

## Physics-1

### Physics

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The objectives of the department are to develop the student's comprehension of the basic principles of physics, to instill a sense of inquiry in the student, to develop an appreciation of the role of physics in our attempt to understand the universe, and to develop an understanding of its power to deal with problems related to technology and the environment.

The physics major in the Liberal Arts track (PHYA) can, by proper choice of electives, prepare for graduate work in physics, astronomy and astrophysics, geophysics, environmental science, or professional schools such as medicine or law. The student may also choose to work in industry, public service, teaching, or wherever problem-solving abilities are needed.

The Teacher Preparation Track (PHYT) will prepare graduates to teach various courses ranging from high school physics to science in the junior high and middle schools, depending on the courses elected. Therefore, it is strongly recommended that the student elect those courses which will satisfy the demands of his or her chosen profession.

The Computational Physics track (PHYC) combines physics, computer science, and mathematics. A graduate of this program will have an understanding of physics and, in addition, will be able to apply computer knowledge to the solution of various technical problems.

The Biomedical Physics track (PHYH) allows students to enhance their education in biology, chemistry, and bioengineering while using their physics skills and analytical problem solving abilities. This track is suitable for those interested in careers in medicine, biology, biophysics, or medical physics. The track satisfies the general medical school admissions requirements when proper choices of options and electives are made.

The Earth Science track (PHYG) establishes a physics education and applies it to physical processes in the Earth System through observational, computational, and data analyses. A graduate of this program will gain an appreciation for the interdisciplinary complexity and coupled nature of our solid earth, atmosphere and hydrosphere.

### Program Entrance, Retention, and Exit Standards

Every major program at the College has set standards for allowing students to remain in that program, to transfer within the College from one program to another, and to graduate from a program. The following are the standards for physics programs. Minimum grades are noted in parentheses.

- Retention in the program is based on the following performance standards in these "critical content courses": PHY 201 (C–), PHY 202 (C–), PHY 321 (C–).
- Transfer into the program from another program within the College is based upon the following performance standards in this "foundation course": PHY 201 (C–).
- Graduation requires a GPA of 2.0 in courses for the program and earning a minimum grade of C– in the following courses: PHY 201 (C–), PHY 202 (C–), PHY 321 (C–).

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### Study Abroad

One of the opportunities available to students pursuing a degree in physics is to study abroad for a semester. Any student interested in studying abroad should meet with his/her faculty advisor early in his/her college career to plan a curriculum so that the student may complete his/her studies in four years. He/she may also need to meet with the Office of [International and Off-Campus Programs](#). The student must receive approval from the chairperson of the Physics Department in order for courses taken abroad to count toward requirements in the major.

### Physics Major (PHYA)—Physics Liberal Arts Track

#### Physics Major Required Courses (14 course units)

PHY 099/Orientation to Physics	0 course unit
PHY 201, 202/General Physics I, II	2 course units
PHY 306/Mathematical Physics	1 course unit
PHY 311/Analog and Digital Electronics	1 course unit
PHY 321/Modern Physics	1 course unit
PHY 401/Classical Mechanics	1 course unit
PHY 411/Optics and Wave Motion	1 course unit
PHY 416/Thermodynamics	1 course unit
PHY 421, 422/Electromagnetic Theory I, II	2 course units
PHY 431/ Quantum Mechanics	1 course unit
PHY 451/Experimental and Analytical Physics	1 course unit
Two physics options (see below)	2 course units

#### Physics Major Option Courses (select two course units)

PHY 413/General Relativity and Cosmology	1 course unit
PHY 426/Particle and Nuclear Physics	1 course unit
PHY 436/Condensed Matter	1 course unit
PHY 466/Astrophysics	1 course unit

#### Physics Electives (select two course units)

PHY 316/Biomedical Physics	1 course unit
PHY 391/Independent Study	1 course unit
PHY 393/Independent Research I	1 course unit
PHY 493/Independent Research II	1 course unit

#### Physics required correlates (six course units)

CHE 201, 202/General Chemistry I, II	2 course units
CSC 215/Computer Science I	
<i>or</i>	
CSC 220 Computational Problem Solving	1 course unit
MAT 127, 128/Calculus A, B	2 course units
MAT 326/Differential Equations	1 course unit

#### Suggested First-Year Sequence (PHYA)

##### Fall Semester

FSP First Seminar	1 course unit
PHY 099/Orientation to Physics	0 course unit
PHY 201/General Physics I	1 course unit

