

PHYSICS

- Bachelor of Science, Physical Science (p. 1)
- Bachelor of Science, Physics (p. 2)

Minor

- Physics (p. 3)

The program leading to the Bachelor of Science with a major in physics is designed to provide a strong yet versatile basis for a subsequent scientific career or advanced study. Minimum requirements for all majors are listed below, but students planning for graduate work in physics or an allied area are advised to select additional mathematics and physics courses. A physics major must complete all 300-400-level courses with a 2.0 minimum grade-point average.

Students have the option of adding a multidisciplinary concentration in electro-optics to their physics degree. The concentration is appropriate for physics majors who wish to pursue possible careers in photonics or graduate degrees in the area of optics.

PHY, and PSC majors are required to attain a grade of C- or better in all physics and math courses that are prerequisite courses for physics courses required of majors.

A minor in physics consists of twelve semester hours.

FACULTY LISTINGS (<https://udayton.edu/artssciences/academics/physics/facstaff/>)

Bachelor of Science, Physical Science (PSC) minimum 120 hours

The Physical Science Program is administered by the Department of Physics. It provides a broad training in the physical sciences that is desirable for one who plans to pursue a goal built on a composite science background. The physical science major combines adequate physics, chemistry, geology, and mathematics to provide a sound working knowledge of physical science. Since the program is less specialized than one in a single science, it has provision for adequate course selections and sufficient electives to provide the opportunity for concentrated study in a discipline chosen to meet the career objectives of the individual student.

The Common Academic Program (CAP) is an innovative curriculum that is the foundation of a University of Dayton education. It is a learning experience that is shared in common among all undergraduate students, regardless of their major. Some CAP requirements must be fulfilled by courses taken at UD. Some major requirements must also be fulfilled by courses taken at UD. Students should consult with their advisor regarding applicability of transfer credit to fulfill CAP and major program requirements.

Common Academic Program (CAP) ¹

First-Year Humanities Commons ²	6 cr. hrs.
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HUM 101	Chaminade Seminar: Reading and Responding to the Signs of the Times
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HUM 102	Marie Thérèse Seminar: Human Dignity and the Common Good	
Second-Year Writing Seminar		3 cr. hrs.
Oral Communication		3 cr. hrs.
Mathematics		3 cr. hrs.
Social Science		3 cr. hrs.
Arts		3 cr. hrs.
Natural Science ³		4 cr. hrs.
Crossing Boundaries		9 cr. hrs.
Faith Traditions (3 cr. hrs.)		
Practical Ethical Action (3 cr. hrs.)		
Interdisciplinary Investigations (3 cr. hrs.) ⁴		
Advanced Study		9 cr. hrs.
Religious Studies (3 cr. hrs.)		
Philosophical Studies (3 cr. hrs.)		
Historical Studies (3 cr. hrs.)		
Diversity and Social Justice ⁵		3 cr. hrs.
Major Capstone ⁶		0-6 cr. hrs.
Experiential Learning ⁷		0-3 cr. hrs.

¹ The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student's degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.

² May be completed with ASI 110 through the Core Program.

³ Must include a lecture course and an accompanying lab.

⁴ New Crossing Boundaries category effective with the 2025-26 Catalog, which incorporates all courses previously approved in the Crossing Boundaries Inquiry or Integrative categories. This new category does not include any restriction that students must take the course outside of their unit or division.

⁵ May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, or Natural Science CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student's major.

⁶ The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.

⁷ The course or experience will have variable credit, depending on the intensity and duration of the experience, or where it is housed in existing curricular and co-curricular spaces.

Science Breadth Requirements

CPS 132 or CPS 150	Computer Programming for Engineering & Science Algorithms & Programming I	3
MTH 168	Analytic Geometry & Calculus I (Satisfies CAP Mathematics)	4
MTH 169	Analytic Geometry & Calculus II	4
MTH 218	Analytic Geometry & Calculus III	4
MTH 219	Applied Differential Equations	3
CHM 123	General Chemistry I	3
CHM 123L	General Chemistry Laboratory	1
CHM 124	General Chemistry II	3
CHM 124L	General Chemistry II Laboratory	1
GEO 115	Physical Geology	3
GEO 115L	Physical Geology Laboratory	1
GEO 116	Geological History of the Earth	3
GEO 116L	Geological History of the Earth Laboratory	1
PHY 206	General Physics I - Mechanics	3
PHY 207	General Physics II - Electricity & Magnetism	3
PHY 210L	General Physics Laboratory I	1
PHY 211L	General Physics Laboratory II	1

Total Hours **42**

Major Requirements

PHY 208	General Physics III- Thermodynamics, Waves, and Fluids	3
PHY 321	General Physics IV - Modern Physics	3
PHY 480	Physics Capstone (Satisfies CAP Major Capstone)	1
Physical science courses (300/400 level)		23

Total Hours **30**

Breadth

ASI 150	Introduction to the University Experience	1
Social and Behavioral Sciences (includes CAP Social Science)		6
Total Hours to total at least		120

Bachelor of Science, Physics (PHY) minimum 120 hours

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regarding applicability of transfer credit to fulfill CAP and major program requirements.

