Physics courses deal mainly with the laws governing fundamental natural phenomena and the applications of those laws. The major study program can provide a sound basis for students going on to graduate work in physics or engineering and for those planning to teach physics or seeking a background in physics for work in other fields.

A student who enters Whitman without any prior college-level preparation in physics or calculus will have to complete 47 credits to fulfill the requirements for the physics major. Courses numbered 300 and above may not be taken P-D-F.

Learning Goals: Upon graduation, a student will be able to:
- Solve problems using discipline specific knowledge and techniques.
- Design and conduct an experimental investigation, analyze the data, and assess theoretical models of the system being studied.
- Communicate their results through written and/or oral expression.

Distribution: Some courses completed in physics apply to the science, science laboratory, and quantitative analysis distribution areas.

The Physics major:
- 30 credits (29 if completing Phys 347 in lieu of Phys 155) and 16 additional credits in mathematics (with no prior experience in physics)
- Required courses
  - Physics 145 or 155 or 347
  - Physics 156, 245, 255, 267, and 339
  - Four additional courses from among 300 to 480 level physics offerings and the course/lab combination of BBMB 324/334. This category’s course selection must include at least three of the following: Physics 325, 347, 357, or 385
    - Physics 347 may not be used to satisfy multiple requirements
  - Mathematics 225, 244, and either 240 or 367
- Other notes
  - If students place out of 155 they must take 347
  - No courses may be taken PDF
- Senior Requirements
  - Written and oral exam
- Honors
  - Students submit a Honors in Major Study Application to their department
  - Students must submit a proposal for their thesis or project
    - Must be submitted within the first six weeks of the two-semester period in which student is eligible
  - Accumulated at least 87 credits
  - Completed two semesters of residency at Whitman.
  - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  - Major GPA of at least 3.500
  - Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  - Earn a grade of at least A- on the honors thesis or project and the honors thesis course.
  - Pass the senior assessment with distinction
The department will submit the Honors applications to the Registrar’s Office of students pursuing Honors by the specified deadline
The department submit “Senior Assessment/Major Study Certificate” to the Registrar’s Office no later than the Reading Day
An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

The Physics minor:

- 18 Credits
- Required Courses
  - Physics 145 or 155, 156, 245, 255, 267
  - Three credits in physics 200-480, or BBMB 324 or 334

The Mathematics-Physics combined major:

- 49 credits (24 credits in Physics and 25 credits in Mathematics, if starting with Physics 155 and Mathematics 125)
- Required Mathematics courses
  - Mathematics 225, 240, 244, 367 or 368
  - 6 additional credits in Mathematics courses numbered above 200
- Required Physics courses
  - Physics 145 or 155 or 347
  - Physics 156, 245, 255, and 267
  - Three additional courses from among 300 to 480 level physics offerings and the course/lab combination of BBMB 324/334. This category’s course selection must include at least two of the following: Physics 325, 339, 347, 357, or 385
    - Physics 347 may not be used to satisfy multiple requirements
- Other notes
  - If students place out of Physics 155 they must take 347
- Senior Requirements
  - Senior assessment
    - Written exam in mathematics
    - Written exam in physics
    - Combined oral exam
      - Scheduled by the physics department
- Honors
  - Students submit a Honors in Major Study Application to their department
  - Students must submit a proposal for their thesis or project
    - Must be submitted within the first six weeks of the two-semester period in which student is eligible
  - Accumulated at least 87 credits
  - Completed two semesters of residency at Whitman.
  - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  - Major GPA of at least 3.500
  - Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  - Earn a grade of at least A- on the honors thesis or project and the honors thesis course.
  - Pass the senior assessment with distinction
  - The department will submit the Honors applications to the Registrar’s Office of students pursuing Honors by the specified deadline
  - The department submit “Senior Assessment/Major Study Certificate” to the Registrar’s Office no later than the Reading Day
  - An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

The Physics-Astronomy combined major:
• 59 Credits
  ○ 22 credits in astronomy
  ○ 24 credits in physics
  ○ 13 credits in mathematics

• Required Courses
  ○ Astronomy 177, 178, 179, 310, 320 or 330
  ○ At least two credits from: Astronomy 320, 330, 350, 360, 380, 391, 392 or 490
  ○ Physics 145 or 155 or 347
  ○ Physics 156, 245, 255, and 267
  ○ Two courses from Physics 325, 339, 347, 357, 385
  ○ One physics course 300-480 or BBMB 324 and 334
  ○ Mathematics 225 and 244

