

PHYSICS (BS)

Department Website (<http://as.nyu.edu/physics/>)

NYSED: 08332 HEGIS: 1902.00 CIP: 40.0801

Program Description

Physics is the most basic of the natural sciences. It is concerned with understanding the world on all scales of length, time, and energy. The methods of physics are diverse, but they share a common objective to develop and refine fundamental models that quantitatively explain observations and the results of experiments. The discoveries of physics rank among the most important achievements of human inquiry and have had an enormous impact on human culture and civilization. Members of the department conduct research in the fields of astrophysics, biophysics, cosmology, elementary particle physics, gravitation, hard and soft condensed matter physics, and statistical physics, carrying out experimental work in state-of-the-art laboratories in the department and at such national and international facilities as the Large Hadron Collider at CERN and large astronomical observatories.

The educational programs of the department are aimed at providing a range of courses to meet the needs of different student groups. For undergraduate Physics majors, there is a rigorous core program, exposure to current frontiers, and opportunities for research. For science majors outside of Physics, there are technical courses that emphasize the fundamental physical laws that underpin other sciences; and for other majors, nontechnical courses introduce some of the most important concepts of physics and their impact on the contemporary world.

Honors Program

Students who have completed at least 64 credits of graded work in the College may be awarded degrees with departmental honors in Physics if they meet all requirements of the major, complete the designated honors requirements, and maintain the requisite grade point average of 3.65 both in the major and overall.

The honors program must minimally be a two-term (8-credit) research experience that includes a capstone research project. The capstone project, which typically culminates in a thesis, should reflect sustained original research over two semesters. A committee of three faculty members of the Department of Physics is created for each honors student. The honors thesis must be approved by the committee, who will judge if the research is of sufficient quality. Publication in a recognized research journal of an article reporting research done primarily by the student is prima facie evidence that the research is deserving of honors. Because of inevitable delay in publication, an article submitted for publication may not be published in the time available, and the thesis committee may express its opinion that the thesis is of publishable quality.

All students completing departmental honors must make public presentations of their work, which may be at the CAS Undergraduate Research Conference (URC) held at the end of the academic year, or in a departmental forum (e.g., oral defenses or presentations), or at a recognized physics conference. Students should apply at the latest by April of junior year. For more information, visit the Physics website (<https://as.nyu.edu/departments/physics/programs/undergraduate.html#honors-program>).

Admissions

New York University's Office of Undergraduate Admissions supports the application process for all undergraduate programs at NYU. For additional information about undergraduate admissions, including application requirements, see How to Apply (<https://www.nyu.edu/admissions/undergraduate-admissions/how-to-apply.html>).

Program Requirements

The major in Physics leading to the BS degree requires twenty-one courses completed with a grade of C or better (courses graded Pass/Fail do not count). It differs from the BA in Physics (found elsewhere in this Bulletin) by deducting one (free) advanced elective in PHYS-UA while adding all of the following: PHYS-UA 210 Computational Physics; one year of General Chemistry; and either one course in biology or an additional course in chemistry, as outlined below.

| Course | Title | Credits |
|---|---|------------|
| General Education Requirements | | |
| First-Year Seminar | | 4 |
| EXPOS-UA 1 | Writing as Inquiry | 4 |
| Foreign Language ¹ | | 16 |
| Texts and Ideas | | 4 |
| Cultures and Contexts | | 4 |
| Societies and the Social Sciences | | 4 |
| Expressive Culture | | 4 |
| Major Requirements | | |
| MATH-UA 121 | Calculus I | 4 |
| MATH-UA 122 | Calculus II | 4 |
| PHYS-UA 91 & PHYS-UA 71 | Physics I and Introductory Experimental Physics I | 5 |
| PHYS-UA 93 & PHYS-UA 72 | Physics II and Introductory Experimental Physics II | 5 |
| MATH-UA 123 | Calculus III | 4 |
| PHYS-UA 95 & PHYS-UA 73 | Physics III and Intermediate Experimental Physics I | 5 |
| PHYS-UA 120 | Dynamics | 3 |
| PHYS-UA 74 | Intermediate Experimental Physics II | 2 |
| PHYS-UA 106 | Mathematical Physics | 3 |
| PHYS-UA 112 | Advanced Experimental Physics | 3 |
| PHYS-UA 123 | Quantum Mechanics I | 3 |
| PHYS-UA 131 | Electricity & Magnet I | 3 |
| PHYS-UA 140 | Thermal & Statistical Physics | 3 |
| Select one advanced physics elective | | 4 |
| PHYS-UA 210 | Computational Physics | 4 |
| Select one of the following: | | 10 |
| CHEM-UA 125 & CHEM-UA 126 | General Chemistry I & Laboratory and General Chemistry II & Laboratory | |
| CHEM-UA 129 | Accelerated General Chemistry | |
| Select one biology or chemistry course ² | | 4 |
| Electives | | |
| Other Elective Credits | | 16-25 |
| Total Credits | | 128 |

