

Physics, Minor

Minor in Physics

The Minor in Physics is designed to provide a solid foundation in physics at the introductory level, followed by elective courses that will familiarize students with areas of modern physics and the concepts and techniques employed therein. The physics minor requires seven courses of at least 9 units each, of which four are prescribed and three are electives.

The minor is open to all students in the university, but students with non-calculus-based majors should be aware of the mathematics requirements for many physics courses (21-120, 21-122, and 21-259). Students are required to have successfully completed at least one of the required physics courses at Carnegie Mellon before declaring the minor, and should declare the minor no later than the add date of their final semester. Interested students should contact Dr. Gillian Ryan, Director of Undergraduate Affairs.

Course Requirements

	Units
33-121 Physics I for Science Students	12
or 33-141 Physics I for Engineering Students	
or 33-151 Matter and Interactions I	
33-122 Physics II for Biological Sciences and Chemistry Students	12
or 33-142 Physics II for Engineering and Physics Students	
or 33-152 Matter and Interactions II	
33-104 Experimental Physics	9
33-211 Physics III: Modern Essentials	10
33-xxx Three Qualifying Physics Electives or Physics Core Electives ¹	27-36
Total Physics Minor Units	70-79

¹ The physics electives (p.) are decided after consultation with, and approval by, the Director of Undergraduate Affairs. Students may take courses from the Qualifying Physics List or additional courses from the Physics Core list, such as Quantum Physics or Electronics I.

Physics Electives

Physics Breadth Electives

Students pursuing a B.S. in Physics must take at least one course from the Physics Breadth Elective list to gain experience in a subfield of physics. Some tracks have this course prescribed, while others allow free choice from this list. All of these courses may also be taken as Qualifying Physics Electives, but they may not fulfill both requirements simultaneously.

	Units
33-224 Stars, Galaxies and the Universe	9
33-226 Physics of Energy	9
33-353 Intermediate Optics	12
33-355 Nanoscience and Nanotechnology	9
33-431 Stars and Black Holes	9
33-432 Galaxies	9
33-433 Cosmology	9
33-441 Introduction to Biophysics	10
33-444 Introduction to Nuclear and Particle Physics	9
33-448 Introduction to Solid State Physics	9
33-650 General Relativity	9
Total Physics Breadth Elective Units	9-12

Qualifying Physics Electives

Students pursuing a B.S. in Physics must take at least three courses totaling at least 27 units from the Qualifying Physics Elective list, not including the 100-level courses. Some tracks have these courses prescribed, while others

allow free choice from this list, enabling students to choose between broad and in-depth study.

Students pursuing a B.A. in Physics must take at least two courses totaling at least 18 units from this list and may take **only one** of the 100-level courses.

Students pursuing a Minor in Physics must take at least three courses totaling at least 27 units from this list or non-prescribed courses from the Physics Core list.

While all courses on the Physics Breadth Elective list are also on the Qualifying Physics Elective list, a course may not fulfill both requirements simultaneously. Certain courses are offered only in alternate years, as indicated.

33-114 Physics of Musical Sound (B.A. and Minor only) ^a	9
33-115 Physics for Future Presidents (B.A. and Minor only) ^a	9
33-120 Science and Science Fiction (B.A. and Minor only) ^a	9
33-224 Stars, Galaxies and the Universe	9
33-226 Physics of Energy	9
33-241 Introduction to Computational Physics	9
33-332 Physical Mechanics II	10
33-339 Intermediate Electricity and Magnetism II	10
33-342 Advanced Thermal & Statistical Physics	10
33-350 Undergraduate Research ^b	Var.
33-353 Intermediate Optics	12
33-355 Nanoscience and Nanotechnology	9
33-431 Stars and Black Holes	9
33-432 Galaxies	9
33-433 Cosmology	9
33-441 Introduction to Biophysics	10
33-444 Introduction to Nuclear and Particle Physics	9
33-445 Advanced Quantum Physics I	9
33-446 Advanced Quantum Physics II	9
33-448 Introduction to Solid State Physics	9
33-451 Senior Research ^b	Var.
33-456 Advanced Computational Physics	9
33-499 Supervised Reading ^b	Var.
33-650 General Relativity	9
33-658 Quantum Computation and Quantum Information Theory	10
33-659 Modern Topics in Condensed Matter Physics	12
33-7xx Physics Graduate Level Courses (see list below)	

Total Qualifying Physics Electives Units 27-37

a Only one of these three courses (33-114, 33-115, and 33-120) may be used for the B.A. These classes may not be used as Qualifying Physics Electives for the B.S.

b Only one of these three courses (33-350, 33-451, and 33-499) of 9 units may be used as a Qualifying Physics Elective. To be counted as a Qualifying Physics Elective, all 9 units must be taken in a single semester. Any exceptions must be approved by the Director of Undergraduate Affairs.

Qualifying Physics Electives Recommended for Physics Graduate School

Students planning to undertake graduate studies in physics are strongly advised to take the following courses, which may count as Qualifying Physics Electives and STEM Electives.

	Units
33-332 Physical Mechanics II	10
33-339 Intermediate Electricity and Magnetism II	10
33-445 Advanced Quantum Physics I	9
33-446 Advanced Quantum Physics II	9

Physics Graduate Courses

These courses are intended for graduate students in physics, but may be taken by advanced undergraduates as Qualifying Physics or STEM Electives.

Undergraduate students require special permission of both the course instructor and the Director of Undergraduate Affairs to register for these classes.

		Units
33-731	Stars and Black Holes	12
33-732	Galaxies	12
33-733	Cosmology	12
33-755	Quantum Mechanics I	12
33-756	Quantum Mechanics II	12
33-757	Classical Mechanics	12
33-761	Classical Electrodynamics I	12
33-762	Classical Electrodynamics II	12
33-765	Statistical Mechanics	12
33-767	Biophysics: From Basic Concepts to Current Research	12
33-769	Quantum Mechanics III: Many Body and Relativistic Systems	12
33-770	Field Theory I	12
33-771	Field Theory II	12
33-779	Introduction to Nuclear and Particle Physics	12
33-780	Nuclear and Particle Physics II	12
33-783	Solid State Physics	12