• Other notes
  ○ If students place out of Physics 155, they must take Physics 347
  ○ Physics 347 may not be used to satisfy multiple requirements
  ○ Additional physics courses, Computer Science 167, Mathematics 240, 367, and 368 are recommended
  ○ No courses may be taken PDF

• Senior Requirements
  ○ Senior assessment consisting of a
    ■ Two-part comprehensive written examination
    ■ One-hour oral exam conducted jointly

• Honors
  ○ Students submit a Honors in Major Study Application to their department
  ○ Students must submit a proposal for their thesis or project
    ● Must be submitted within the first six weeks of the two-semester period in which student is eligible
  ○ Accumulated at least 87 credits
  ○ Completed two semesters of residency at Whitman.
  ○ Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  ○ Major GPA of at least 3.500
  ○ Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  ○ Earn a grade of at least A- on the honors thesis or project and the honors thesis course.
  ○ Pass the senior assessment with distinction
  ○ The department will submit the Honors applications to the Registrar’s Office of students pursuing Honors by the specified deadline
  ○ The department submit “Senior Assessment/Major Study Certificate” to the Registrar’s Office no later the Reading Day
  ○ An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

The Geology-Physics combined major

• 61-62 total credits (with no credit for prior experience)
  ○ 25 credits in geology
  ○ 21-22 credits in physics
  ○ 13 credits in mathematics
  ○ 4 credits in chemistry

• Required geology courses:
  ○ Introductory geology: Geology 110 and 111, or 120 and 121, or 125 and 126
  ○ Geology 227, 270, 310, 358, 405, 420, and 470
● Required physics courses:
  ○ Physics 145 or 155 or 347
  ○ Physics 156, 245, 255, and 267
  ○ Two of the following: Physics 325, 339, 347, 357, or 385
    ■ Physics 347 may not be used to satisfy multiple requirements

● Required supporting science courses:
  ○ Chemistry 125 and 135
  ○ Mathematics 225 and 244

● Other Notes:
  ○ No courses taken PDF may be applied to the major
  ○ If students place out of Physics 155, they must take Physics 347

● Senior requirements:
  ○ Geology 470
  ○ Senior assessment:
    ■ Comprehensive written exams in both geology and physics
    ■ One-hour oral exam by physics and geology faculty

● Honors
  ○ Students submit a Honors in Major Study Application to their department
  ○ Students must submit a proposal for their thesis or project
    • Must be submitted within the first six weeks of the two-semester period in which student is eligible
  ○ Accumulated at least 87 credits
  ○ Completed two semesters of residency at Whitman.
  ○ Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  ○ Major GPA of at least 3.500
  ○ Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  ○ Earn a grade of at least A- on the honors thesis or project and the honors thesis course.
  ○ Pass the senior assessment with distinction
  ○ The department will submit the Honors applications to the Registrar’s Office of students pursuing Honors by the specified deadline
  ○ The department submit “Senior Assessment/Major Study Certificate” to the Registrar’s Office no later than Reading Day
  ○ An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

The Physics-Environmental Studies combined major: The requirements are fully described in the Environmental Studies section of the catalog.

The Physics/Pre-engineering (3/2 Engineering) program: The requirements are fully described in the Combined Plans section of the catalog.

Program Planning: A typical program of the required physics courses and mathematics and statistics requirements for students taking a physics major with no advanced placement in calculus is as follows:
I.First-year: Mathematics 125 (three credits); Physics 155, Mathematics 126 (seven credits).
II.Second year: Physics 156, Mathematics 225 (eight credits); Physics 245, 255, Mathematics 244 (eight credits).
III.Third year: Physics 325, a 2nd 300-level Physics course, Mathematics 240 (nine credits).
IV.Fourth year: Physics 385 (four credits).

Note that additional physics courses must be taken during the third and fourth years to meet the minimum credit requirement. Every effort will be made to offer courses required for the major and combined majors every year. Upper-level electives will typically be offered in alternate years. Students seriously considering graduate studies in physics or a physics-related field are encouraged to consult with their major advisor to design a course of study that will be best suited to their goals.
Among other electives for the physics major, Computer Science 167 is highly recommended. A year of chemistry also is recommended. Chemistry 345, Mathematics 349, 368, or 467 can be especially useful for physicists.

