

PHYSICS AND ASTRONOMY

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Varley, Yau

Assistant Professors:

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Physical Sciences Learning Center Director: Marilyn Rothschild

Advisers:

(majors) Steve Greenbaum; (teacher education) Rodney Varley;

(pre-engineering) Leon Cohen; (evening/graduate) Gregory Foster

HEGIS Code: 1902

Majors Offered	Options in Degree	Number Credits	Recommended/Required GER	Prereq	Recommended Minor
BA in Physics	Option 1 For students in the BA/MA program, students intending to teach grades 7-12, and students intending to enter the medical profession	30 in physics + 15-24 credits of allied courses: 1. Intro courses (PHYS 111, 121 preferred) [8 cr] 2. Phys 221, 222[lab], 330, 334, and 335 [18 credits] 3. Phys 230 and Phys 235 [4 cr] 4. 15-24 credits of allied courses [mathematics and chemistry]	See Adviser	MATH 150 or equivalent	For students in the BA/MA program and students intending to enter the medical profession, 12 credits in biological sciences, chemistry, computer science, geology, mathematics, or another approved field selected after conference with the major adviser. For students planning to become physics teachers grades 7-12, the 23-credit adolescence education sequence is taken in lieu of a minor.
	Option 2 (Laser and Fiber Optics Concentration) All four courses of the sequence PHYS 231, 232, 233, and 234 are required. No more than 4 credits of the sequence PHYS 231-234 may be used toward the major]	30 in physics + 15-24 credits of allied courses: 1. Intro courses (PHYS 111, 121 preferred) [8 cr] 2. Phys 231, 232, 233 and 234 [4 cr] (no more than 4 cr of the sequence may be used towards the major) 3. Phys 221, 222[lab], 330, 334, and 335 [18 credits] 4. 15-24 credits of allied courses [mathematics and chemistry]		MATH 150 or equivalent	12 credits in biological sciences, chemistry, computer science, geology, mathematics, or another approved field selected after conference with the major adviser.
BA/MA in Physics	BA/MA is recommended for students planning to pursue a PhD in physics	30 in physics + 15-24 credits of allied courses: 1. Intro courses (PHYS 111, 121 preferred) [8 cr] 2. Phys 221, 222[lab], 330, 334, and 335 [18 credits] 3. Phys 230 and Phys 235 [4 cr] 4. 15-24 credits of allied courses [mathematics and chemistry] 5. 30 credits for the graduate curriculum		MATH 150 or equivalent	12 credits in biological sciences, chemistry, computer science, geology, mathematics, or another approved field selected after conference with the major adviser.

Physics is the study of the basic interactions that govern the behavior of the universe as we know it. As such, a knowledge of physics is necessary for the proper understanding of any science, and, of course, it is an exciting field of study in its own right.

The department offers comprehensive training in physics that can lead to a teaching position in grades 7-12; industrial, institutional and government work; and graduate study. The major includes lecture courses, laboratory courses, and a chance for qualified students to participate in research with faculty members.

Graduate Study

The Department of Physics and Astronomy offers a number of advanced courses, listed in the Graduate Catalog, which give credit toward the degree of master of arts. Qualified undergraduate students may be admitted to these courses with the approval of the department chair.

Accelerated BA/MA Program in Physics

This special program for a limited number of well-qualified students leads to a bachelor of arts and a master of arts degree. Students are offered the opportunity quickly to reach a level where they can stand in competition for admission into any doctoral program in physics. The program requires

124-126 credits (including the 30 credits required for a physics major BA degree and 30 credits from the graduate curriculum). Because this program requires a large number of physics courses, many of which have other physics courses as prerequisites, students in this program should begin taking physics courses in their first or second semester. Students should consult the department chair, undergraduate adviser or graduate adviser for details as early as possible.

Dual degrees BA/BS in physics and engineering are proposed for the near future; contact the pre-engineering adviser.

Physics for Non-Physics Majors

A minimum of one year of physics is recommended for all majors in sciences and health sciences.

