

## Physics

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Physics is a mathematical science and as such is rigorous and demanding. It presents a challenge found in few other disciplines. At Norwich University, the Bachelor of Science in Physics is offered to students desiring an excellent schooling in the fundamentals of physics. The program encompasses a complete curriculum comprised of classical and quantum physics ranging from the properties of particles to the dynamics of the universe. All disciplines in science and engineering turn to physics to address the foundation of their fields.

Hallmarks of a Norwich education include experiential learning and leadership development. The Department of Physics therefore not only accentuates laboratory work but also insists upon peer collaboration throughout the curriculum. Physics majors, having the advantage of a 3-to-1 student-to-faculty ratio, develop close working relationships with their faculty mentors culminating in original research conducted in a faculty laboratory. Physics majors regularly present the results of their research at regional and national conferences. Currently, the research interests of the faculty include particle physics, material science, astrophysics and geophysical fluid dynamics.

### Goals:

- The Department is committed to developing the maximum potential of every individual majoring in physics. It is devoted to the proposition that physics majors will, upon graduation, have a well-founded understanding of the physics that underlies all aspects of the physical universe. Such an education will insure that Norwich graduates have open to them and are successful in a full range of satisfying career opportunities.

### Outcomes:

- Graduates understand fundamental physical processes from classical mechanics, quantum mechanics, electricity and magnetism, and statistical mechanics and thermodynamics.
- Graduates are able to apply and interpret the mathematics used in modeling physical situations.
- Graduates are able to apply sound research methods to address questions they develop and those posed by others.
- Graduates function as effective communicators, both in spoken and written words.
- Graduates are prepared for successful employment in physics and related fields or for entry into graduate and professional schools.
- Graduates are prepared to function as members of inter- and cross-disciplinary teams that formulate and execute solutions to complex, open-ended problems.

### Careers for this Major:

- Industry
- Government
- Graduate work in physics and other physical sciences
- Military

### B. S. in Physics - Curriculum Map 2017-2018 Catalog

Print PDF Curriculum Map ([http://catalog.norwich.edu/residentialprogramscatalog/collegeofscienceandmathematics/physics/phys\\_1499806224335.pdf](http://catalog.norwich.edu/residentialprogramscatalog/collegeofscienceandmathematics/physics/phys_1499806224335.pdf))

Freshman		
Fall	Cr. Spring	Cr.
CH 103 General Chemistry I (General Education Lab Science)	4 CH 104 General Chemistry II (General Education Lab Science)	4
EN 101 Composition and Literature I	3 EN 102 Composition and Literature II	3
MA 121 Calculus I (General Education Math)	4 MA 122 Calculus II (General Education Math)	4
PS 107 Introductory Solar System Astronomy	4 PS 108 Stellar and Galactic Astronomy	4
Semester Total Credits	15 Semester Total Credits	15
Sophomore		
Fall	Cr. Spring	Cr.
MA 223 Calculus III	4 MA 224 Differential Equations	4
PS 211 University Physics I	4 MA 241 Mathematical Computation and Modeling	3
General Education Ethics ( <a href="http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals">http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals</a> )	3 PS 212 University Physics II	4
General Education Literature ( <a href="http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals">http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals</a> )	3 General Education History ( <a href="http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals">http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals</a> )	3
	General Education Social Science ( <a href="http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals">http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals</a> )	3
Semester Total Credits	14 Semester Total Credits	17
Junior		
Fall	Cr. Spring	Cr.
PS 341 Modern Physics or 426 <sup>1</sup>	3 PS 334 Classical Mechanics or 356 <sup>1</sup>	3
PS 373 Junior Laboratory I	2 PS 374 Junior Laboratory II	2
Mathematics Elective <sup>2</sup>	3 PS 444 Quantum Physics or 428 <sup>1</sup>	3
Free Elective	3 Mathematics Elective <sup>2</sup>	3
Free Elective	3 Free Elective	3
General Education Arts & Humanities ( <a href="http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals">http://catalog.norwich.edu/archives/2017-18/residentialprogramscatalog/generaleducationgoals</a> )	3	
Semester Total Credits	17 Semester Total Credits	14
Senior		
Fall	Cr. Spring	Cr.
PS 426 Electricity and Magnetism or 341 <sup>1</sup>	3 PS 356 Thermodynamics & Statistical Mechanics or 334 <sup>1</sup>	3