In the final semester of the senior year, the student must pass a senior assessment consisting of a written exam and a one-hour oral exam.

Non-major Courses: Courses numbered below 110 are intended for students majoring in fields other than science.

General Physics: There are two versions of the introductory general physics sequence. Physics 145/146 is intended for students planning no further study in physics. Physics 155/156 is intended for students planning to take upper level physics courses, including physics majors, physics combined majors, 3-2 engineering majors and BBMB majors.

101, 102 Special Topics
3 credits
Course designed for nonscience majors to explore some basic concepts of physics and their applications through readings, discussion, problem-solving, and occasional laboratory activities. Possible course titles include: How Things Work, Light and Color, and Physical Science. The topic for each course will be designated prior to registration for the semester in which the course will be taught. Students with AP credit for physics at Whitman or who have received credit for Whitman’s Physics 145 or higher cannot receive credit for Physics 101 or 102. Any current offerings follow.

103 Sound and Music
Not offered 2021-22
3 credits
This course will provide students with conceptual, quantitative, and laboratory based analysis of sound, musical instruments, music recording and storage, and room acoustics. Through detailed analysis of musical instruments as physical systems, students will develop an understanding of important physical concepts including sound waves, harmonic oscillators, energy, standing waves, resonance, and more. The course will culminate in student projects that may include building an instrument, designing and executing an experimental investigation related to acoustics, or extending course material to a new area of inquiry through a research paper. The course will meet four hours a week with two of those hours typically devoted to laboratory based learning.

104 Quantum Physics: What Gives?
Not offered 2021-22
3 credits
Quantum physics is the most precisely tested physical theory yet produced. It can explain the behavior of elementary particles, atoms, lasers, electronic circuits and nuclear reactors. Quantum physics promises to yield unbreakable encryption and ultrafast computation. Yet, its predictions often defy common sense; objects can be in multiple places at once and they appear to influence each other instantaneously over great distances. This course will provide an introduction to the concepts of quantum physics with no prerequisites beyond algebra and trigonometry. Students with AP credit for physics at Whitman or who have received credit for Whitman’s Physics 145 or higher cannot receive credit for Physics 104.

105 Energy and the Environment
Not offered 2021-22
3 credits
This course examines the physical principles that govern energy transformations. It will focus on the use of energy in the world, specifically its production, transportation, consumption and the implications this use has for the environment. Topics addressed will range from the mechanical to electricity and magnetism and from thermodynamics to atomic/nuclear physics. Energy resources both new and traditional (fuel cells versus oil) will be addressed as well as environmental issues ranging from global warming to the disposal of radioactive waste. This course assumes a basic familiarity with algebra.
115, 116 Contemporary Issues in Physics
Not offered 2021-22 1 credit
This course serves as an introduction to contemporary issues and topics in physics. Through readings and discussions, students will explore the activities of modern-day physicists. Although this course is intended for students planning to continue toward a physics or physics-related major, it is an excellent course for students wanting a better understanding of what physics is “all about” and how it is done, as a profession, at the beginning of the 21st century. Corequisites: for Physics 115: Physics 155; for Physics 116: Physics 156; or consent of instructor. Physics 115 and 116 each may be taken once for a total of two credits. No examinations. Graded credit/no credit only. Does not fulfill science or quantitative analysis distribution.

145 General Physics I – with Applications to Life and Earth Sciences
Fall 4 credits
This course focuses on classical mechanics: kinematics, Newton's Laws, energy and momentum conservation, torques, fluids, and waves. Examples and problems will focus on applications of physical principles to life and earth science fields to a greater extent than in Physics 155. Students enrolling in this course also will be required to enroll in an associated laboratory course (Physics 145L). Three 50-minute or two 80-minute class meetings and two 90-minute laboratory meetings per week. Evaluation based on homework, laboratory reports, and examinations. Pre- or corequisite: Mathematics 125.

146 General Physics II – with Applications to Life and Earth Sciences
Spring 4 credits
This course is a continuation of the course Physics 145. Topics studied include electricity and magnetism, circuits, optics, nuclear and atomic physics. Examples and problems will focus on applications of physical principles to life and earth science fields to a greater extent than in Physics 156. Not intended for students planning to take upper level physics or biophysics. Students enrolling in Physics 146 also will be required to enroll in an associated laboratory course (Physics 146L). Three 50-minute or two 80-minute class meetings and two 90-minute laboratory meetings per week. Evaluation based on homework, laboratory reports, and examinations. Prerequisites: Physics 145, 155 and Mathematics 125.