Medical and dental schools also require one year of physics. Students requiring one year of physics may take either the PHYS 110-120 sequence (9 cr) or the PHYS 111-121 sequence (11 cr). Although both sequences cover the same topics, PHYS 111-121 utilizes elementary calculus and meets for one additional lecture hour each week. It is recommended for science students and those premed students who satisfy the mathematics pre- or corequisite. PHYS 101 (4 cr) should be taken only by those who want a one-semester terminal course in physics; it does not satisfy pre-professional requirements. Students should take no more than one first-semester course (PHYS 101, 110, 111) and no more than one second-semester course (PHYS 120, 121) since they may receive credit for no more than one course from each group.

MAJOR

The major consists of 8 credits of introductory physics courses and a 22-credit concentration in physics courses at the 200 level and higher. Additionally, 15-24 credits of allied courses (mathematics and chemistry) are also required. Together, the introductory physics and the Option 1 concentration (30 credit total) satisfy the major requirement for certification as a teacher of physics in grades 7-12. Option 1, together with the MA (see the Accelerated BA/MA Program in Physics), is recommended for students planning to pursue a PhD in physics. Option 2 is recommended for those interested in a career in the telecommunications industry, as it includes a foundation in lasers and fiber optics. Eight (8) credits of introductory physics are required, with PHYS 111-121 recommended. PHYS 110-120 may be taken instead. No more than 8 credits toward the major can be obtained from these courses. It is recommended that PHYS 190 be taken if the PHYS 110-120 sequence is taken instead of the PHYS 111-121 sequence. MATH 150, 155, 250, and 254 (15 cr) are required of all physics majors in addition to one year of high school chemistry or college chemistry.

Concentration in Physics

Four intermediate-level lecture courses (16 cr), PHYS 221, 330, 334, and 335, must be taken in addition to the lab course PHYS 222 (2 cr). Also, one of two options below is necessary.

Option 1

For students in the BA/MA program, students intending to teach grades 7-12, and students intending to enter the medical profession. Two physics laboratory courses (4 cr), PHYS 230 and 235, are required.

Option 2

(Laser and Fiber Optics Concentration) All four courses of the sequence PHYS 231, 232, 233, and 234 are required. No more than 4 credits of the sequence PHYS 231-234 may be used toward the major.

Minor

12 credits in biological sciences, chemistry, computer science, geology, mathematics, or another approved department or program that leads to a BA degree and is selected after conference with the major adviser. For students planning to become physics teachers at the secondary level the 23-credit sequence in secondary education constitutes an appropriate minor.

Minor for Non-Majors

Students choosing to minor in physics should consult their major department adviser for appropriate course recommendations. Faculty from the physics and astronomy department will be pleased to help in the selection of courses for the minor in physics and astronomy.

Preparation for Teaching

The major in physics satisfies the requirements for NY State initial certification of at least 30 credits for teachers in adolescence education: physics (grades 7-12).

Students preparing to teach physics are advised to include the following courses or their equivalents in their undergraduate program: MATH 254; CHEM 102, 103, 104, 105; ASTRO 100;

GEOL 101; and BIOL 100. See the School of Education section of this catalog for additional requirements and consult with an adviser in the School of Education.

Honors Work

The opportunity for students to do individual research (experimental or theoretical) is offered in courses PHYS 453 and 454.

Articulation Agreement for Queensborough AAS Degree in Laser Technology

An articulation agreement is in place for AAS graduates from Queensborough Community College with a degree in Laser Technology. Consult the Physics department for further information.

Pre-Engineering Program

The college offers courses that will prepare the student in the first two years of study to pursue a career in engineering. Students planning to go into engineering should consult the pre-engineering adviser during preadmission conference days and also at least once each semester.

This program is directed toward the degree of bachelor of science in engineering. The courses offered are chosen so that students will have satisfied their first two years' requirement if they transfer to another college for their final two years.

Those students planning to go to an engineering school other than City College should see the pre-engineering adviser to work out a program suitable to their needs.

If, by the end of the fourth semester, students decide not to continue their engineering degree and to remain at Hunter College, they become subject to the same requirements as other Hunter College students. Many of the courses taken in the pre-engineering program may be used to satisfy these requirements.

