

# 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:

- Because of its importance to so many fields, physics serves as an ideal springboard for a rich diversity of careers in the sciences, mathematics and engineering. The training necessary to become a physicist develops analytical skills that allow graduates to branch out into a wide variety of technological professions that value the interdisciplinary talent that physicists have in understanding fundamental physical processes through experimentation.

Because it is one of the most challenging programs at any school, including Norwich, the personal reward of a degree in physics is great. The intellectual growth that is realized opens many doors including: pursuit of the Masters and Doctorate degrees leading to an academic position; a career as a research scientist in a laboratory of industry or government; the profession of education in high school; employment as a scientific consultant to lawyers and politicians; or service in technical branches of the military.

## Careers for this Major:

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

## B. S. in Physics - Curriculum Map 2016-2017 Catalog

Print PDF Curriculum Map ([http://catalog.norwich.edu/residentialprograms/catalog/collegeofscienceandmathematics/physics/phys\\_1472148088029.pdf](http://catalog.norwich.edu/residentialprograms/catalog/collegeofscienceandmathematics/physics/phys_1472148088029.pdf))

Freshman		
Fall	Cr. Spring	Cr.
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
CH 103 General Chemistry I (General Education Lab Science)	4 CH 104 General Chemistry II (General Education Lab Science)	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.
EN 201 World Literature I (General Education Literature)	3 EN 202 World Literature II	3
MA 223 Calculus III	4 MA 224 Differential Equations	4
PS 211 University Physics I	4 PS 212 University Physics II	4
General Education Ethics	3 General Education History	3
	General Education Social Science	3
Semester Total Credits	14 Semester Total Credits	17
Junior		
Fall	Cr. Spring	Cr.
PS 334 Classical Mechanics or 356 Thermodynamics & Statistical <sup>1</sup>	3 PS 444 Quantum Physics or 428 Electrodynamics & Optics <sup>1</sup>	3
PS 341 Modern Physics or 426 Electricity and Magnetism <sup>1</sup>	3 PS 374 Junior Laboratory II	2
PS 373 Junior Laboratory I	2 Mathematics Elective <sup>2</sup>	3
Mathematics Elective <sup>2</sup>	3 General Education Arts & Humanities	3
Free Elective	3 Free Elective	3
	Free Elective	3
Semester Total Credits	14 Semester Total Credits	17
Senior		
Fall	Cr. Spring	Cr.
PS 356 Thermodynamics & Statistical or 334 Classical Mechanics <sup>1</sup>	3 PS 428 Electrodynamics & Optics or 444 Quantum Physics <sup>1</sup>	3
PS 426 Electricity and Magnetism or 341 Modern Physics <sup>1</sup>	3 PS 452 Seminar II (Capstone)	1
PS 451 Seminar I	1 PS 474 Senior Laboratory II	3
PS 473 Senior Laboratory I	3 Free Elective	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 2016-2017 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 100 Elementary Physics 4 Cr.

A selection of topics from kinematics, dynamics, fluids, energy, acoustics, electricity, optics, and modern physics required of an informed citizenry. Classroom: 3 hours; laboratory: 2 hours. Note: Credit cannot be received for PS100 if credit has been earned in PS 201 or PS 211.

#### 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 110 Physics of Continuous Media 3 Cr.

An introduction to fluid mechanics, sound and thermal physics. Open only to first year students or by permission of department. Classroom: 3 hours. Pre- or Co-Requisite: MA 108 or MA 121. Offered spring semesters only.

#### PS 1XL Physics Lab 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 205 Basic Instrumentation in the Natural Sciences 4 Cr.

An introduction to instrumentation theory and measurement technique. Emphasis on identification of and models for the behavior of measuring system components, the combinations of components in typical research equipment and the statistical analysis necessary for interpretation of measurements. Classroom: 3 hours; laboratory: 3 hours. Prerequisite: permission of instructor. Offered fall semester of odd-numbered years only.

#### PS 207 Meteorology and Climatology 3,4 Cr.

A first study of atmospheric processes, elementary forecasting, and the major climatic classes. Particular emphasis is placed on the effects of these phenomena on human activities. Laboratory practice includes elementary forecasting techniques, observations, calculations, and theoretical analysis of weather and climate patterns. Classroom: 3 hours; laboratory: 2 hours. Prerequisite: PS 201 or PS 202 or permission of the instructor. Does not count as a lab science if taken for 3 credits.

#### 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 232 University Physics III 3 Cr.

A study of topics from quantum phenomena, spectroscopy, relativity, nuclear and solid state physics. Classroom 3 hours. Prerequisite: PS 212 or permission of instructor.

#### PS 299 Topics in Physics 4 Cr.

#### 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 fall semester of odd-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 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 fall semester of even-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 capstone 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 capstone course integrates reading, writing, speaking, and critical thinking skills. Classroom: 1 hour. Prerequisite: permission of the instructor. Offered spring semesters only.

**PS 461 Senior Project I 1 Cr.**

A project-oriented capstone experience that integrates reading, writing, speaking and critical thinking. The senior student chooses a project with faculty advice and takes charge of its execution to a satisfying conclusion. The course requires oral and written presentations of the project results. Prerequisites: senior class standing and permission of the instructor. Offered fall semesters only.

**PS 462 Senior Project II 1 Cr.**

A project-oriented capstone experience that integrates reading, writing, speaking and critical thinking. The senior student chooses a project with faculty advice and takes charge of its execution to a satisfying conclusion. The course requires an oral and written presentation of the completed project. Prerequisites: senior class standing and 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 fall semesters only. Prerequisites: PS 473 or permission of instructor.