

# ENGINEERING PHYSICS

The Engineering Physics major is designed for students who have an interest in and an aptitude for both engineering and physics. The program provides students with a firm foundation in physics and mathematics, together with engineering design and problem-solving skills. This background prepares students to tackle complex problems in multidisciplinary areas that are at the forefront of 21<sup>st</sup>-century technology, such as solid state devices, quantum optics and photonics, materials science, nanotechnology, electromechanical systems, energy systems, and any engineering field that requires a very solid background in physics. Because the program emphasizes science, mathematics and engineering, students are well prepared to pursue graduate work in either engineering or physics.

## **REQUIREMENTS for the MAJOR**

### **Math and Science Requirements:**

Includes the following required courses:

**Math:** (MATH 51 and 52) or (CME 100 and 104), MATH 53 or CME 102, MATH 131

**Science:** PHYSICS (41, 43, 44, 45, 46, 70) or (61, 63, 64, 65, 67)

### **Technology in Society:**

One 3-5 unit approved course required; see Figure 3-3 for SoE approved course list.

### **Engineering Fundamentals and Depth:**

At least 50 of the units in Engineering Fundamentals, Required Depth Classes, Required Depth Electives, and Technology in Society must be engineering units.

### **Engineering Fundamentals:**

Three courses from approved list; see Figure 3-4.

A course in computer science, such as CS106, is recommended.

### **Core Courses Required of All Majors:**

Intermediate Mechanics                      ENGR 15 or PHYSICS 110

Intermediate Electricity and Magnetism   EE (141 and 142) or PHYSICS (120 and 121)

Advanced Mathematics                      One additional math course such as EE 261,

PHYSICS 112, or CME 106/ENGR 155C

Numerical Methods	AP 215 or CME 108/CS 137 or PHYSICS 113
Electronics Laboratory	ENGR 40 or EE 122 or PHYSICS 105 or AP 207
Writing Laboratory (WIM)	(EE108A and ENGR 102E) or
	(ME 203 and ENGR 102M) or PHYSICS 107 or
MATSCI 161	
Quantum Mechanics	(EE 222 and 223) or (PHYSICS 130 and 131)
Thermodynamics, Kinetics, and Statistical Mech	PHYSICS 170 and PHYSICS 171

### **Design Course:**

At least one of the following design-project courses must be included in each program:

EE 133, EE 144, CS 108, ME 203, ME 210, PHYSICS 108

If ME 203 is used to satisfy both the Writing Laboratory and the Design Course requirements, then the combination of ME 203, ME 103D and ENGR 102M should be taken.

### **Three Courses from one of the following Specialty Areas:**

1. In the **Solid State Physics** specialty, students have the opportunity to learn about the macroscopic physical properties of solids, including electrical, magnetic and optical properties, superconductivity, and heat transfer in solids. Students learn how these properties can be manipulated and applied in electronic devices. Choose three from: PHYSICS 172, PHYSICS 173, EE 116, EE 216, AP 272/EE 236/MATSCI 331, AP 273/EE 237/MATSCI 332, MATSCI 199/EE 238

2. The **Photonics** specialty provides the opportunity for students to learn about the emission, transmission, amplification, detection, modulation and switching of optical and infrared light. Students can apply this knowledge to optoelectronic devices such as lasers, photodetectors, waveguides and photonic crystals, or to quantum information science, with applications in quantum communication and quantum computing. Choose three from: EE 216, EE 231, EE232, EE234, MATSCI 199/EE 238, EE 243, EE 268/PHYSICS 181 [PHYSICS 107 recommended as WIM course.]

3. In the **Materials Science** specialty, students learn how to design and synthesize materials with particular structures at the nanometer and micrometer scale that provide special electrical, optical, magnetic or mechanical properties. Students can learn how to use these materials to make integrated circuits, light-emitting diodes, solar cells, fuel cells, microelectromechanical systems

and other advanced devices. Choose three from: MATSCI 151, 152, 155, 160, 161, 162, 163, 190, 194, (PHYSICS 172 or MATSCI 199) In addition, ENGR 31 or CHEM 31 highly recommended.

