Physics

Physics is the study of the fundamental laws governing the natural world. It is used to explain phenomena that range from the tiny, such as the arrangement of electrons within an atom, to the huge, such as the collection of galaxies into clusters and super-clusters; from the gentle, such as the radiation pressure exerted by sunlight striking a satellite's solar panels, to the fierce, such as the crushing force of gravity at the surface of a neutron star. Those laws form a framework upon which all the other natural sciences are built. The need to express those natural laws in mathematical language has been the driving force behind many advances in mathematics, and physics lies at the core of applied science and engineering.

The Physics Department offers a Bachelor of Science degree with a choice of concentrations in either Physics, Applied Physics, or Biophysics, as well as several pre-engineering options. (See the pre-engineering options later in this section.) While the department tailors the course of study to students' individual needs and goals, all students majoring in physics obtain a strong foundation focusing on critical thinking, problem solving, and research. The faculty maintain open office hours, and facilities are open extended hours for majors. Research is actively encouraged, and many opportunities exist: students can work with a faculty mentor on campus during the summer or participate in one of many off-campus opportunities in both academia and industry. Students regularly present their work at professional meetings and publish papers in national journals.

The Physics concentration is excellent preparation for graduate school in physics, engineering, and closely related scientific fields. The Physics concentration is also designed to support the various options of the pre-engineering program. The Applied Physics concentration is designed to prepare students for employment immediately upon graduation in industrial research and development laboratories, technical consulting firms, and technically-oriented government agencies. The Applied Physics concentration is not recommended for those intending to pursue graduate degrees in either physics or engineering, but it is a good choice for students interested in patent law. The Biophysics concentration is excellent preparation for medical school and other health-oriented professional schools. The Physics major (the Physics concentration, Applied Physics concentration, or Biophysics concentration) is an outstanding liberal arts degree that develops critical thinking skills that are in high demand by employers in the private and public sectors. Graduates of the Physics Department work in a wide variety of careers, including faculty in universities, medical schools, and high schools; they are employed by companies such as IBM and Northrop-Grumman and by government agencies such as the Department of Energy and NASA.

More information can be found online at https://www.stetson.edu/other/academics/undergraduate/physics.php.

Pre-Engineering and the Dual Degree Program

All accredited engineering schools require their first- and second-year students to take a relatively standardized set of mathematics and physics courses that are commonly referred to as pre-engineering courses. Students who perform well in these courses are accepted into the engineering program of their choice, and they complete the specialized courses associated with that program during their third and fourth years. Stetson does not offer an engineering degree, but it does offer the standard pre-engineering courses, and students interested in engineering have the three options listed below available to them. Students who choose to attend Stetson while preparing for a career in engineering benefit from the fostering atmosphere of small class sizes and close interaction with faculty, in addition to developing the communication and critical thinking skills that are the hallmarks of a liberal arts education.

Pre-Engineering Option One

Students choosing this option complete their first two years on the Physics track at Stetson and then transfer to an engineering school, where they complete their undergraduate work and earn a Bachelor of Science in engineering. While at Stetson, the students take essentially the same pre-engineering courses that their counterparts at the engineering school take, laying a solid foundation in mathematics and physics, plus the General Education courses that are required by the engineering school.

Pre-Engineering Option Two (The Dual Degree Program)

Students choosing this option earn Bachelor of Science degrees from both Stetson and an engineering school. Students spend three years at Stetson completing the requirements for a physics major (Physics Track only), and then they transfer to an accredited engineering school, where they are usually able to complete the engineering degree in two years. Upon receiving the engineering degree, they are also awarded the B.S. degree in Physics from Stetson. Students are free to complete the dual degree program at ***any accredited engineering school***.

Pre-Engineering Option Three

Many of our pre-engineering students like what they find at Stetson so much that they choose to complete their Bachelor of Science degree in Physics at Stetson (Physics Track only), and then they pursue specialized training in engineering at the graduate level. Students choosing this option are able to take many more electives in physics and develop a much deeper understanding of the science that underlies the field of engineering in which they are interested. They also benefit from having their written and oral communication skills more finely honed. This option proves to be an excellent foundation for graduate studies in engineering, and students are able to make the transition with little or no difficulty.

