Physics

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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 will have to complete 49 credits to fulfill the requirements for the physics major. Courses numbered 300 and above may not be taken P-D-F. Courses completed in the physics major apply to the science and quantitative analysis (selected courses) distribution areas.

The Physics major: A minimum of 33 credits in physics including Physics 155, 156, 245, 246, 255, 256, 325, 335, 336, 347, 385. Additional courses to meet credit requirements are to be taken from 300-480 level physics offerings, or from BBMB 324 and BBMB 334. In addition, the following mathematics courses are required: 225, 235, 236, 244, and either 300 or 367.

The Physics minor: A minimum of 18 credits in physics to include Physics 155, 156, 245, 246, 255, 256 plus two credits in any physics courses numbered from 200-480, or from BBMB 324 and BBMB 334.

The Mathematics-Physics combined major: Mathematics 225, 235, 236, 244, 300, and nine additional credits in mathematics courses numbered above 200; Physics 155, 156, 245, 246, 255, 256, 335, either 325 or 347, and five credits from physics courses numbered from 300-480, or from BBMB 324 and BBMB 334. Courses completed in this major apply to the science and quantitative analysis (selected courses) distribution areas.

The Physics-Astronomy combined major: Astronomy 177, 178, 179, 310, 320; at least two credits in any of the following: 330, 340, 350, 380, 391, 392 or 490; Physics 155, 156, 245, 246, 255, 256, either 325 or 347, and five credits from physics courses numbered from 300-480; Mathematics 225, 235, 236, and 244. Additional physics courses, Mathematics 167 and 300 are strongly recommended. Courses completed in this major apply to the science and quantitative analysis (selected courses) distribution areas.

The Geology-Physics combined major: Physics 155, 156, 245, 246, 255, 256, either 325 or 347, and three credits from physics courses numbered from 300-480, or from BBMB 324 and BBMB 334; either Geology 110, 120, or 210, and 220, 310, 345, 346, 350, 420, 470 and a minimum of one credit in 358; Mathematics 225, 235, 236, and 244; Chemistry 125. Courses completed in this major apply to the science and quantitative analysis (selected courses) distribution areas.

The Physics-Environmental Studies combined major: The requirements are fully described in the Environmental Studies listing of the Catalog. Courses completed in this major apply to the social science, science and quantitative analysis (selected courses) distribution areas.

Program Planning

A typical program of the required physics courses and mathematics requirements for students taking a physics major with no advanced placement in calculus is as follows:

First year: Physics 155, Mathematics 125 (7 credits); Physics 156, Mathematics 126 (7 credits).
Second year: Physics 245, 255, Mathematics 225, 235 (8 credits); Physics 246, 256, Mathematics 236, 244 (8 credits).
Third year: Physics 325, 335, Mathematics 300 (11 credits); Physics 336, 347 (5 credits).
Fourth year: Physics 385.

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 adviser to design a course of study that will be best suited to their goals.

Among other electives for the physics major, Mathematics 167 is highly recommended. A year of chemistry is also recommended. Chemistry 345, Mathematics 338, 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.

101, 102 Special Topics
3, 3

Course designed for non-science 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 or IB credit for physics at Whitman or who have received credit for Whitman's Physics 155 or higher cannot receive credit for Physics 101 or 102.

101A ST: Women in Physical Science
3, x **Smith**

This course examines the scientific contributions and lives of prominent women in science past to present. Student evaluation will be based on exams, homework, group projects, and short papers. This course is designed for non-science majors and problem-solving will involve some mathematics but nothing beyond algebra.

101B ST: How Things Work
3, x **Moore**

A thematically oriented course introducing students to the physical interactions underpinning everyday experiences. Example topics that may be addressed include: transportation, high technology, energy and power. Designed for non-science majors and will use little mathematics and nothing beyond algebra and simple trigonometry. Occasional laboratory exercises. Evaluation based on exams, homework, group projects, short papers.

103 Sound and Music
3; not offered 2007-08

Investigating the nature of sound. Topics include vibrations, waves, sound production, sound synthesis, and hearing. Primary emphasis on the study of sound as it relates to music. Intended for non-science majors including students with little background in mathematics. A typical text is: Backus, *The Acoustical Foundations of Music*.

105 Energy and the Environment
x, 3 **Beck**

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
1, 1 **Staff**

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 towards 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 twenty-first century. *Co-requisite:* Physics 155 or 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.

135, 136 Introductory Physics Laboratory
1, 1 **Staff**

A series of experiments to illustrate experimental methods, basic measuring techniques and equipment and important phenomena. Offered to facilitate awarding of AP credit on the AP Physics C exam and to offer an introductory laboratory experience for student who have taken introductory physics without a laboratory at another institution. No examinations. Graded credit/no credit only. Consent of instructor required.