155 General Physics I
Spring 4 credits
This course focuses on classical mechanics: kinematics, Newton’s laws of motion, energy and momentum conservation, and waves. Students enrolling in this course also will be required to enroll in an associated laboratory course (Physics 155L). Three 50-minute or two 80-minute class meetings and two 90-minute laboratory meetings per week. Evaluation based on homework, laboratory reports, and examinations. Pre- or corequisite: Mathematics 125.

156 General Physics II
Fall 4 credits
This course is a continuation of the course Physics 155. Topics studied include electricity and magnetism, circuits, optics, plus brief introductions to more contemporary topics such as special relativity or quantum physics. Students enrolling in Physics 156 also will be required to enroll in an associated laboratory course (Physics 156L). Three 50-minute or two 80-minute class meetings and two 90-minute laboratory meetings per week. Evaluation based on homework, laboratory reports, and examinations. Prerequisite: Physics 145 or 155. Pre- or corequisite: Mathematics 126.

200-203 Special Topics
1-4 credits
Any current offerings follow.
245 Twentieth Century Physics I  
Spring  
Juers  
3 credits  
Topics include thermodynamics, special relativity, nuclear decay and radiation, wave nature of particles, introduction to the Schrödinger Equation: infinite well. Mathematical methods relevant to these areas of inquiry will be discussed: probability theory, differential equations. Prerequisites: Physics 156; Mathematics 126. Corequisite: Mathematics 225.

255 Twentieth Century Physics Laboratory  
Spring  
Hoffman  
1 credit  
Experimental investigations of a variety of phenomena relating to the Physics 245 course. Experimental topics studied include: thermodynamics, nuclear decay and radiation, photoelectric effect and standing waves. Emphasis on experimental technique, problem-solving, data analysis, and scientific writing. No examinations. One three-hour laboratory per week.

267 Analog & Digital Electronics and Instrumentation  
Fall  
Hoffman  
3 credits  
This is a semester long course/laboratory combination that serves as an in-depth introduction to the theory and practice of analog/digital electronics and instrumentation. The course content may include: combinational logic, Boolean algebra, Karnaugh maps, sequential logic, digital circuit design, AC signals, equivalent circuits, filter theory and implementation, transistor theory and implementation, and operational amplifier circuits. Meets for one 80 minute class and one 3-hour lab per week (two sections of lab offered). Prerequisite: Physics 245.

300-303 Special Topics  
1-4 credits  
Any current offerings follow:

300 ST: Soft Matter Physics  
Spring  
Juers  
3 credits  
The physics of squishy stuff. Colloidal dispersions, polymers, surfactants, liquid crystals, gels, foams, and granular materials all share the characteristic of being easily deformed by external stresses. Many of these materials are common in everyday life, including biological materials, foods, and silly putty. They often run against, or straddle, conventional classifications of matter. A key aspect of soft matter is that interactions between a relatively small number of particles at nanometer lengths (i.e. thousands of particles) can cause complex behavior which has real impacts at human length scales. We will explore the phenomenology of a variety of soft matter as well as models which attempt to account for the complex behavior. The topic is interdisciplinary and should be of interest to students in a variety of fields. Problem sets, exams, and one project/report. Prerequisite: Physics 156. Pre or Co-Requisite: Mathematics 225. Distribution area: None.

324 Biophysics  
Fall  
Juers  
3 credits  
The application of concepts and approaches from physics (e.g. mechanics, thermodynamics and electromagnetism) to deepen understanding of molecular and cell biology. We will focus on simplified models that capture the salient features of biological systems. Example topics include diffusion, hydrodynamics and cellular locomotion, free energy transduction, ligand binding, entropic forces, enzyme kinetics, molecular motors, macromolecular conformation, and signal propagation in neurons. Three one-hour lectures per week; weekly problem sets; exams. May be elected as BBMB 324. Prerequisites: Physics 156 and Mathematics 225.
325 Electricity and Magnetism  
Not offered 2021-22  
3 credits  
Electrostatics, electric and magnetic properties of materials, electromagnetic theory. Maxwell’s equations, electromagnetic waves, boundary value problems. Includes mathematical methods of wide use in physics. Lectures and problems. Prerequisites: Physics 245 and Mathematics 244.