Learning Outcomes

Student learning outcomes describe what students know, understand and are able to do as a result of completing a degree program. The learning outcomes for this program are:

1. Write a journal style article or formal lab report
2. Compile a thorough, well-organized laboratory notebook and apply standard laboratory techniques to collect and analyze data
3. Deliver an effective technical conference-style oral presentation
4. Use standard computer software and programming techniques for data collection and analysis, problem solving, and presentations
5. Demonstrate quantitative problem solving skills in the theory-oriented required courses in any of the three concentrations (physics, applied physics or biophysics)

Minors

Minor in Physics - 7 units

Code	Title	Units
Department Requirements		
PHYS 141P	University Physics I	1
PHYS 142P	University Physics II	1
PHYS 243	Modern Physics	1
PHYS 380	Physics Colloquium	0
Two units in PHYS numbered 300 or higher		2
Collateral Requirements		
MATH 141Q	Calculus I with Analytic Geometry [1]	1
MATH 142Q	Calculus II with Analytic Geometry	1
Total Units		**7**

[1] Students not prepared to take MATH 141Q will be allowed to substitute MATH 130/MATH 131Q

Advising Course Plans

Advising Course Plans

Physics Major (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/physics-plan/)

Physics Major - Applied Physics Concentration (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/applied-physics-plan/)

Physics Major - Biophysics Concentration (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/biophysics-plan/)

Plans for Transfer Students and Students Changing Their Major

Physics Major

- 3 Year Plan (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/physics-plan-3yr-plan/)
- 2 Year Plan (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/physics-plan-2yr-plan/)

Physics Major - Applied Physics Concentration

- 3 Year Plan (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/applied-physics-3yr-plan/)
- 2 Year Plan (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/applied-physics-2yr-plan/)

Physics Major - Biophysics Concentration

- 3 Year Plan (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/biophysics-3yr-plan/)
- 2 Year Plan (https://catalog.stetson.edu/undergraduate/arts-sciences/physics/biophysics-2yr-plan/)

Courses

Astronomy

ASTR 111P. The Solar System. 1 Unit.
An introduction to astronomy that highlights the observational foundations for modern theories. Topics include motions of celestial objects, eclipses, historical development, the nature of light, telescopes, properties and evolution of the solar system. Mathematics (computations and basic algebra) is used extensively throughout the course in problem sets, laboratories and exams; the relevant mathematical techniques are reviewed and practiced to aid students who lack confidence in their mathematical skills. Weekly labs emphasize the important role of observation and measurement in improving understanding and validating theories. No prerequisites. Offered every other year. Can be used as a Q course.

ASTR 112P. Stars, Galaxies, and Cosmology. 1 Unit.
An introduction to astronomy that highlights the observational foundations for modern theories. Topics include the sun, stellar properties, stellar evolution including black holes and neutron stars, the Milky Way, galactic evolution, and the structure, history, and future of the universe. Mathematics (computations and basic algebra) is used extensively throughout the course in problem sets, laboratories and exams; the relevant mathematical techniques are reviewed and practiced to aid students who lack confidence in their mathematical skills. Weekly labs emphasize the important role of observation and measurement in improving understanding and validating theories. No prerequisites. Offered every other year. Can be used as a Q course.

Physics

PHYS 113P. Energy for a Sustainable Future. 1 Unit.
An introduction to the scientific study of global energy production and usage that emphasizes renewable energy sources. Also covered are the topics of energy conservation and the impact of various energy sources on global climate change. Mathematics (computations and basic algebra) is used throughout the course in problem sets, laboratories and exams; the relevant mathematical techniques are reviewed and practiced to aid students who lack confidence in their mathematical skills. Weekly labs emphasize the important role observation and measurement in improving understanding and validating theories. No prerequisites. Offered every year. Can be used as a Q course.

PHYS 114P. The Science of Music. 1 Unit.
An introduction to the physics of sound and music. Topics covered include the production, propagation, and reception of sound (physical acoustics), and the physics of musical instruments (musical acoustics). Mathematics (computations and very basic algebra) is used extensively throughout the course in problem sets, laboratories and exams; the relevant mathematical techniques are carefully reviewed and practiced to aid students who lack confidence in their mathematical skills. Three lectures and one laboratory per week. No prerequisites. Can be used as a Q course.

PHYS 121P. College Physics I. 1 Unit.
This is the first course in a two-course, algebra-based, introduction to physics. Topics include mechanics, heat, and wave motion. Three lectures and one laboratory per week. High school algebra is used extensively. Can be used as a Q course.

PHYS 122P. College Physics II. 1 Unit.
This is the second course in a two-course, algebra-based introduction to physics. Topics include electromagnetism, optics, and modern physics. Three lectures and one laboratory per week. High school algebra is used extensively. Prerequisite: PHYS 121P. Can be used as a Q course.

PHYS 141P. University Physics I. 1 Unit.
Calculus-based introductory physics for physics, preengineering, mathematics and other science majors. Topics include mechanics, waves, sound and heat. Four lectures and one laboratory per week. Mathematics prerequisite/corequisite: credit earned for MATH 131Q, MATH 141Q or MATH 151, or registration in MATH 130, MATH 131Q, MATH 141Q, or MATH 151.