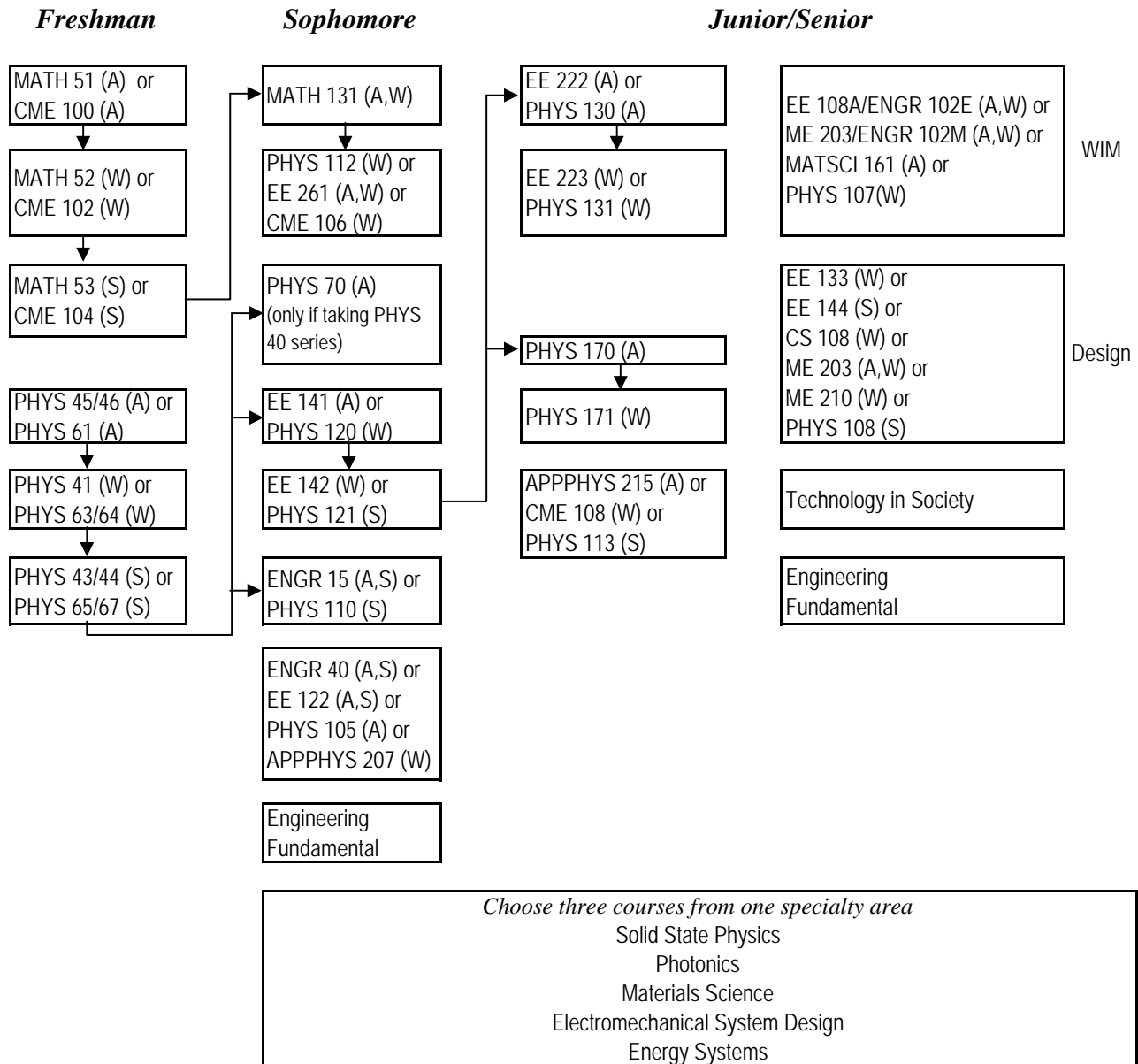
4. The **Electromechanical System Design** specialty provides the opportunity for students to explore the process of design, analysis, and realization of modern electromechanical systems including “smart products” with embedded sensing and actuation. Choose three from: ME 80+81, ME 112, ME 210. Take ME 203/ENGR 102M as WIM Course. ME 101 and ME 103D also recommended.

5. The **Energy Systems** specialty provides the opportunity for students to explore how energy is manipulated in both device applications and for modern energy conversion systems including electrical power, transportation, and propulsion. Take: ME 131A, ME 131B, ME 140. Take ME 203/ENGR 102M as WIM and/or Design Course. ME 103D and ME 70 also recommended.]

6. Other Specialty: With approval of advisor, a set of three courses in one area of concentration (e.g., astrophysics and astronautics; quantum information; biophysics).