The following courses comprise the pre-engineering curriculum:

CREDITS TO BE TAKEN TO PREPARE FOR:

COURSES	CHEMICAL ENGINEERING	CIVIL ENGINEERING	ELECTRICAL ENGINEERING	MECHANICAL ENGINEERING
SCIENCE COURSES				
Mathematics				
MATH 150, 155, 250, 254	15	15	15	15
MATH 211	—	—	3	—
Chemistry				
CHEM 102, 103	4.5*	4.5*	4.5**	4.5*
CHEM 104, 105	4.5*	4.5*	—	4.5*
Computer Science				
CSCI 130	4	4	4	4
Geology				
GEOL 101	—	4	—	—
Physics				
PHYS 111, 121	11	11	11	11
PHYS 330 or 360	4	4	4	4
PHYS 335 or 365	4	—	4	—
Technical Drawing				
ARTCR 261	3	3	—	3
OTHER COURSES				
English				
ENGL 120	3	3	3	3
Humanities & Social Sciences				
3-4 courses***	9-12	9-12	9-12	9-12
Economics				
ECO 200 – or – 201	3	3	3	3

* CHEM 102 and 104 can be replaced by CHEM 111, 112, 113 (3 semesters).

** CHEM 102 can be replaced by CHEM 111, 112 (2 semesters) for 4 cr.

*** Skills courses will not be credited. For example, accounting, statistics, photography, drawing, musical instruments technique, non-literature courses, etc., are regarded as skills courses.

COURSE LISTINGS

ASTRO 100 Basic Concepts in Astronomy

GER 2/E

An introductory 1-semester astronomy course designed for non-science majors. GER 2/E credit awarded as a non-laboratory science course. Core credit awarded for a science course with lab only if ASTRO 100 and ASTRO 107 are completed.

3 hrs, 3 cr.

ASTRO 107 Laboratory Exercises in

Astronomy

GER 2/E

Laboratory exercises in astronomy to observe the major features of the night sky, demonstrate the physical basis of astronomical instruments, and experiment with astronomical phenomena. Core credit awarded only if ASTRO 100 or equivalent and ASTRO 107 are completed.

pre- or coreq: ASTRO 100

2 hrs, 1 cr.

PHYS 101 Study of Selected Phenomena and Basic Concepts of Physics

GER 2/E

Introductory one-semester physics course designed for non-science majors and others requiring a one-semester terminal course.

6 hrs (3 lec, 3 lab), 4 cr.

PHYS 110 General Physics: Introductory Course in Mechanics, Heat, and Sound

GER 2/E

First semester of two-semester introductory physics course using algebra.

prereqs: MATH 125; pre-calculus or equiv. by math dept. exam.

7 hrs (3 lec, 3 lab, 1 rec), 4.5 cr.

PHYS 111 General Physics: Introductory Course in Mechanics, Heat, and Sound

GER 2/E

For physics and other science majors. First semester of a two-semester introductory physics course using calculus.

pre- or coreq (with perm dept.): MATH 150
8 hrs (4 lec, 3 lab, 1 rec), 5.5 cr.

PHYS 120 General Physics: Introductory Course in Electricity and Magnetism, Light, and Atomic Physics

GER 2/E

Second semester of PHYS 110, a two-semester introductory physics course using algebra.

prereq: PHYS 110 or 111

7 hrs (3 lec, 3 lab, 1 rec), 4.5 cr.

PHYS 121 General Physics: Introductory Course in Electricity and Magnetism, Light, and Atomic Physics

GER 2/E

Second semester of PHYS 111, a two-semester introductory physics course using calculus.

prereq: PHYS 110 or 111

pre- or coreq (with perm dept.): MATH 155
8 hrs (4 lec, 3 lab, 1 rec), 5.5 cr.

PHYS 190 Tutorial in Mathematical Physics

Applications of differential and integral calculus to selected topics chosen from the major subfields of physics. Completion of this course and its prerequisites is equivalent to completion of the calculus-based general physics sequence, PHYS 111 and 121.

prereqs: MATH 155, PHYS 120

3 hrs (2 lec, 1 rec), 2 cr.