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MAT 127/Calculus A	1 course unit
Liberal Learning	1 course unit

#### Spring Semester

PHY 202/General Physics II	1 course unit
CSC 215/Computer Science I	
<i>or</i>	
CSC 220/Computational Problem Solving	1 course unit
MAT 128/Calculus B	1 course unit
WRI 102/Academic Writing* (if not exempted)	1 course unit

*\*It is recommended that students exempted from this course take another liberal learning course.*

### Physics Major (PHYC)—Computational Physics Track

#### Physics Major Required Core Courses (five course units)

PHY 099/Orientation to Physics	0 course unit
PHY 201, 202/General Physics I, II	2 course units
PHY 306/Mathematical Physics	1 course unit
PHY 311/Analog and Digital Electronics	1 course unit
PHY 321/Modern Physics	1 course unit

#### Physics Options (select six course units)

PHY 316/Biomedical Physics	1 course unit
PHY 393/Independent Research I	1 course unit
PHY 401/Classical Mechanics	1 course unit
PHY 411/Optics and Wave Motion	1 course unit
PHY 413/General Relativity and Cosmology	1 course unit
PHY 416/Thermodynamics	1 course unit
PHY 421/Electromagnetic Theory I	1 course unit
PHY 422/Electromagnetic Theory II	1 course unit
PHY 426/Particle and Nuclear Physics	1 course unit
PHY 431/Quantum Mechanics	1 course unit
PHY 436/Condensed Matter	1 course unit
PHY 451/Experimental and Analytical Physics	1 course unit
PHY 493/Independent Research II	1 course unit
PHY 466/Astrophysics	1 course unit

#### Computation Core (six course units)

MAT 127, 128/Calculus A,B	2 course units
CSC 215/Computer Science I	1 course unit
CSC 220/Computational Problem Solving	1 course unit
CSC 230/Computer Science II	1 course unit
CSC 340/Programming in the Large	1 course unit

#### Computation Options (two course units—by advisement)

CSC 310/Discrete Structures	1 course unit
CSC 325/Computer Architecture	1 course unit
CSC 350/Computer Graphics	1 course unit
CSC 360/Networks	1 course unit
CSC 370/Stack Machines	1 course unit
CSC 380/Artificial Intelligence	1 course unit
CSC 390/Programming Language	1 course unit

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STA 115/Statistics I	1 course unit
MAT 315/Linear Algebra I	1 course unit
MAT 316/Probability	1 course unit
MAT 326/Differential Equations	1 course unit

### Suggested First-Year Sequence (PHYC)

#### Fall Semester

FSP First Seminar	1 course unit
PHY 099/Orientation to Physics	0 course unit
PHY 201/General Physics I	1 course unit
MAT 127/Calculus A	1 course unit
Liberal Learning	1 course unit

#### Spring Semester

PHY 202/General Physics II	1 course unit
CSC 220/Computational Problem Solving	1 course unit
MAT 128/Calculus B	1 course unit
WRI 102/Academic Writing* (if not exempted)	1 course unit

*\*It is recommended that students exempted from this course take another liberal learning course.*

### Physics Major (PHYT)—Physics Teacher Preparation Track

An overview of the entire secondary-level teacher preparation sequence for students can be found in the section of this bulletin for the Department of Education Administration and Secondary Education.

Students planning to teach middle or high school physics should consult with their advisor in planning their academic program. These plans should take into account requirements for: the major, liberal learning, professional courses, and state certification. To be retained in the program, a student must earn at least a 2.5 cumulative grade point average before enrolling in the junior year education sequence. The student must establish a minimum 2.75 GPA in order to be allowed to student teach.

Candidates for a teacher-education certificate must have a 2.75 or higher cumulative grade point average to successfully complete their teacher education program. They also must meet the state hygiene/physiology requirement, and pass the appropriate Praxis examination before the New Jersey State Department of Education will issue the appropriate certificate. Teacher-education candidates will receive a “certificate of eligibility with advanced standing” which requires a candidate to be provisionally certified for his or her first year of teaching. After one year of successful teaching, the candidate is eligible for a permanent certificate

### Required Major Courses (10 course units)

PHY 161/Introduction to Astronomy	1 course unit
PHY 120/Introduction to Geology	1 course unit
PHY 171/Introduction to Meteorology	1 course unit
PHY 099/Orientation to Physics	0 course unit
PHY 201, 202/General Physics I, II	2 course units
PHY 311/Analog and Digital Electronics	1 course unit
PHY 321/Modern Physics	1 course unit
PHY 390/Methods of Teaching Science	1 course unit
Two physics options (see below)	2 course units