# Engineering Physics

*Typical Sequence of Courses*



## Engineering Physics

*Electromechanical System Design Specialty Area*

	<b>Class</b>	<i>Fall</i> <b>Math/ Sci</b>	<b>Eng</b>	<b>Class</b>	<i>Winter</i> <b>Math/ Sci</b>	<b>Eng</b>	<b>Class</b>	<i>Spring</i> <b>Math/ Sci</b>	<b>Eng</b>
<i>Freshman*</i>	CME100 Phys45/46	5 5		CME102 Phys41	5 4		CME104 Phys43/44	5 5	
<i>Sophomore</i>	Math131 Phys70 EE141	3 4		Phys112 EE142	4		Eng40 Phys110 ME80 (Depth) ME81 (Depth)	4	3 3 3 1
<i>Junior</i>	ME101 CS106X		3 3	ME112(Depth) ME203(Des/WIM) ME103D E102M(WIM)		4 3 1 1	Phys113	4	
<i>Senior</i>	EE222 Phys170		3 4	EE223 Phys172 ME210(Depth)		3 4 4	Engr Course Engr Course		3 3
<i>Units:</i>		21	13		17	19		18	13
<i>Total Math/Sci Units:</i>		56							
<i>Engineering Units:</i>		45							
<i>STS</i>		3 to 5							
<i>Third Eng Fund</i>		3 (E40 and CS106 already listed above)							
<b>Total Eng:</b>		<b>51</b>							
<b>Total Math/Sci/Eng:</b>		<b>107</b>							

\* In the Freshman year, students can take the Math 50 series rather than the CME 100 series. If a student has a solid background in math and physics from high school, they can take the Physics 60 series rather than the Physics 40 series, in which case they do not take Phys70 in the Sophomore year.

## Engineering Physics

*Energy Systems Specialty Area*

	<b>Class</b>	<i>Fall</i> <b>Math/ Sci</b>	<b>Eng</b>	<b>Class</b>	<i>Winter</i> <b>Math/ Sci</b>	<b>Eng</b>	<b>Class</b>	<i>Spring</i> <b>Math/ Sci</b>	<b>Eng</b>
<i>Freshman*</i>	CME100 Phys45/46	5 5		CME102 Phys41	5 4		CME104 Phys43/44	5 5	
<i>Sophomore</i>	Math131 Phys70 EE141	3 4		Phys112 EE142	4		Eng40 Phys110 ME70	4	3  3
<i>Junior</i>	ME101 CS106X ME130A(Depth)		3 3 3	ME131B(Depth) ME203(WIM) ME103D E102M(WIM)		4 3 1 1	ME140(Depth) Phys113	4	4
<i>Senior</i>	EE222 Phys170		3	EE223 Phys172 ME210(Depth)		3 4 4			
<i>Units:</i>		21	16		17	19		18	10
<i>Total Math/Sci Units:</i>		56							
<i>Engineering Units:</i>		45							
<i>STS</i>		3 to 5							
<i>Third Eng Fund</i>			3 (E40 and CS106 already listed above)						
<b>Total Eng:</b>			<b>51</b>						
<b>Total Math/Sci/Eng:</b>			<b>107</b>						

\* In the Freshman year, students can take the Math 50 series rather than the CME 100 series. If a student has a solid background in math and physics from high school, they can take the Physics 60 series rather than the Physics 40 series, in which case they do not take Phys70 in the Sophomore year.

## Engineering Physics

*Materials Science Specialty Area*

	<b>Class</b>	<i>Fall</i> <b>Math/ Sci</b>	<b>Eng</b>	<b>Class</b>	<i>Winter</i> <b>Math/ Sci</b>	<b>Eng</b>	<b>Class</b>	<i>Spring</i> <b>Math/ Sci</b>	<b>Eng</b>
<i>Freshman*</i>	CME100 Phys45/46	5 5		CME102 Phys41	5 4		CME104 Phys43/44	5 5	
<i>Sophomore</i>	Engr31 Phys70 EE141	4	4	Math131 E50 EE142	3	4	Eng40 Phys110 MatSci152 (Depth)	4	3 3 3
<i>Junior</i>	EE222 Phys170 EE261	4	3	EE223 Phys171	4	3	MatSci199(Depth)		3
<i>Senior</i>	MatSci193 AP215 MatSci161(WIM)		4 3 4				Phys108(Depth) MatSci162(Depth)	3	4
<i>Units:</i>		18	25		16	10		17	13
<i>Total Math/Sci Units:</i>		51							
<i>Engineering Units:</i>		48							
<i>STS</i>		3 to 5							
<i>Third Eng Fund</i>			3 (E40 and E50 already listed above)						
<i>Total Eng:</i>			54						
<b>Total Math/Sci/Eng:</b>		<b>105</b>							

\* In the Freshman year, students can take the Math 50 series rather than the CME 100 series. If a student has a solid background in math and physics from high school, they can take the Physics 60 series rather than the Physics 40 series, in which case they do not take Phys70 in the Sophomore year.