PHYS 142P. University Physics II. 1 Unit.
This is the second course in the calculus-based introductory sequence for physics. Topics include electrostatic and magnetostatic fields, dc and ac circuits, electromagnetic radiation, and optics. Four lectures and one laboratory per week. Prerequisite: PHYS 141P. Mathematicsprerequisite/corequisite: credit earned for MATH 142Q or MATH 151, or registration in MATH 131Q, MATH 142Q.

PHYS 243. Modern Physics. 1 Unit.
This course is the third and final course in the introductory sequence of courses. It introduces the fields of physics that were first developed in the twentieth century, and that continue to evolve today. Topics include special relativity, the quantum theory of light, the structure of the atom, elementary wave mechanics, the properties of nuclei, and the properties of elementary particles. Three lectures and one lab per week Prerequisite: PHYS 142P. Corequisites: MATH 243Q or permission of instructor, and PHYS 380.

PHYS 251. Biophysics. 1 Unit.
Principles drawn from physics are used to build an understanding of biological systems. Topics may include: processes or functions at the level of molecules, cells, or organs; the theory underlying techniques used to make measurements; and the theory underlying techniques used to treat injuries and disease. Prerequisites: MATH 131Q or MATH 141Q, and PHYS 122P or PHYS 142P, and BIOL 141P.

PHYS 285. Independent Study. 0.5 or 1 Units.

PHYS 304. Mathematical Methods in Physics. 1 Unit.
This course introduces the mathematical tools that are required for many of the upper-level physics courses. The course emphasizes recognizing the equations that appear repeatedly in many different areas of physics and understanding their solutions. Topics include ordinary differential equations of first and second order, series solution of differential equations, vector analysis, Fourier series, partial differential equations, boundary value problems, Laplace and Fourier transforms, calculus of variations, and functions of a complex variable. Five lectures per week. Prerequisite: MATH 243Q.

PHYS 312. Laboratory Techniques. 1 Unit.
A study of experimental techniques and apparatus. Topics include an introduction to laboratory software, statistical analysis of data, error analysis, cryogenics, vacuum techniques, radiation safety and detection, and signal processing. One lecture and two laboratory periods per week. Prerequisite: PHYS 243. Corequisite: PHYS 380.

PHYS 322. Mechanics I. 1 Unit.
This course revisits the Newtonian mechanics learned in University Physics, but it harnesses more sophisticated mathematical tools that allow a much richer set of physical problems and phenomena to be studied. Topics include Newton's laws, dynamics of particles, statics of rigid bodies, noninertial reference frames, and gravitation and central forces. Prerequisite: PHYS 141P. Corequisites: PHYS 304 or permission of the instructor, and PHYS 380.

PHYS 332. Electricity and Magnetism. 1 Unit.
This course further develops the basic principles of electricity and magnetism introduced in University Physics by harnessing symmetry arguments and vector calculus for derivations and problem solving. Topics include electric fields and potentials, capacitance and dielectrics, magnetic flux and magnetic materials, and electromagnetic induction. Prerequisites: PHYS 142P and PHYS 304 or permission of instructor. Corequisite: PHYS 380.

PHYS 343. Quantum Mechanics I. 1 Unit.
This course revisits the wave mechanics that were introduced in Modern Physics, but it examines the theory more thoroughly and applies it to much more sophisticated problems. Topics include the Schrödinger equation, infinite and finite steps, barriers and wells, harmonic oscillators, and the hydrogen atom. Prerequisites: PHYS 243 and PHYS 304 or permission of the instructor. Corequisite: PHYS 380.

PHYS 352. Optics. 1 Unit.
This course covers basic optical theory, examining both geometric optics (the ray model) and physical optics (wave theory). Many of the optical phenomena and instruments discussed in the lectures are examined in the laboratory. Topics include thin lenses, thick lenses via matrix methods, optical instruments, interference and interferometers, polarization, diffraction, lasers, holography, Fourier optics, and non-linear optics. Prerequisite: PHYS 142P.

PHYS 356. Electronics. 1 Unit.
This is an introductory course in laboratory electronics covering both analog and digital circuits. Many of the circuits discussed in the lectures are built and tested in the laboratory. Topics include ac circuits, transistor circuits, amplifiers, and linear and digital integrated circuits. Prerequisite: PHYS 142P.