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### Physics Options (select 2 course units)

PHY	306/Mathematical Physics	1 course unit
PHY	316/Biomedical Physics	1 course unit
PHY	393/Independent Research I	1 course unit
PHY	401/Classical Mechanics	1 course unit
PHY	411/Optics and Wave Motion	1 course unit
PHY	413/General Relativity and Cosmology	1 course unit
PHY	416/Thermodynamics	1 course unit
PHY	421/Electromagnetic Theory I	1 course unit
PHY	422/Electromagnetic Theory II	1 course unit
PHY	426/Particle and Nuclear Physics	1 course unit
PHY	431/Quantum Mechanics	1 course unit
PHY	436/Condensed Matter	1 course unit
PHY	451/Experimental and Analytical Physics	1 course unit
PHY	466/Astrophysics	1 course unit
PHY	493/Independent Research II	1 course unit

### Required Correlates (seven course units)

CHE	201, 202/General Chemistry I, II	2 course units
CHE	Chemistry options (see below)	2 course units
CSC	215/Computer Science I	
<i>or</i>		
	220/Computational Problem Solving	1 course unit
MAT	127, 128/Calculus A, B	2 course units

### Chemistry Options (select two course units)

CHE	353, 354/Organic Chemistry I, II
CHE	371/Physical Chemistry
CHE	340/History of Chemistry and Physics
CHE	310/Analytical Chemistry

### Professional Education Sequence:

SED	224/Adolescent Learning and Development	1 course unit
EFN	298/School and Communities	1 course unit
SED	399/Pedagogy in Secondary Schools	1 course unit
SPE	323/Secondary Content Literacy in Inclusive Classrooms	1 course unit
EFN	398/Historical and Political Context of Schools	1 course unit
PHY	490/Student Teaching	2 course units
SED	498/Collaborative Capstone for Professional Inquiry	1 course unit

### Suggested First-Year Sequence (PHYT)

#### Fall Semester

FSP	First Seminar	1 course unit
PHY	099/Orientation to Physics	0 course unit
PHY	201/General Physics I	1 course unit
MAT	127/Calculus A	1 course unit
	Liberal Learning	1 course unit

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### Spring Semester

PHY	202/General Physics II	1 course unit
CSC	215/Computer Science I	
<i>or</i>		
CSC	220/Computational Problem Solving	1 course unit
MAT	128/Calculus B	1 course unit
WRI	102/Academic Writing* (if not exempted)	1 course unit

*\*It is recommended that students exempted from this course take another liberal learning course.*

### Physics Major PHYG—Earth Science Track

#### Required Courses (11 course units)

PHY	161/Introduction to Astronomy	1 course unit
PHY	120/Introduction to Geology	1 course unit
PHY	220/Advanced Geology	1 course unit
PHY	171/Introduction to Meteorology	1 course unit
PHY	099/Orientation to Physics	0 course unit
PHY	201, 202/General Physics I, II	2 course units
PHY	311/Analog and Digital Electronics	1 course unit
PHY	321/Modern Physics	1 course unit
	Three physics options (see below)	3 course units

#### Physics Options (select 3 course units)

PHY	261/Stellar Astronomy	1 course unit
PHY	306/Mathematical Physics	1 course unit
PHY	316/Biomedical Physics	1 course unit
PHY	393/Independent Research I	1 course unit
PHY	401/Classical Mechanics	1 course unit
PHY	411/Optics and Wave Motion	1 course unit
PHY	413/General Relativity and Cosmology	1 course unit
PHY	416/Thermodynamics	1 course unit
PHY	421/Electromagnetic Theory I	1 course unit
PHY	422/Electromagnetic Theory II	1 course unit
PHY	426/Particle and Nuclear Physics	1 course unit
PHY	431/Quantum Mechanics	1 course unit
PHY	451/Experimental and Analytical Physics	1 course unit
PHY	466/Astrophysics	1 course unit
PHY	493/Independent Research II	1 course unit

#### Required Correlates (five course units)

CHE	201, 202/General Chemistry I, II	2 course units
CSC	215/Computer Science I	
<i>or</i>		
	220/ Computational Problem Solving	1 course unit
MAT	127, 128/Calculus A, B	2 course units

#### Suggested First-Year Sequence (PHYG)

FSP	First Seminar	1 course unit
PHY	099/Orientation to Physics	0 course unit
PHY	201, 202/General Physics I, II	2 course units