PS 451 Seminar I	1	PS 428 Electrodynamics & Optics or 444 <sup>1</sup>	3
PS 473 Senior Laboratory I	3	PS 452 Seminar II	1
Free Elective	3	PS 474 Senior Laboratory II (Capstone)	3
Free Elective	3	Free Elective	3
Free Elective	3		
Semester Total Credits	16	Semester Total Credits	13
Total Credits For This Major: 121			

<sup>1</sup> This course is offered in alternate years. Both courses listed are required. For the years these courses are offered, see Course Descriptions.

<sup>2</sup> The approval of the Department of Physics is required.

### Physics Minor Curriculum Map 2017-2018 Catalog

PS 211	University Physics I	4
PS 212	University Physics II	4
PS Elective		3
PS Elective		3
PS Elective (300 level or higher)		3
PS Elective (300 level or higher)		3
Total Cr.		20

### Courses

#### PS 107 Introductory Solar System Astronomy 4 Cr.

A descriptive study of the solar system, including the sun, planets, asteroids, comets and interplanetary space. The role of observation in the evolution of astronomy is emphasized. Classroom: 3 hours; laboratory: 2 hours. Does not count as a lab science if taken for 3 credits.

#### PS 108 Stellar and Galactic Astronomy 4 Cr.

A descriptive introduction to the universe, including stars, galaxies, and recent deep space discoveries. Discussions survey the techniques used by astronomers to interpret the wide variety of observed phenomena in the cosmos. Classroom: 3 hours; laboratory: 2 hours. Does not count as a lab science if taken for 3 credits.

#### PS 1XL Physics Lab Transfer Elective 4 Cr.

#### PS 201 General Physics I 4 Cr.

An algebra-based study of mechanics, sound and heat, with correlated laboratory experiments. Classroom 3 hours, laboratory 2 hours. Prerequisite: MA 107. Note: No student will receive credit for both PS 201 and PS 211, or for both PS 202 and PS 212.

#### PS 202 General Physics II 4 Cr.

An algebra-based study of magnetism, electricity, light, and atomic physics, with correlated laboratory experiments. Classroom: 3 hours; laboratory: 2 hours. Prerequisite: PS 201. Note: Credit cannot be received for both PS 202 and PS 212. Offered spring semesters only.

#### PS 211 University Physics I 4 Cr.

A calculus-based study of vectors; Newton's laws; uniform, accelerated, rotational and harmonic motion; conservation laws; fluid mechanics; elasticity. Classroom: 3 hours; laboratory: 2 hours. Prerequisite: MA 121. Note: Credit cannot be received for both PS 201 and PS 211. Offered fall semesters only.

#### PS 212 University Physics II 4 Cr.

A calculus-based study of topics in electricity, magnetism, waves and optics. Classroom: 3 hours; laboratory: 2 hours. Prerequisite: PS 211; Pre- or Co-requisite: MA 122. Note: Credit cannot be received for both PS 202 and PS 212. Offered spring semesters only.

#### PS 2XX Physics Elective 3 Cr.

#### PS 334 Classical Mechanics 3 Cr.

A study of Newtonian mechanics including motion of a particle, a system of particles and rigid bodies; gravitation; oscillations; central forces; conservation laws. Introduction to Lagrangian and Hamiltonian formulations of dynamics. Classroom: 3 hours. Offered spring semester of even-numbered years. Prerequisites: PS 212 and MA 224 or permission of instructor.

#### PS 341 Modern Physics 3 Cr.

A study of the quantum revolution including special relativity, structure and spectra of atoms and molecules, radioactivity, nuclear models, and nuclear interactions. Classroom: 3 hours. Offered fall semester of odd-numbered years. Prerequisites: PS 212 and MA 224 or permission of instructor.

#### PS 356 Thermodynamics & Statistical Mechanics 3 Cr.

A study of the foundations of thermodynamics and statistical physics: first and second laws of thermodynamics with applications; thermodynamic potentials and applications to systems in equilibrium; statistical mechanics including Boltzmann statistics, quantum statistics and statistical interpretation of entropy. Classroom: 3 hours. Offered spring semester of odd-numbered years. Prerequisites: PS 212 and MA 224 or permission of instructor.