PHYS 362. Thermophysics. 1 Unit.
This is an introductory course in thermodynamics and statistical mechanics. The topics that are studied include: heat transfer, general gas laws, equations of state, phase diagrams, the laws of thermodynamics, engines, refrigerators, entropy, Maxwell's thermodynamic relations, microcanonical, canonical and grand canonical ensembles, and statistical distribution laws. Prerequisites: PHYS 243 and PHYS 304 or permission of instructor. Corequisite: PHYS 380.

PHYS 380. Physics Colloquium. 0.0 Units.
(Pass/Fail only). Physics Colloquium is a corequisite for many physics courses numbered 200 or higher. Physics majors should register for it every semester even if they happen to not be in one of the courses explicitly requiring it as a corequisite. The class will meet once a week and will be the venue for most student presentations assigned as a part of other physics courses. Other activities may include presentations given by faculty or visiting speakers, or discussions of current events that are of interest to the physics community.

PHYS 385. Independent Study. 0.5 or 1 Units.
Study of selected topics or laboratory research under the guidance of a professor.

PHYS 390. Special Topics in Physics. 1 Unit.
Topics determined by student interest and the availability of staff. Examples include: computational physics, digital electronics, and physical acoustics. Prerequisite: permission of instructor.

PHYS 395. Teaching Apprenticeship. 0.5 Units.

PHYS 397. Internship in Physics. 0.5 or 1 Units.
(Letter-graded or Pass/Fail). This course allows students in the physics,, applied physics, and biophysics tracks to complete an internship experience in an approved research/development setting. Settings include industrial research and development laboratories, technical consulting firms, and national laboratories or other technically oriented government agencies. Students will be required to maintain a laboratory notebook (consistent with any proprietary requirements) and will present a colloquium talk on their internship work. A letter of evaluation from the student's supervisor will also be required. Typically, full unit internships require approximately 140 hours for the semester. Specific requirements will be presented by way of a contract signed by the students. If this internship is used to fulfill a major requirement in the applied physics track, it must be letter-graded and for a full unit of credit. Prerequisites: permission of department head and instructor and PHYS 312. Enrollment in an internship course requires students to attend an orientation prior to beginning work at their internship site. For more information regarding internship orientations, please contact Career & Professional Development at career@stetson.edu or 386-822-7315.

PHYS 412. Advanced Laboratory Techniques. 1 Unit.
This is a continuation of PHYS 312 intended for students who are interested in pursuing graduate study in physics or a career working in the laboratory. One lecture and two three-hour laboratory periods per week. Prerequisite: PHYS 312 or permission of instructor. Corequisite: PHYS 380.

PHYS 422. Mechanics II. 1 Unit.
This is a continuation of Mechanics I. Topics include the mechanics of continuous media, dynamics of rigid bodies, and an introduction to the Lagrangian and Hamiltonian formulations of mechanics. Prerequisite: PHYS 322. Corequisite: PHYS 380.

PHYS 432. Electromagnetic Theory. 1 Unit.
This is a continuation of Electricity and Magnetism which includes a more sophisticated look at electrostatics and magnetostatics using more advanced problem solving techniques. It then examines the behavior of electromagnetic waves arising from Maxwell's equations. The course concludes with a brief introduction to relativistic electromagnetism. Prerequisite: PHYS 332. Corequisite: PHYS 380.

PHYS 443. Quantum Mechanics II. 1 Unit.
The concepts of quantum mechanics are reexamined using the Dirac formalism, which is used for essentially all advanced work in quantum mechanics. The Dirac formalism is introduced and applied to simple systems. Approximation techniques (time independent and time dependent perturbation theory, the variational principle, and WKB approximation) are applied to more complex systems. Nuclear scattering theory via the Born approximation is also discussed. Prerequisite: PHYS 343. Corequisite: PHYS 380.

PHYS 485. Independent Study. 0.5 or 1 Units.
Study of selected topics or laboratory research under the guidance of a professor.

PHYS 490. Special Topics in Physics. 1 Unit.
Topics determined by student interest and the availability of staff. Examples include: atomic, nuclear and particle physics, solid state physics, astrophysics, and general relativity. Prerequisite: Permission of instructor.

PHYS 497. Senior Project Proposal. 0.5 Units.
Students are matched with a faculty mentor, and then guided through the process of developing, writing, and orally presenting a proposal for their senior project. Corequisite: PHYS 380.

PHYS 498. Senior Project. 1 Unit.
Students perform the laboratory work for their senior project. The class will meet once a week to discuss progress, plans, and any difficulties that have arisen. Prerequisite: PHYS 497. Corequisite: PHYS 380.

PHYS 499. Senior Seminar. 0.5 Units.
Students report the results of their senior project in a number of formats including a journal style paper, a poster, a short conference style presentation, and a 40-minute oral presentation and defense. Prerequisite: PHYS 498. Corequisite: PHYS 380.