- ¹ The foreign language requirement is satisfied upon successful completion through the Intermediate level of a language. This may be accomplished in fewer than 16 credits, but those credits must then be completed as elective credit.
- ² In biology at or above the level of BIOL-UA 11 Principles of Biology I, or in chemistry above the level of CHEM-UA 126 General Chemistry II & Laboratory

Acceptable Advanced Electives in Physics for the BA and BS Majors

The courses below are offered in either the fall or spring term (not both), and some are not offered every year. Please see course descriptions in this Bulletin for prerequisites and frequency of offering. Additional electives may be available; majors should contact the Department of Physics for more information.

| Course | Title | Credits |
|-------------|---|---------|
| PHYS-UA 110 | Electronics for Scientists I | 4 |
| PHYS-UA 115 | Advanced Mathematical Physics | 3 |
| PHYS-UA 124 | Quantum Mechanics II | 3 |
| PHYS-UA 132 | Electricity & Magnet II | 3 |
| PHYS-UA 135 | Condensed Matter Physics | 3 |
| PHYS-UA 136 | Readings in Particle Physics | 3 |
| PHYS-UA 138 | Quantum Information and Quantum Computing | 4 |
| PHYS-UA 150 | Astrophysics | 4 |
| PHYS-UA 170 | General Relativity | 3 |
| PHYS-UA 180 | Introduction to Fluid Dynamics | 4 |
| PHYS-UA 210 | Computational Physics | 4 |
| PHYS-UA 800 | Special Topics in Physics: | 4 |

Sample Plan of Study

| Course | Title | Credits |
|--------------------------|--------------------------------------|-----------|
| 1st Semester/Term | | |
| PHYS-UA 91 | Physics I | 3 |
| PHYS-UA 71 | Introductory Experimental Physics I | 2 |
| MATH-UA 121 | Calculus I | 4 |
| Texts and Ideas | | 4 |
| First-Year Seminar | | 4 |
| Credits | | 17 |
| 2nd Semester/Term | | |
| PHYS-UA 93 | Physics II | 3 |
| PHYS-UA 72 | Introductory Experimental Physics II | 2 |
| MATH-UA 122 | Calculus II | 4 |
| EXPOS-UA 1 | Writing as Inquiry | 4 |
| Cultures and Contexts | | 4 |
| Credits | | 17 |
| 3rd Semester/Term | | |
| PHYS-UA 95 | Physics III | 3 |
| PHYS-UA 73 | Intermediate Experimental Physics I | 2 |
| MATH-UA 123 | Calculus III | 4 |
| Foreign Language | | 4 |
| Expressive Culture | | 4 |
| Credits | | 17 |
| 4th Semester/Term | | |
| PHYS-UA 106 | Mathematical Physics | 3 |
| PHYS-UA 120 | Dynamics | 3 |