155 General Physics I
4, x **Staff**

The Physics 155, 156 sequence is intended for all students seeking a firm understanding of basic physical principles. This course focuses on classical mechanics: kinematics, Newtonian mechanics, energy and momentum conservation, and waves. This course is required for physics majors. Students enrolling in this course will also be required to enroll in an associated laboratory course (Physics 155L). Three 50-minute class meetings and two 90-minute laboratory meetings per week. Evaluation based on homework, laboratory reports, and examinations. *Prerequisite or co-requisite*: Mathematics 125.

156 General Physics II
x, 4 **Staff**

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. This course is required for physics majors. Students enrolling in Physics 156 will also be required to enroll in an associated laboratory course (Physics 156L). Three 50-minute class meetings and two 90-minute laboratory meetings per week. Evaluation based on homework, laboratory reports, and examinations. *Prerequisite or co-requisite*: Mathematics 126, Physics 155.

245, 246 Twentieth-Century Physics
3, 3 **Beck**

Probability, topics in kinetic theory, basic experiments and concepts in quantum physics, introduction to quantum mechanics, atoms, molecules, solids, nuclei, particles, special relativity, topics in mechanics. Lectures and problems. *Prerequisites*: Physics 156 and Mathematics 126; *Co-requisite* in Mathematics 225 recommended. Three lectures per week.

255, 256 Twentieth-Century Physics Laboratory
1, 1 **Fall: Juers; Spring: Burciaga, Juers**

Experimental investigations of a variety of phenomena, including the motion of charged particles in electric and magnetic fields, physical electronics, scattering and selected quantum effects. Students encouraged to alter or extend many of the experiments and engage in projects. Emphasis on experimental technique, problem solving, data analysis, and scientific writing. No examinations. One three-hour laboratory per week. *Prerequisites or co-requisites*: Physics 245, 246.

318 Computational Physics
x, 3 **Smith**

Methods of solution of physics problems using computational techniques. Problems taken from classical mechanics, electricity and magnetism, quantum mechanics, and thermal physics. Methods include computer modeling, graphical techniques, and simulation. Numerical techniques include those of iteration, relaxation, and the Monte Carlo method. Emphasis on the physical content of solutions and on analyses of their reliability. Lectures, problems, student presentations, and a special project. *Pre-requisites*: Physics 246, some computer programming experience is highly desirable.

325 Electricity and Magnetism
3, x **Juers**

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 246 and Mathematics 244.

326 Electricity and Magnetism
3; not offered 2007-08

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 246 and Mathematics 244.

335, 336 Advanced Laboratory
2, 2 **Moore**

Linear circuits, including transistors and other solid state devices, techniques of electrical measurement, and application of electrical measurement techniques in experiments in modern physics, including study of semiconductor properties. *Prerequisite*: Physics 256. One lecture and one three-hour laboratory per week.

347 Classical Mechanics
x, 3 **Burciaga**

Motion of a particle, coordinate transformations, non-inertial coordinate systems, systems of particles, rigid body motion. Lagrangian mechanics, normal modes of vibration, and Hamiltonian mechanics. Includes mathematical methods of wide use in physics. Lectures and problems. *Prerequisite*: Physics 246. Three lectures per week.

348 Modern Optics
3, x **Burciaga**

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. *Prerequisite*: Physics 156. Three lectures per week.

357 Thermal Physics
3; not offered 2007-08

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*: Physics 246.

385 Quantum Mechanics I
4, x **Beck**

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). Three hours of lecture each week, and three hours of laboratory every other week. Laboratories include single photon interference, and tests of local realism (e.g., Bell inequalities). *Prerequisites:* Physics 246, 256 and Mathematics 244; Mathematics 300 or 367 are recommended. Distribution area: science and quantitative analysis.

386 Quantum Mechanics II
x, 3 **Beck**

Atomic physics and perturbation theory. Also includes other advanced topics, such as quantum information or molecular physics. Three hours of lecture each week. *Prerequisite*: Physics 385. Distribution area: science and quantitative analysis.

451, 452 Advanced Topics in Physics

1-3

Specialized topics in physics such as: spectroscopic techniques, semiconductor physics, laser physics, plasma physics, advanced instrumentation techniques. Topics offered in any given year will be announced in the yearly class schedule. *Prerequisite:* consent of instructor.

481, 482 Seminar

1, 1 **Staff**

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.

483, 484 Independent Study

1-3, 1-3 **Staff**

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

3, 3 **Staff**

Preparation of a thesis.

498 Honors Thesis

3, 3 **Staff**

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.