## Engineering Physics

*Photonics Specialty Area*

		<i>Fall Math/ Sci</i>	Eng	Class	<i>Winter Math/ Sci</i>	Eng	Class	<i>Spring Math/ Sci</i>	Eng
<i>Freshman*</i>	CME100 Phys45/46	5 5		CME102 Phys41	5 4		CME104 Phys43/44	5 5	
<i>Sophomore</i>	Math131 Phys70 EE141	3 4		EE261 EE142		3 3	Eng40 Phys110	4	3
<i>Junior</i>	EE222 Phys170	4	3	EE223 Phys171 EE101A	4	3 4	MatSci 199 (Depth) EE101B		3 4
<i>Senior</i>	EE231 (Depth) AP 215		3 3	EE133(Design) EE243(Depth) Phys107 (WIM)		3 3 4			
<i>Units:</i>		21	13		17	19		14	10
<i>Total Math/Sci Units:</i>		52							
<i>Engineering Units:</i>		42							
<i>STS</i>		3 to 5							
<i>Two Engr Fund</i>			6 (E40 already listed above)						
<b>Total Eng:</b>		<b>51</b>							
<b>Total Math/Sci/Eng:</b>		<b>103</b>							

\* In the Freshman year, students can take the Math 50 series rather than the CME 100 series. If a student has a solid background in math and physics from high school, they can take the Physics 60 series rather than the Physics 40 series, in which case they do not take Phys70 in the Sophomore year.

## Engineering Physics

*Solid State Physics Specialty Area*

	<i>Fall</i>			<i>Winter</i>			<i>Spring</i>		
	<b>Class</b>	<b>Math/ Sci</b>	<b>Eng</b>	<b>Class</b>	<b>Math/ Sci</b>	<b>Eng</b>	<b>Class</b>	<b>Math/ Sci</b>	<b>Eng</b>
<i>Freshman*</i>	CME100 Phys45/46	5 5		CME102 Phys41	5 4		CME104 Phys43/44	5 5	
<i>Sophomore</i>	Math131 Phys70 EE141	3 4		EE261  EE142		3	Eng40 Phys110 Phys113	4 4	3
<i>Junior</i>	EE222 Phys170 CS106X	4	3	EE223 Phys171 EE101A	4	3	EE116(Depth) EE101B		3 4
<i>Senior</i>	EE108A (WIM) Eng102E (WIM)		3 1	EE133(Design) EE236(Depth)		3 3	EE237(Depth)		3
<i>Units:</i>		21	14		13	19		18	13
<i>Total Math/Sci Units:</i>		52							
<i>Engineering Units:</i>		46							
<i>STS</i>		3 to 5							
<i>Third Eng Fund</i>		3		(E40, CS106X already listed above)					
<b>Total Eng:</b>		<b>52</b>							
<b>Total Math/Sci/Eng:</b>		<b>104</b>							

\* In the Freshman year, students can take the Math 50 series rather than the CME 100 series. If the student has a solid background in high school math and physics, they can take the Phys 60 series rather than the Phys 40 series, in which case they do not take Phys70 in the Sophomore year.

## INSTRUCTIONS FOR DECLARING A MAJOR IN ENGINEERING PHYSICS

1. Declare the Engineering Physics major on Axess: **Select “Engineering” as your major and "Engineering Physics" as your subplan.**
2. Send an email notice to Doris Chan, Student Services Specialist, at [dschan@stanford.edu](mailto:dschan@stanford.edu). Her office is located in the Materials Science and Engineering Dept. (Building 550, Room 551E). On your major declaration form, indicate a preference for a major advisor, if any. She will reply to confirm your advisor choice.
3. Print your unofficial Stanford transcript from Axess.
4. Download the Engineering Physics Program Sheet from the School of Engineering web site at <http://ughb.stanford.edu>. Complete the Program Sheet, indicating how you plan to fulfill the major requirements (or do this when you meet with your advisor).
5. Make an appointment with your advisor to discuss your program. Have your advisor sign the Program Sheet and the declaration form. Your program proposal may change as you progress in the program; submit revisions in consultation with your advisor. **(Submit a final Program Sheet at least two quarters before you graduate.)**
6. Return the signed forms to Doris Chan in Materials Science and Engineering.