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HUM 102	Marie Thérèse Seminar: Human Dignity and the Common Good	
Second-Year Writing Seminar		3 cr. hrs.
Oral Communication		3 cr. hrs.
Mathematics		3 cr. hrs.
Social Science		3 cr. hrs.
Arts		3 cr. hrs.
Natural Science ³		4 cr. hrs.
Crossing Boundaries		9 cr. hrs.
Faith Traditions (3 cr. hrs.)		
Practical Ethical Action (3 cr. hrs.)		
Interdisciplinary Investigations (3 cr. hrs.) ⁴		
Advanced Study		9 cr. hrs.
Religious Studies (3 cr. hrs.)		
Philosophical Studies (3 cr. hrs.)		
Historical Studies (3 cr. hrs.)		
Diversity and Social Justice ⁵		3 cr. hrs.
Major Capstone ⁶		0-6 cr. hrs.
Experiential Learning ⁷		0-3 cr. hrs.

¹ The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student's degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.

² May be completed with ASI 110 through the Core Program.

- ³ Must include a lecture course and an accompanying lab.
- ⁴ New Crossing Boundaries category effective with the 2025-26 Catalog, which incorporates all courses previously approved in the Crossing Boundaries Inquiry or Integrative categories. This new category does not include any restriction that students must take the course outside of their unit or division.
- ⁵ May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, or Natural Science CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student's major.
- ⁶ The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.
- ⁷ The course or experience will have variable credit, depending on the intensity and duration of the experience, or where it is housed in existing curricular and co-curricular spaces.

Science Breadth Requirements

CHM 123 & 123L	General Chemistry I and General Chemistry Laboratory	4
CHM 124 & 124L	General Chemistry II and General Chemistry II Laboratory	4
CPS 132 or CPS 150	Computer Programming for Engineering & Science Algorithms & Programming I	3
MTH 168	Analytic Geometry & Calculus I (Satisfies CAP Mathematics)	4
MTH 169	Analytic Geometry & Calculus II	4
MTH 218	Analytic Geometry & Calculus III	4
MTH 219	Applied Differential Equations	3
MTH 301 or MTH 310	Matrix Theory and Applications Linear Algebra & Matrices	3

Major Requirements

Select one concentration from:

General Physics Concentration 39

PHY 206	General Physics I - Mechanics	3
PHY 207	General Physics II - Electricity & Magnetism	3
PHY 208	General Physics III- Thermodynamics, Waves, and Fluids	3
PHY 210L	General Physics Laboratory I	1
PHY 211L	General Physics Laboratory II	1
PHY 301	Thermal Physics	3
PHY 303	Intermediate Mechanics I	3
PHY 321	General Physics IV - Modern Physics	3
PHY 333	Digital & Analog Electronics for Scientists	3
PHY 390	Introduction to Quantum Mechanics	3
PHY 408	Intermediate Electricity & Magnetism I	3
PHY 430	Advanced Lab	3
PHY 480	Physics Capstone (Satisfies CAP Major Capstone)	1
PHY electives (300/400 level)		6

Physics and Electro-Optics Concentration 42

ECE 443	Introduction to Electro-Optics	3
PHY 206	General Physics I - Mechanics (Applies to Cap Natural Science)	3
PHY 207	General Physics II - Electricity & Magnetism	3

PHY 208	General Physics III- Thermodynamics, Waves, and Fluids	3
PHY 210L	General Physics Laboratory I	1
PHY 211L	General Physics Laboratory II	1
PHY 301	Thermal Physics	3
PHY 303	Intermediate Mechanics I	3
PHY 333	Digital & Analog Electronics for Scientists	3
PHY 390	Introduction to Quantum Mechanics	3
PHY 404	Physical Optics	3
PHY 408	Intermediate Electricity & Magnetism I	3
PHY 430	Advanced Lab	3
PHY 480	Physics Capstone (Satisfies CAP Major Capstone)	1
Select two courses from:		6
EOP 501	Fundamentals of Optical Design	
EOP 502	Light and Matter Interaction	
EOP 505	Introduction to Lasers	
EOP 506 or ECE 573	Photonic Devices & Systems	
EOP 514 or ECE 574	Guided-Wave Optics	

