

# MIT Department of Physics

Undergraduate Program

## The Undergraduate Programs in Physics

Classes of 2010-2013

August, 2009

The Physics Department offers two different programs leading to a Bachelor of Science in Physics, giving students the opportunity to tailor their study of physics to their individual career goals. The focused option is an ideal preparation for those students who plan to go on to graduate school in physics or a related field.

### Course VIII Focused Option

The Course VIII focused option is designed to provide the best possible preparation for graduate study in physics. Many students have also found this program to be an excellent, broad based preparation for professional work in related fields such as astrophysics, biophysics, geophysics, and many engineering disciplines. The focused option is unusual among pre-professional programs at MIT in that it offers a particularly large amount of elective freedom: as many as six subjects may be chosen as unrestricted electives without exceeding the minimum requirements for an undergraduate degree.

The Departmental program for the focused option consists of the following required subjects and restricted electives. The full requirements for the degree, including the General Institute Requirements, may be found in the MIT Bulletin.

#### Required Subjects

8.03	Physics III (vibrations and waves)
18.03 or 18.034	Differential Equations
8.033	Relativity
8.223 (IAP)	Classical Mechanics II (Class of 2013 and later)
8.04	Quantum Mechanics I
8.044	Statistical Physics I
8.05	Quantum Mechanics II
8.06 CI-M*	Quantum Mechanics III
8.13 CI-M*	Experimental Physics I
8.14	Experimental Physics II
8.ThU	Thesis (12 units)

#### Restricted Electives

One subject given by the Mathematics Department beyond 18.03

Two additional subjects given by the Physics Department beyond 8.02 including at least one of the following: 8.07, 8.08, 8.09

A typical focused option schedule showing how these required subjects might be distributed throughout a student's four undergraduate years, is shown at the end of this document.

### **Course VIII Flexible Option**

This option is designed for students who wish to develop a strong background in the fundamentals of physics and then build on this foundation as they prepare for career paths that may not involve a graduate degree in physics. In the past many students have found an understanding of the basic concepts of physics and an appreciation of the physicist's approach to problem solving an excellent preparation for careers in business, law, medicine or engineering. This option should be even more attractive today in light of the growing spectrum of non-traditional, technology-related career opportunities.

The freedom of choice associated with the flexible option does not preclude the possibility of going on to graduate school in physics. The number of physics subjects in this program is still comparable to that required of physics majors at many of our peer universities. Students who wish to pursue the flexible option should inform their departmental advisor during their sophomore year in order to have enough time to design a complete program. Specific plans for the experimental and focus requirements (see below) require the written approval of the Department's Flexible Option Coordinator.

The Departmental program for the flexible option consists of the following required subjects and restricted electives. The full requirements for the degree, including the General Institute Requirements, may be found in the MIT Bulletin.

#### **Required Subjects**

- |                 |  |
|-----------------|--|
| 8.03            | Physics III (vibrations and waves)                                     |
| 18.03 or 18.034 | Differential Equations   |
| 8.04            | Quantum Mechanics I  |
| 8.044           | Statistical Physics II   |
|                 | and one of the following subjects                                      |
| 8.05            | Quantum Mechanics II, or   |
| 8.20            | Introduction to Special Relativity, or                                 |
| 8.033           | Relativity   |
|                 | and one of the following subjects (Class of 2013 and later)            |
| 8.223 (IAP)     | Classical Mechanics II, or   |
| 8.21            | Physics of Energy  |
|                 | and one of the following experimental experiences, subject to approval |
| 8.13 CI-M*      | Experimental Physics I   |
|                 | or a laboratory subject of similar intensity in another dept.          |
|                 | or an experimental research project or senior thesis                   |
|                 | or an experimentally oriented summer externship                        |

#### **Restricted Electives**

- One additional subject given by the Physics Department beyond 8.02
- A three-subject focus group forming one coherent unit in some area, not necessarily physics, subject to the approval of the Department

Possible areas of focus include astronomy, biophysics, computational physics, nanotechnology, history of science, science and technology policy, philosophy of science, science teaching, pre-medical or pre-law programs, and management. Some students may choose to satisfy their experimental requirement and remaining restricted elective requirement in the same area as their focus; others may opt for greater breadth by choosing other fields for these requirements. The subjects in the focus group must be separate from those used to satisfy the student's HASS requirements. A physics subject included in the focus group may be used to satisfy the restricted elective requirement of one additional physics subject beyond 8.02, but may not be used to satisfy the experimental requirement.

\*The departmental portion of the Communications Requirement in the flexible option can be satisfied by taking two of the following: 8.06, 8.13, 8.225J, or 8.287J. The department may accept substitutions for any of these subjects by CI-M subjects from other departments if they form a natural part of the student's individual program.