#### PS 373 Junior Laboratory I 2 Cr.

A laboratory course devoted to scientific inquiry through a collaborative research project under faculty supervision. Introduction to formulation of research questions, experimental design, system modeling, measurement, data collection and data analysis. Laboratory methodology including safety procedures. Read published literature; communicate research results. Written and oral reports required. Laboratory: 6 hours. Offered fall semesters only. Prerequisites: PS 212 and MA 224 or permission of instructor.

#### PS 374 Junior Laboratory II 2 Cr.

A laboratory course devoted to scientific inquiry through a continuation of the collaborative research project started in Junior Laboratory I. Project culminates in public presentations, written and oral, of research results. Laboratory: 6 hours. Offered spring semesters only. Prerequisite: PS 373 or permission of instructor.

**PS 399 Topics: 4 Cr.****PS 421 Advanced Laboratory I 1-4 Cr.**

A laboratory investigation in a specific area of experimental physics designed in consultation with physics faculty. Prerequisite: Permission of the instructor. Offered fall semesters only.

**PS 422 Advanced Laboratory II 1-4 Cr.**

A laboratory investigation in a specific area of experimental physics designed in consultation with physics faculty. Prerequisite: Permission of the instructor. Offered spring semesters only.

**PS 426 Electricity and Magnetism 3 Cr.**

A study of electrical circuits, and electrostatic and magnetostatic fields. Includes RLC circuits; applications of Gauss' Law and Laplace's equation; dielectric theory; magnetic fields; and theory of magnetic materials. Classroom: 3 hours. Offered fall semester of even-numbered years. Prerequisites: PS 212, MA 223 and MA 224 or permission of instructor.

**PS 428 Electrodynamics & Optics 3 Cr.**

This course continues PS 426 (Electricity & Magnetism), combining electricity, magnetism and optics into a unified theory embodied by Maxwell's equations. Includes an introduction to relativistic applications and optical phenomena. Classroom: 3 hours. Offered spring semester of odd-numbered years. Prerequisites: PS 426 or permission of instructor.

**PS 444 Quantum Physics 3 Cr.**

A study of the mathematical structure of quantum mechanics and applications to atomic and nuclear phenomenon. Topics include: postulates of quantum mechanics, operators, Schrödinger's equation, one dimensional potentials, angular momentum, spin, perturbation theory, and identical particles. Classroom: 3 hours. Offered spring semester of even-numbered years. Prerequisites: PS 341 or permission of instructor.

**PS 451 Seminar I 1 Cr.**

A study of special topics of current interest. This course integrates reading, writing, speaking and critical thinking skills. Classroom: 1 hour. Prerequisite: permission of the instructor. Offered fall semesters only.

**PS 452 Seminar II 1 Cr.**

A continuation of PS 451, investigating special topics of current interest. This course integrates reading, writing, speaking, and critical thinking skills. Classroom: 1 hour. Prerequisite: permission of the instructor. Offered spring semesters only.

**PS 473 Senior Laboratory I 3 Cr.**

A laboratory course devoted to scientific inquiry through a collaborative research project under faculty supervision. Introduction to formulation of research questions, experimental design, system modeling, measurement, data collection and data analysis. Laboratory methodology including safety procedures. Read published literature; communicate research results. Written and oral reports required. Students serve as project leaders as well as research investigators. Conference: 1 hour. Laboratory: 6 hours. Offered fall semesters only. Prerequisites: PS 374 or permission of instructor.

**PS 474 Senior Laboratory II 3 Cr.**

A laboratory course devoted to scientific inquiry through a collaborative research project under faculty supervision. Introduction to formulation of research questions, experimental design, system modeling, measurement, data collection and data analysis. Laboratory methodology including safety procedures. Read published literature; communicate research results. Written and oral reports required. Students serve as project leaders as well as research investigators. Conference: 1 hour. Laboratory: 6 hours. Offered spring semesters only. Prerequisites: PS 473 or permission of instructor.