Breadth

ASI 150	Introduction to the University Experience	1
Social Science and Behavioral Science (Includes CAP Social Science)		6
Total Hours to total at least		120

Minor in Physics (PHY)

Physics 12

Select four PHY courses (300/400 level)	
Total Hours	12

- Bachelor of Science, Physical Science (p. 3)
- Bachelor of Science, Physics (p. 4)

Bachelor of Science, Physical Science

First Year				
Fall	Hours	Spring	Hours	
ASI 150		1 PHY 207 & PHY 211L	4	
PHY 206 & PHY 210L (Satisfies CAP Natural Science)		4 CHM 124 & 124L	4	
CHM 123 & 123L		4 MTH 169	4	
MTH 168 (Satisfies CAP Mathematics)		4 HUM 102 (CAP Humanities Commons)	3	
HUM 101 (CAP Humanities Commons)		3		
		16		15
Second Year				
Fall	Hours	Spring	Hours	
PHY 208		3 PHY 321 (Or PHY elective, 300/400 level)	3	
GEO 115 & 115L		4 GEO 116 & 116L	4	

MTH 218	4	MTH 219	3	MTH 168 (Satisfies CAP Mathematics)	4
ENG 200 (CAP Second-Year Writing)	3	CMM 100 (CAP Oral Communication)	3		16
		CAP Social Science Course	3		15
	14		16		
Third Year					
Fall	Hours	Spring	Hours		
CPS 150		4 PHY 321 (Or PHY Elective, 300/400 level)	3	ENG 200 (CAP Second-Year Writing)	3
PHY Elective (300/400 level)		3 PHY Elective (300/400 level)	3		3
PHY Elective (300/400 level)		3 Social Science Elective	3		3
CAP Arts Course		3 CAP Advanced Religious Studies Course	3		3
CAP Faith Traditions Course		3 CAP Advanced Historical Studies Course	3		3
	16		15		
Fourth Year					
Fall	Hours	Spring	Hours		
PHY Elective (300/400 level)		3 PHY 480 (Satisfies CAP Major Capstone)	1		15
PHY Elective (300/400 level)		3 PHY Elective (300/400 level)	3		15
CAP Advanced Philosophical Studies/Practical Ethical Action Course		3 PHY Elective (300/400 level)	3		15
CAP Interdisciplinary Investigations Course		3 CAP Diversity and Social Justice Course	3		15
		General Elective	3		15
		General Elective	3		15
	12		16		
Total credit hours: 120					

Bachelor of Science, Physics

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Courses

PHY 100. Seminar. 0 Hours

Opportunity to become acquainted with the broad spectrum of modern science through periodic meetings with the entire department. Invited speakers, films, student presentations, book reviews, and informal discussions. For all physics, physical science, and physics-computer science majors.

PHY 108. Physical Science of Light & Color. 3 Hours

Conceptual study of physical science with emphasis on light, color, and the interaction of light with materials.

PHY 108L. Light & Color Laboratory. 1 Hour

Laboratory experiences to accompany PHY 108. Corequisite(s): PHY 108.

PHY 201. College Physics I. 3 Hours

Topics from classical mechanics, thermal and mechanical properties of matter, wave motion, and sound without the formalism of calculus.

PHY 201L. College Physics Laboratory I. 1 Hour

Algebra-based introductory laboratory. Experimental scientific techniques and the use of standard laboratory equipment. One two-hour period each week. Corequisite(s): PHY 201 or PHY 206.

PHY 202. College Physics II. 3 Hours

Continuation of PHY 201 with a treatment of electricity and magnetism, wave motion and properties of light, atomic and nuclear physics. Second term, each year. Prerequisite(s): PHY 201.

PHY 202L. General Physics Laboratory. 1 Hour

Experimental scientific techniques and the use of standard laboratory equipment. One two-hour period per week. Second term, each year. Prerequisite(s): PHY 201L.

PHY 206. General Physics I - Mechanics. 3 Hours

Calculus-based introductory course in mechanics. Three lectures, one recitation each week. Corequisites: MTH 148 or MTH 168.

PHY 207. General Physics II - Electricity & Magnetism. 3 Hours

The basic principles of electricity and magnetism. Three lectures, one recitation each week. Prerequisite(s): PHY 201 or PHY 206. Corequisite(s): MTH 149 or MTH 169.