PHYS 221 Electronics

GER 3/B

Circuit theory of passive devices (resistors, capacitors, and inductors). Semi-conductor principles and transistor amplifier design. Integrated circuit applications and digital computer logic circuit principles.

prereq: PHYS 120 or PHYS 121

4 hrs, 4 cr.

PHYS 222 Electronics Laboratory

GER 3/B

Experiments are performed with passive devices (capacitors, inductors, resistors) and active devices (diodes, transistors). A variety of transistor amplifier and oscillator circuits are studied as well as integrated circuit applications.

coreq: PHYS 221

4 hrs, 2 cr.

PHYS 230 Classical Physics Laboratory

GER 3/B

Selected experiments of mechanics, electricity/magnetism, and thermodynamics. Experiments may include driven oscillator resonance, coupled oscillators, liquid nitrogen heat of vaporization, Fourier analysis/filtering, ferromagnetic hysteresis, and the nonlinear pendulum period. Elementary error analysis techniques and computer software for data analysis/graphing.

prereq: PHYS 120 or 121

4 hrs, 2 cr.

PHYS 231 Fundamentals of Laser and Fiber Optics

GER 3/B

Topics in optics related to lasers and optical fiber and devices for modulating and directing signals from such devices. Geometrical optics with emphasis on ray tracing. Matrix methods in optics. Lenses thick and thin, mirrors, prisms and other passive optical elements and systems. Propagation of light in materials. Dispersion and its effects. Special topics in geometric and wave optics. Laboratory complements classwork.

prereqs: PHYS 120 or 121 or equiv; MATH 125

5 hrs, 4 cr.

PHYS 232 Laser and Electro-Optics Technology

GER 3/B

Wave optics, interference, coherence, polarization, birefringence, diffraction, gratings in two and three dimensions, power and energy measurements, basics of laser safety, ultra-fast pulse technology measurements, basics of laser safety, ultra-fast pulse technologies, electro-optics and acousto-optics switches, optical materials, non-linear optics. Laboratory complements classwork.

prereq: PHYS 231

7 hrs, 5 cr.

PHYS 233 Laser Electro-Optics Devices, Measurements and Applications

GER 3/B

Laser as a device, principle of operation, cavity modes and their control (tuning elements, Q switching, mode-locking) and detection, laser design, types of lasers, includes discussion of laser types for medical, ranging and tracking, material processing, pollution monitoring, and optical memory applications, semiconductor laser. Laboratory complements class work.

prereq: PHYS 231

6 hrs, 4 cr.

PHYS 234 Fiber Optics Devices, Measurements, and Applications

GER 3/B

Propagation of light in optical fiber, including analysis of the behavior of different modes. Dispersion and distortion. Specialized light sources and their characterization. Fiber optic sensors. All-optical fiber amplifiers. Optical switches and logic gates. Optical isolators. Techniques for joining fibers. Instruments for characterizing fiber and fiber links. Optical communications systems and protocols. Wavelength division multiplexing. Medical applications including fiber optics-diagnostic and surgical. Optical data processing and optical memories. Laboratory complements classwork.

prereq: PHYS 231

6 hrs, 4 cr.

PHYS 235 Modern Physics Laboratory

GER 3/B

Selected experiments of quantum physics and optics. Experiments may include nuclear half-life, microwave diffraction, Bragg scattering of x-rays, nuclear multichannel scintillation, Franck-Hertz quantum levels, Millikan oil drop. Error analysis techniques including Gauss and Poisson distributions and correlation of data. Programming for data analysis.

prereq: PHYS 120 or 121

4 hrs, 2 cr.

PHYS 301 Theoretical Physics

Analysis of mathematical techniques for solving partial differential equations occurring in physics. Cross-listed as MATH 301.

prereq: MATH 254

4 hrs, 4 cr.

PHYS 330 Atomic and Nuclear Physics

Examines experimental evidence and develops modern view of structure of atom and nucleus.

prereq: PHYS 120 or 121

pre- or coreq: MATH 250

4 hrs, 4 cr.