**Stanford University ♦ School of Engineering**  
**Engineering Physics**  
**2006-2007 Program Sheet**

Name: \_\_\_\_\_  
 Local Address: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

SU ID: \_\_\_\_\_  
 Local Phone: \_\_\_\_\_  
 Email: \_\_\_\_\_  
 Date B.S. expected: \_\_\_\_\_

**Mathematics and Science Requirement (Delete courses not taken)**

Dept	Course	Title	Units	Grade	✓ if Transfer	Transfer/AP Approval	
						Initials	Date
<b>Mathematics</b>							
MATH or CME	51 or 100		5				
MATH or CME	52 or 104		5				
MATH or CME	53 or 102		5				
MATH	131		3				
MATH		Elective; see Note 1	3 or 4				
		<i>Mathematics Unit Total</i>					
<b>Science</b>							
<i>School of Engineering Approved Science Courses</i>							
PHYS	41 or 61	Mechanics (req'd)	4				
PHYS	43/44 or 63/64	Light and Heat plus lab (req'd)	5				
PHYS	45/46 or 65/67	Electricity and Magnetism (req'd)	5 or 6				
PHYS	70	See note 2	4				
		<i>SOE Science Unit Total</i>					
		<i>Mathematics and Science Total</i>					

**Technology in Society Requirement (1 course required; see UGHB, Fig. 3-3 for SoE approved list)**

			3 to 5				
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**NOTES**

- \* This form is available as an Excel file at <http://ughb.stanford.edu/>. The printed form must be signed by the advisor
- \* All courses listed on this form must be taken for a letter grade if offered by the instructor.
- \* Minimum Grade Point Average (GPA) for all courses in Engineering Topics (Fundamentals and Depth combined) is
- \* Transfer and AP credits in Math, Science, Funds., & TIS must be approved by the SoE Dean's Office. Transfer credits in Engineering Depth must be approved by the Advisor. Transfer credit information and petitions are available at <http://ughb.stanford.edu/>
- \* All courses listed on this form must only be included under one category. Delete courses/units not taken.
- (1) Recommended courses are EE 261, Physics 112, or CME 106
- (2) This course required only if taking the Physics 40 series (omit if taking Physics 60 series)

*program sheet continues on page 2*

## Engineering Physics Program Sheet (continued)

### Engineering Fundamentals (three courses minimum; CS 106X or B recommended)

<i>Engineering Fundamentals Total</i>				<i>(3 courses required)</i>		

### Engineering Physics Depth (delete courses and units not taken)

Dept	Course	Title	Units	Grade	✓ if Transfer	Transfer/AP Approval	
						Initials	Date
ENGR or PHYS	15 or 110	Dynamics or Intermediate Mechanics	3 or 4				
EE or PHYS	141 or 120	Int. Electricity & Magnetism	4				
EE or PHYS	142 or 121	Electromagnetic Waves	3 or 4				
AppPhys	215	Numerical Meth Phys & Engrs (see note 3)	3 or 4				
ENGR	40	Intro to Electronics(see note 4)	3 or 5				
EE/ENGR	108A/102E	Tech/Prof Writing (WIM; see note 5)	4 or 5				
EE	222	Applied Quantum Mechanics I (see note 6)	3				
EE	223	Applied Quantum Mechanics II (see note 6)	3				
PHYS	170	Thermodynamics, Kinetic Theory, & Stat. Mechanics	4				
PHYS	171	Thermodynamics, Kinetic Theory, & Stat. Mechanics	4				
		Design course; choose one; see note 7	3 or 4				
		Three courses from one speciality area	9to12				
<i>Engineering Depth Total</i>							

### Program Totals

*Math + Science + Engineering Physics Depth*  *(45 units minimum)*  
*Engineering (Fundamentals + Depth) Units*  *(50 units minimum in SoE)*

### Program Approvals

#### Advisor

Printed Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Signature: \_\_\_\_\_

#### Departmental

Printed Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Signature: \_\_\_\_\_

#### School of Engineering

Printed Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Signature: \_\_\_\_\_

### NOTES (continued from page 1)

- (3) Alternative approved courses are CME 108 or PHYS 113
- (4) Alternative approved courses are EE 122, PHYSICS 105, or AppPhys 207
- (5) Alternative approved WIM courses are ME 203/ENGR 102M, MATSCI 161, OR PHYSICS 107
- (6) Alternative approved courses are PHYS 130 AND 131
- (7) Approved courses are EE 133, 144, CS 108, ME203, 210, OR PHYSICS 108