| | | |
|--|--|------------|
| PHYS-UA 74 | Intermediate Experimental Physics II | 2 |
| Foreign Language | | 4 |
| Societies and the Social Sciences | | 4 |
| Credits | | 16 |
| 5th Semester/Term | | |
| PHYS-UA 123 | Quantum Mechanics I | 3 |
| PHYS-UA 131 | Electricity & Magnet I | 3 |
| CHEM-UA 125 | General Chemistry I & Laboratory | 5 |
| Foreign Language | | 4 |
| Credits | | 15 |
| 6th Semester/Term | | |
| PHYS-UA 112 | Advanced Experimental Physics | 3 |
| PHYS-UA 140 | Thermal & Statistical Physics | 3 |
| CHEM-UA 126 | General Chemistry II & Laboratory | 5 |
| Foreign Language | | 4 |
| Credits | | 15 |
| 7th Semester/Term | | |
| PHYS-UA XXX | Advanced Physics Elective ¹ | 3 |
| BIOL-UA 11 | Principles of Biology I ² | 4 |
| Elective | | 4 |
| Elective | | 4 |
| Credits | | 15 |
| 8th Semester/Term | | |
| PHYS-UA 210 | Computational Physics | 4 |
| Elective | | 4 |
| Elective | | 4 |
| Elective | | 4 |
| Credits | | 16 |
| Total Credits | | 128 |

- ¹ Chosen from a list of approved elective courses on the curriculum tab.
- ² Students may substitute this course for one course above CHEM-UA 126 General Chemistry II & Laboratory.

Learning Outcomes

Upon completion of program requirements, students are expected to have acquired:

1. A fundamental command of physics, as well as of the subdisciplines of classical mechanics and electromagnetism, special relativity, quantum mechanics, and statistical and thermal physics.
2. Facility in advanced topics (chosen from among general relativity, condensed matter physics, biophysics, and others) relevant to modern research.
3. The mathematical skills required to describe and predict the behavior of physical systems from first principles.
4. The experimental and analytical skills needed to test the application of physical laws to real systems.
5. Facility in advanced topics in mathematics, chemistry, and/or biology, and an understanding of their relation to concepts in physics.

Policies

Program Policies

Advanced Placement Policy

In the summer before their first year, students considering a major in Physics may consult with the department about possibly counting credit for AP Physics C: Mechanics and/or AP Physics C: Electricity and Magnetism toward the major and placing out of Physics I (PHYS-UA 91) and/or Physics II (PHYS-UA 93), respectively. Students are usually

advised, however, to take Physics I and II at NYU as a foundation for doing well in the major curriculum. If majors are granted permission to place out of PHYS-UA 91 and 93, they must still complete the laboratory classes that are taken with those lectures (Introductory Experimental Physics I and II, PHYS-UA 71 and 72). They are also required to take (with departmental advisement) one or two additional advanced PHYS-UA electives (beyond the basic major requirement of two advanced electives in this department). Finally, Physics majors who are prehealth must be sure to present a year of physics with labs to meet admissions requirements of health professional schools; they cannot rely on their Physics AP C exams to meet the requirements of these schools. No other AP credit in Physics (or from similar international exams) can be applied to the requirements of the Physics major.

Although Physics I and Physics II have a number of topics that are nominally included in the AP Physics C curriculum, they are all treated in greater depth and with more rigor in our courses, which use differential and integral calculus. In addition, Physics I and Physics II cover several topics that are not included in a high school AP course. These include approximately two weeks on Einstein's theory of special relativity in Physics I, and AC circuits, phasors, electromagnetic radiation, Maxwell's equations, and Poynting's theorem in Physics II. Students with credit for either or both of the AP Physics C exams will not find Physics I and II to be redundant.

Mathematics Requirement

Potential Physics majors should begin their calculus sequence in the fall semester of their first year. Students are advised to take advanced mathematics courses—such as Linear Algebra (MATH-UA 140)—as they proceed in the major.

School of Engineering courses

This option is open only to students with declared majors in the Department of Physics. They may seek prior permission from the director of undergraduate studies to take advanced electives in the School of Engineering and apply them to the major. This is reviewed on a case-by-case basis. These courses count against each student's 16-credit allowance in the other divisions of NYU and cannot be applied to the 64-credit UA residency requirement.

NYU Policies

University-wide policies can be found on the New York University Policy pages (<https://bulletins.nyu.edu/nyu/policies/>).

College of Arts and Science Policies

A full list of relevant academic policies can be found on the CAS Academic Policies page (<https://bulletins.nyu.edu/undergraduate/arts-science/academic-policies/>).