PHYS 334 Intermediate Electricity and Magnetism

Electrostatics, currents, magnetism, and introduction to electromagnetic theory of light.

prereq: PHYS 120 or 121

pre- or coreq: MATH 250

4 hrs, 4 cr.

PHYS 335 Intermediate Mechanics

Study of laws of motion and coordinate systems; introduction to powerful analytical techniques.

prereq: PHYS 120 or 121

pre- or coreq: MATH 250

4 hrs, 4 cr.

PHYS 336 Thermodynamics and Statistical Mechanics

Study of fundamental ideas of heat, reversibility, and entropy. Introduction to statistical nature of some physical laws.

prereqs: PHYS 120 or 121; MATH 250
4 hrs, 4 cr.

PHYS 342 Optics

Study of lenses, mirrors, interference, diffraction, and polarization, as well as lasers, holography, and Fourier optics.

prereqs: PHYS 120 or 121; MATH 250
3 hrs, 3 cr.

PHYS 385 Numerical Methods I

Accuracy and precision, convergence, iterative and direct methods. Topics selected from: solution of polynomial equations and linear systems of equations, curve fitting and function approximation, interpolation, differentiation and integration, differential equations. Note: Cross-listed as MATH 385 and CSCI 385 so that students in the mathematics and computer science departments can use the course toward the completion of their major requirements.

prereq: MATH 254
3 hrs, 3 cr.

PHYS 411 Theoretical Mechanics

Classical mechanics of particles and rigid bodies; special relativity; Hamilton's formulation; Liouville's theorem.

prereq: PHYS 335
pre- or coreq: MATH 254
3 hrs, 3 cr.

PHYS 415 Electromagnetic Theory

Electrostatics; electromagnetics; Maxwell's equation with application to waves; waves in guides; radiation.

prereq: PHYS 334
pre- or coreq: MATH 254
3 hrs, 3 cr.

PHYS 424 Plasma Physics

Motion of charged particles in external magnetic and electrical field; fusion using tokamaks, mirrors, and lasers.

prereq: PHYS 334
3 hrs, 3 cr.

PHYS 425 Quantum Theory

From Bohr model and DeBroglie waves to Schrodinger wave equation; solutions for simple cases; transformations.

prereq: PHYS 330
pre- or coreq: MATH 254
3 hrs, 3 cr.

PHYS 427 Intermediate Physics Laboratory

Study of modern experimental techniques in variety of fields.

prereq: PHYS 235
4 hrs, 2 cr.

PHYS 445 Solid State Physics

Energy levels in atoms, molecules, and solids; crystal structure; properties of solids; semiconducting devices.

prereq: PHYS 330
3 hrs, 3 cr.



PHYS 453 Introduction to Research

Independent theoretical or experimental research or independent study of approved topic.

prereqs: PHYS 330, 334, 335, and 427 or *perm chair*
1-3 cr.

PHYS 454 Introduction to Research

Independent theoretical or experimental research or independent study of approved topic.

prereq: PHYS 453 or *perm chair*
1 to 3 cr.

PHYS 485 Numerical Methods II

Topics in numerical methods selected from solutions of linear equations, interpolating functions, root finding methods, nonlinear equations, Fourier series and the fast Fourier transform, partial differential equations. A major term project will be assigned. Note: Cross-listed as MATH 485 and CSCI 485 so that students in the mathematics and computer science departments can use the course toward the completion of their major requirements.

prereq: PHYS 385
3 hrs, 3 cr.

Courses Not Offered During 2004-2007:

ASTRO 101 Concepts and Laboratory Exercises in Astronomy

ASTRO 181 Astronomy of the Solar System

ASTRO 182 Stellar Astronomy

PHYS 145 Physics of Computers

PHYS 186 Acoustics of Music

PHYS 240 Physics of Biological Systems

PHYS 245 Computer Applications in Physical Sciences

PHYS 280 Astrophysics

PHYS 360 Atomic and Nuclear Physics for Engineers

PHYS 364 Electricity and Magnetism for Engineers

PHYS 365 Analytical Mechanics

PHYS 403 Topics in Modern Physics