One possible four year flexible schedule is shown at the end of this document. The following examples of possible focus groups in different areas are not intended to be exhaustive. Other subjects may be used to comprise a focus in these areas, and other areas of focus may be proposed.

#### EXAMPLES OF POSSIBLE FOCUS SELECTIONS

##### Astronomy

12.400 (3-0-9) The Solar System  
8.284 (3-0-9) Modern Astrophysics  
8.286 (3-0-9) The Early Universe

to satisfy the experimental requirement

12.410J (2-4-6) Observational Techniques of Optical Astronomy

##### Biophysics

7.03 (4-0-8) Genetics  
7.05 (5-0-7) General Biochemistry  
8.593J (formerly 8.515J) (4-0-8) Biological Physics

to satisfy the experimental requirement

7.02 (2-8-5) Introduction to Experimental Biology

##### Computational Physics

6.001 (5-3-7) Structure and Interpretation of Computer Programs  
18.330 (3-0-9) Introduction to Numerical Analysis  
6.042J (5-0-7) Mathematics for Computer Science

to satisfy the experimental requirement

8.13 (0-6-12) Experimental Physics I

### Nanotechnology

- 8.231 (4-0-8) Physics of Solids I
- 6.152J (3-4-5) Microelectronics Processing Technology
- 6.781 (3-0-9) Submicrometer and Nanometer Technology

to satisfy the experimental requirement  
Summer externship at Lucent Technologies, Bell Laboratories

### Philosophy of Science

- 8.06 (formerly 8.059) (3-0-9) Quantum Physics III
- 24.111 (3-0-9) Philosophy of Quantum Mechanics
- 24.215 (3-0-9) Topics in the Philosophy of Science

to satisfy the experimental requirement  
8.13 (0-6-12) Experimental Physics I

### History of Science

- 8.286 (3-0-9) The Early Universe
- STS.003 (3-0-9) The Rise of Modern Science
- STS.023J (2-6-4) Historic Experimentation

to satisfy the experimental requirement  
8.13 (0-6-12) Experimental Physics I

### Science Teaching

A relativity subject if not chosen under required subjects; otherwise, another core science subject beyond the GIRs

- 8.299 (arranged) Physics Teaching
- 11.124 (3-6-3) Introduction to Teaching and Learning Mathematics and Science

to satisfy the experimental requirement  
8.13 (0-6-12) Experimental Physics I

### Management

- 14.01 (3-0-9) Principles of Microeconomics
- 14.02 (3-0-9) Principles of Macroeconomics
- 15.501 (3-0-9) Introduction to Financial and Management Accounting

### Medicine or Law

A set of subjects comprising part of a pre-medical or pre-law program  
We suggest that the student consult with premed and pre-law advisors.

# Physics: Focused Option, Typical Schedule

Students in the Focused Option have five free electives.

Freshman		Sophomore		Junior		Senior	
Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
8.01*	8.02*	8.03	8.04	8.05	8.06	8 Elec	Thesis
Chem*	Bio*	8.033	8.044	Jr. Lab.	Jr. Lab.		8 Elec
18.01*	18.02*	18.03	18 Elec				
HASS*	HASS*	HASS*	HASS*	HASS*	HASS*	HASS*	HASS*

IAP: 8.223

\* = General Institute Requirement

Dark Grey slots are open for electives

8.03 and 18.03 also satisfy REST requirement

Jr. Lab. also satisfies Institute lab requirement

8.01 Introductory Mechanics

8.02 Electricity and Magnetism

8.03 Vibrations and Waves

8.033 Relativity

8.044 Statistical Physics I

8.04 Quantum Mechanics I

8.05 Quantum Mechanics II

8.06 Quantum Mechanics III

# Physics: Flexible Option, Possible Schedule

Students in the Flexible Option have eight free electives in addition to the three subject focus group.

Freshman		Sophomore		Junior		Senior	
Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
8.01*	8.02*	8.03	8.04	8.05		8 Elec	
Chem*	Bio*		8.044	Jr. Lab.			
18.01*	18.02*	18.03		Focus	Focus	Focus	
HASS*	HASS*	HASS*	HASS*	HASS*	HASS*	HASS*	HASS*

IAP: 8.223

\* = General Institute Requirement

Lt. Grey indicates one possible menu choice

Dark Grey indicates unrestricted electives

8.03 and 18.03 also satisfy REST requirement

Jr. Lab. also satisfies Institute lab requirement

8.01 Introductory Mechanics

8.02 Electricity and Magnetism

8.03 Vibrations and Waves

8.223 Classical Mech. II

8.044 Statistical Physics I

8.04 Quantum Mechanics I

8.05 Quantum Mechanics II