II

ENGR 40M An Intro to Making: What is EE (or ENGR 40A+ENGR 40B; must take both [not offered 2019-20])

PHYSICS 104 Electronics and Introduction to Experimental Methods (2020-21 only)

PHYSICS 105 Intermediate Physics Laboratory I: Analog Electronics

APPPHYS 207 Laboratory Electronics

Writing in the Major (WIM)
Select one of the following: 4-5

AA 190 Directed Research and Writing in Aero/Astro (for Aerospace specialty only)
ENGR 102W Technical and Professional Communication
ENGR 199W Writing of Original Research for Engineers (for students pursuing an independent research project)

BIOE 131 Ethics in Bioengineering (for Biophysics specialty only)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CS 181W</td>
<td>Computers, Ethics, and Public Policy (for Computational Science specialty or other specialty with prereqs)</td>
</tr>
<tr>
<td>CS 182W</td>
<td>Ethics, Public Policy, and Technological Change (for Computational Science specialty or other specialty with prereqs)</td>
</tr>
<tr>
<td>EE 134</td>
<td>Introduction to Photonics (for Photonics specialty only. Not offered 2019-20)</td>
</tr>
<tr>
<td>MATSCI 161</td>
<td>Energy Materials Laboratory (for Materials Science and Renewable Energy specialties)</td>
</tr>
<tr>
<td>MATSCI 164</td>
<td>Electronic and Photonic Materials and Devices Laboratory (for Materials Science and Renewable Energy specialties)</td>
</tr>
<tr>
<td>PHYSICS 107</td>
<td>Intermediate Physics Laboratory II: Experimental Techniques and Data Analysis (if taken 2019-20 or earlier)</td>
</tr>
</tbody>
</table>

**Quantum Mechanics**

Select one of the following sequences: 6-8

- 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**

Select one of the following: 8

- PHYSICS 170 & PHYSICS 171 Thermodynamics, Kinetic Theory, and Statistical Mechanics I and Thermodynamics, Kinetic Theory, and Statistical Mechanics II (or MATSCI 310 or ME 346A; may not be offered every year)

**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 103 Product Realization: Design and Making
- 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: 9-12

**Aerospace Physics:**

- AA 203 Optimal and Learning-based Control
- AA 205 Rarefied and Ionized Gases
- AA 244A Introduction to Plasma Physics and Engineering
- AA 244B Advanced 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
- BIO 42 Physical Biology
- BIO 44 Fundamentals for Engineering Biology Lab
- BIO 101 Systems Biology
- BIO 103 Systems Physiology and Design
- BIO 123 Bioengineering Systems Prototyping Lab
- BIO 211 Biophysics of Multi-cellular Systems and Amorphous Computing
- BIO 214 Representations and Algorithms for Computational Molecular Biology

**Biophysics:**

- BIOE 211 Biophysics of Multi-cellular Systems and Amorphous Computing
- BIOE 214 Representations and Algorithms for Computational Molecular Biology

**Biophysics:**

- BIOE 221 Physics and Engineering of Radionuclide-based Medical Imaging
- EE 169 or EE 369A Introduction to Bioimaging Medical Imaging Systems I

**Computational Science:**

- CME 212 Advanced Software Development for Scientists and Engineers
- CME 215A
- CME 215B
- Any CME course with course number greater than 300 and less than 390
- CS 103 Mathematical Foundations of Computing
- CS 154 Introduction to the Theory of Computation
- 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

**Electromechanical System Design:**

Take two of

- ME 80 Mechanics of Materials
- ME 104 Mechanical Systems Design (prereqs of ME 80, ME 102, & ME 103)
- ME 223A Introduction to Robotics

**Take either**

- ME 210 Introduction to Mechatronics
- ME 346A; may not be offered every year)
- ENGR 240 Introduction to Micro and Nano Electromechanical Systems (2020-21 only)

**Materials Science:**

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

**Quantum Science & Engineering** (See UGHB for further important details.)

- APPPHYS 203 Atoms, Fields and Photons
- APPPHYS 225 Probability and Quantum Mechanics
- APPPHYS 228 Quantum Hardware
- 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 106 Experimental Methods in Quantum Physics
- PHYSICS 134 Advanced Topics in Quantum Mechanics
- PHYSICS 182 Quantum Gases
- PHYSICS 230 Graduate Quantum Mechanics I
- PHYSICS 231 Graduate Quantum Mechanics II
- STATS 376A Information Theory

**Renewable Energy:**

- CEE 176B 100% Clean, Renewable Energy and Storage for Everything
- EE 153 Power Electronics
- EE 155 Green Electronics
Services.

**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.

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