334 Biophysics Laboratory  
Fall  
Juers  
1 credit  
Laboratory exercises on a range of biophysical topics. Experimental testing of models developed in BBMB 324. Study of macromolecules using techniques that may include absorption spectroscopy, fluorescence spectroscopy, circular dichroism, NMR, crystallization and structure determination via X-ray diffraction. One three- to four- hour laboratory per week. May be elected as BBMB 334. Corequisite: Physics 324. Open to non-BBMB/Physics majors only with consent of instructor.

339 Advanced Laboratory  
Spring  
Moore  
3 credits  
Experimental investigations of sophisticated analog and digital circuitry and the fundamental physics underpinning their operation. Students will employ programming tools to automate and enhance aspects of experimental techniques and subsequent analysis of data. Students will design and implement extensions to experiments in classical and modern physics with an emphasis on laboratory technique, technical and scientific writing, and analysis. The course will be a combination of lecture and laboratory activities meeting two days a week. Prerequisite: Physics 267.

347 Classical Mechanics  
Not offered 2021-22  
3 credits  

348 Optics  
Not offered 2021-22  
3 credits  
Modern physical optics including a study of the propagation of light, coherence and interference, diffraction, image formation. Fourier optics, spatial filtering, polarization, the optical activity of solids, the quantum nature of light, lasers, and holography. Lectures and problems. Three lectures per week. Prerequisite: Mathematics 244. Corequisite: Physics 245.

357 Thermal Physics  
Fall  
Gresham  
3 credits  
Thermodynamics, entropy, thermodynamic potentials, phase changes, chemical reactions, kinetic theory, distributions, phase space, transport phenomena, fluctuations; classical and quantum statistical mechanics, application to solids, radiation, superfluids, lasers, and astrophysics. Lectures, discussion, and problems. Prerequisite: Mathematics 244. Corequisite: Physics 245.

377 Particle Physics  
Not offered 2021-22  
3 credits  
From electrons to quarks to neutrinos to the Higgs mechanism, this course centers on a quantitative introduction to the Standard Model of particle physics—the well-tested model that describes all elementary particles and non-gravitational forces discovered up until the present. A significant portion of the class will be dedicated to learning and using the Feynman Calculus to calculate observable properties of elementary particle interactions. The course will end with a description of the Higgs mechanism and a discussion of some of the most pressing outstanding questions in particle physics. Prerequisite: Physics 245. Recommended corequisite: Mathematics 240.
385 Quantum Mechanics I  
Spring Gresham 3-4 credits  
This course begins with the quantum description of some two-dimensional systems (photon polarization and spin-1/2 particles) using the formalism of matrix mechanics. The course then moves on to cover two-particle systems, time evolution, and continuous systems (e.g., the harmonic oscillator). Lectures, discussion, problems. In years when the Quantum Mechanics laboratory is offered as a corequisite with the course experiments will include single photon interference, and tests of local realism (e.g., Bell inequalities). The course will be 3-credits with no lab, and 4-credits with the lab. Prerequisites: Physics 245 and Mathematics 244. Recommended prerequisite: Mathematics 240 or 367.

451, 452 Advanced Topics in Physics  
1-3 credits  
Specialized topics in physics such as: spectroscopic techniques, semiconductor physics, laser physics, plasma physics, advanced instrumentation techniques. Prerequisite: consent of instructor. Any current offerings follow.

481, 482 Seminar  
Not offered 2021-22 1 credit  
Oral reports by students on individual reading and research, talks by faculty and visiting physicists, group discussion of readings of general interest. Students submit notes on talks and their own lecture notes. No examinations. One meeting per week. Graded credit/no credit. Prerequisite: consent of instructor.

483, 484 Independent Study  
Fall, Spring Staff 1-3 credits  
Experimental or theoretical research or reading in an area of physics not covered in regular courses, under supervision of a faculty member. Maximum six credits. Prerequisite: consent of instructor.

490 Thesis  
Fall, Spring Moore 3 credits  
Preparation of a thesis.

498 Honors Thesis  
Fall, Spring Staff 3 credits  
Designed to further independent research or projects leading to the preparation of an undergraduate thesis or a project report. Required of and limited to senior honors candidates in physics. Prerequisite: admission to honors candidacy.