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CSC	215/Computer Science I	
<i>or</i>		
CSC	220/Computational Problem Solving	1 course unit
MAT	127, 128/Calculus A, B	2 course units
WRI	102/Academic Writing (if not exempted) *	1 course unit
Liberal Learning		1 course unit

*\*It is recommended that students exempted from this course take another liberal learning course.*

## Physics Major (PHYH)—Biomedical Physics Track

### Physics Major Required Core Courses (six course units)

PHY	201/202	General Physics I and II	
PHY	321	Modern Physics	
PHY	316	Biomedical Physics	
PHY	311	Digital and Analog Electronics	
PHY	451	Experimental and Analytical Physics	<i>or</i> PHY 393/ 493 Independent Research (either of the previous two courses counts as the capstone)

### Physics Options (select two course units)

PHY	306	Mathematical Physics
PHY	401	Classical Mechanics
PHY	411	Optics and Wave Motion
PHY	416	Heat and Thermodynamics
PHY	421/422	Electromagnetic Theory I and II
PHY	426	Particle and Nuclear Physics

### Biology Option (select one course unit)

BIO	321	Genetics
BIO	322	Comparative Vertebrate Anatomy
BIO	413	Microscopic Anatomy & Techniques

### Required Specialization Courses (three course units)

BIO	185	Themes in Biology
BIO	211	Biology of the Eukaryotic Cell
BME	251	Introduction to Biomedical Engineering

### Options Specialization Courses (select three course units, with advisement)

BME	311	Physiological systems (with its associated lab – BME 333)
ENG	272	Advanced Engineering Math I
ELC	321	Signals and Systems
BIO	231	Genetics (with lab)
BIO	332	Comparative Vertebrate Anatomy (with lab)
CHE	331	Organic Chemistry I

[Note: medical school admissions typically require two semesters of Biology with lab (designed for biology majors) and two semesters of Organic Chemistry.]

### Required Correlate Courses

CHE	201/202	General Chemistry I, II
MAT	127/128	Calculus A, B
CSC	215	Computer Science I
<i>or</i>		
CSC	220	Computational Problem Solving

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### **Physics Specialization for M/S/T majors in Elementary Education (ELST), Early Childhood Education (ECST), Special Education (SEST), and Deaf & Hard of Hearing (DHST)**

The M/S/T interdisciplinary major integrates formal study in mathematics, science, and technology to gain a better understanding of the human designed world in which we all live. The major consists of nine (9) units of courses drawn from a common “core”, one (1) approved M/S/T elective, and a four (4) unit “specialization” in one of the M/S/T disciplines. Students in the major receive careful course selection advisement so that they qualify for a middle school endorsement in one of the M/S/T disciplines. **All majors must see the M/S/T academic program coordinator for general advisement.**

Students electing a Physics Specialization will complete MAT 127/128 Calculus A/B, PHY 201/202 General Physics I/II, one approved non-physics science course, ETE 261/Multimedia Design, ETE 271/Structures and Mechanics, MAT 105/Mathematical Structures and Algorithms for Educators I, TED 460/Integrated M/S/T for the Child/Adolescent Learner, and one M/S/T approved electives. The physics specialization consists of three additional course units selected from the following: PHY 120/Introduction to Geology, PHY 161/Introduction to Astronomy, PHY 171/Introduction to Meteorology, PHY 311/Analog and Digital Electronics, or PHY 321/Modern Physics; and an approved elective supporting the middle school endorsement.

### **Suggested Course Sequence M/S/T-Physics Specialization**

#### **Freshman Year (by advisement)**

FSP	First Seminar	1 course unit
MAT	127/Calculus A	1 course unit
TST	161/Creative Design	1 course unit
ETE	261/Multimedia Design	1 course unit
	Science Option #1 (by advisement)	1 course unit
	Math or Science Option (by advisement)	1 course unit
MAT	105/Mathematical Structures and Algorithms for Education I	1 course unit
WRI	102/Academic Writing (if not exempt)*	1 course unit

*\*It is recommended that students exempted from this course take another liberal learning course.*

**Total for year**

**8 course units**

### **Physics Minor**

A minor in physics requires a total of five course units. The required courses are:

PHY	201, 202/General Physics I, II
PHY	306/Mathematical Physics
PHY	321/Modern Physics

One advanced course elected at the 400 level with the prior approval of the physics department chair.

Minimum grade point average for retention and completion of the minor is the same as for the major.