PHY 208. General Physics III- Thermodynamics, Waves, and Fluids. 3 Hours

Introduction to wave phenomena (including mechanical waves, sound waves, physical optics and geometrical optics), thermal physics, and fluids. Prerequisite(s): PHY 206. Pre/Corequisites: MTH 169.

PHY 210L. General Physics Laboratory I. 1 Hour

Introduction to laboratory methods, handling of data, and analysis of results. Experiments appropriate to the background of students with an interest in mathematics and physical sciences. Two hours laboratory, one hour recitation each week. Corequisites: PHY 206.

PHY 211L. General Physics Laboratory II. 1 Hour

Laboratory methods, data handling, and analysis of results. Experiments appropriate to the background of students with an interest in mathematical and physical sciences. Two hours laboratory, one hour recitation each week. Prerequisite(s): PHY 210L. Corequisite(s): PHY 207.

PHY 232. The Physics of Waves. 3 Hours

Examination of analytical approaches and conceptual frameworks of physics applied to wave phenomena in a variety of physical systems. Topics include oscillation in mechanical and electrical systems, mechanical and electromagnetic waves, and geometrical and physical optics. This course is designed for electrical and computer engineering students, but is open to all meeting the prerequisites. Prerequisite(s): PHY 206, MTH 169 (may be taken as co-requisite).

PHY 250. Descriptive Astronomy. 3-4 Hours

Descriptive survey for students who have had little or no previous exposure to astronomy; material from ancient times to present, including pulsars and quasi-stellar objects.

PHY 295. Research Participation I. 1 Hour

No description available.

PHY 301. Thermal Physics. 3 Hours

Thermodynamical descriptions of many particle systems obtained from microscopic statistical considerations; laws of thermodynamics, kinetic theory of dilute gases, and Fermi-Dirac and Bose-Einstein statistics. Prerequisite(s): PHY 208 or PHY 232. Corequisite(s): MTH 219.

PHY 303. Intermediate Mechanics I. 3 Hours

The fundamental concepts of mechanics: virtual work, kinematics, special theory of relativity, Lagrange's equation and central forces, particle dynamics. Prerequisite(s): PHY 208 or PHY 232. Corequisite(s): MTH 219.

PHY 321. General Physics IV - Modern Physics. 3 Hours

Introduction to modern physics. Topics include special relativity, elementary quantum mechanics, the structure of matter, atoms, and nuclei, radioactivity, interactions of radiation with matter, and fundamental particles. Prerequisite(s): (PHY 208 or PHY 232) or permission of the chair of the physics department.

PHY 323. Computational Physics. 3 Hours

The course will explore how computers are used in physics. Topics will include simulations of physical systems, numerical analysis, and the use of mathematical analysis packages (MATHECAD, for example.) Programming will be done in True BASIC and MATHECAD. Prerequisite(s): MTH 218; (PHY 208 or PHY 232).

PHY 333. Digital & Analog Electronics for Scientists. 3 Hours

Basic concepts of digital and analog integrated circuit electronics are developed as a way to understand modern microcomputer based instrumentation. A microcomputer based data collection and analysis system is used to study binary data input and output, analog to digital conversion (ADC) devices, digital to analog conversion (DAC) devices, and other digital integrated circuits and concepts. The analog electronics part of the course begins with a study of discrete analog devices and ends with operational amplifiers and their application. Two hours lecture and two hour laboratories each week. Prerequisite(s): (PHY 202L or PHY 211L) or equivalent.

PHY 390. Introduction to Quantum Mechanics. 3 Hours

Basic postulates of quantum mechanics with applications made to atomic physics. Prerequisite(s): MTH 219; (PHY 208 or PHY 232). Corequisite(s): MTH 310.

PHY 395. Research Participation I. 1-6 Hours

Individual projects conducted as part of the physics Undergraduate Research Participation program to encourage involvement of students with faculty researchers. Projects must be arranged in advance with faculty research directors.

PHY 399. Special Problems in Physics. 1-4 Hours

Special topical courses, laboratory, tutorial, or library work in areas of current interest. Students should consult the composite.

PHY 403. Intermediate Mechanics II. 3 Hours

Emphasis on solving physical problems; noninertial coordinate systems, rigid body motion, rotating systems, coupled systems, introductory fluid statics and dynamics, normal coordinates, and the descriptions of mechanics appropriate for the transition to wave mechanics.

Prerequisite(s): PHY 303.

PHY 404. Physical Optics. 3 Hours

The electromagnetic wave theory of light, propagation of waves, reflection, refraction, dispersion, polarization, dichroism, birefringence, superposition of waves, interference, diffraction, Fourier optics.

Prerequisite(s): MTH 219; (PHY 208 or PHY 232).

PHY 408. Intermediate Electricity & Magnetism I. 3 Hours

Electrostatics, Coulomb's law, Gauss's law, potential, dielectric materials, electrostatic energy, solutions to Laplace's and Poisson's equations, Biot-Savart law, Faraday induction law, magnetization, and Maxwell's equations. Prerequisite(s): MTH 219; (PHY 208 or PHY 232).

PHY 409. Intermediate Electricity & Magnetism II. 3 Hours

Further study of electric and magnetic fields with emphasis on solving problems; Maxwell's equations, propagation of electromagnetic waves, electromagnetic radiation. Prerequisite(s): PHY 408.

PHY 411. Topics in Modern Physics. 3 Hours

Elements of modern optics, solid state and other selected subjects. Consult chairperson for details. Prerequisite(s): PHY 390 or equivalent.

PHY 420. Introduction to Solid State. 3 Hours

Classification of solids, crystals and crystal structures, survey of lattice properties, free electron theory, band theory of solids, semi-conductors, and crystal imperfections. Prerequisite(s): MTH 219; (PHY 208 or 232); PHY 390.

PHY 430. Advanced Lab. 3 Hours

Advanced laboratory course designed for upper-level undergraduate physics majors. Programming and use of data acquisition and analysis systems, analysis of experimental error and uncertainty, design and construction of experiments that combine mechanical, electrical, and optical components, documentation of laboratory procedures, and writing and presenting technical reports are emphasized. Prerequisite(s): PHY 333, PHY 321, MTH 219, and (CPS132 or CPS150 or ECE203).

PHY 431. Advanced Lab II. 2 Hours

Second course in a two-semester laboratory sequence designed for upper-level undergraduate physics majors. Programming and use of data acquisition and analysis systems, design and construction of experiments that combine mechanical, electrical, and optical components, documentation of laboratory procedures, and writing and presenting technical reports are emphasized. Prerequisite(s): PHY 430.

PHY 440. Quantum Mechanics II. 3 Hours

Study of selected principles in quantum mechanics. Prerequisite(s): PHY 390.

PHY 450. Senior Project. 3 Hours

The senior project is a capstone experience for senior physics majors. It will consist of a research project of the student's choosing and will require both an oral and written report. The nature and scope of the project will be chosen in consultation with the student's advisor. Permission of the department chairperson is required. Senior physics majors only.

PHY 460. Seminar. 1 Hour

Presentation of papers by undergraduate students, faculty, and a guest lecturers on topics of concern to the modern physicist. Reviews of books and films appropriate to the group.

PHY 470. Introduction to Computational Physics. 3 Hours

Study of important problems in physics, other sciences, and engineering that require a numerical solution. This course refines computation skills by providing direct experience writing, executing and analyzing computer programs used to solve such problems. The approach in this course is intended to mimic approaches used in research. Prerequisite(s): MTH 219, PHY 208 or PHY 232.

PHY 477. Honors Thesis Project. 3 Hours

First of two courses leading to the selection, design, investigation, and completion of an independent, original Honors Thesis project under the guidance of a faculty research advisor. Restricted to students in the University Honors Program with permission of the program director and department chairperson. Students pursuing an interdisciplinary thesis topic may register for three semester hours each in two separate disciplines in consultation with the department chairpersons. Prerequisite(s): Approval of University Honors Program.

PHY 478. Honors Thesis Project. 3 Hours

Second of two courses leading to the selection, design, investigation, and completion of an independent, original Honors Thesis project under the guidance of a faculty research advisor. Restricted to students in the University Honors Program with permission of the program director and department chairperson. Students pursuing an interdisciplinary thesis topic may register for three semester hours each in two separate disciplines in consultation with the department chairpersons. Prerequisite(s): Approved 477; approval of University Honors Program.

PHY 480. Physics Capstone. 1 Hour

This seminar course is the capstone for all physics majors. Students will complete an independent research project and present their results in written form and in a presentation. Students will learn about the variety of career paths available after completing an undergraduate physics degree, and how to engage in these career paths in an ethical manner.

PHY 495. Research Participation II. 1-6 Hours

Individual projects conducted as part of the physics Undergraduate Research Participation program to encourage involvement of students with faculty researchers. Projects must be arranged in advance with faculty research directors.

PHY 499. Special Problems in Physics. 1-6 Hours

Laboratory, tutorial, or library work in one of such selected topics as solid state physics, polymers, atomic and nuclear physics, modern optics, theoretical physics, surface physics, or general physics. Prerequisite(s): Permission of department chairperson.