

# PHYSICS (PHYS)

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## PHYS 1000 Fundamentals of Physics (3 credits)

General Education: Scientific Ways of Knowing

For students in nontechnical fields. Conceptual study of laws of nature and their application, including mechanics, heat, electricity and magnetism, light, and modern physics. Three lectures per week. (Carries no credit after PHYS 1111 or PHYS 2110. ) Typically Offered: Spring.

## PHYS 1000L Fundamentals of Physics Lab (1 credit)

For students in nontechnical fields. Conceptual study of laws of nature and their application, including mechanics, heat, electricity and magnetism, light, and modern physics. One 2-hour lab per week. Typically Offered: Spring.

**Coreqs:** PHYS 1000

## PHYS 1030 General Astronomy (3 credits)

General Education: Scientific Ways of Knowing

Descriptive and physical astronomy; development of astronomical thought; properties and evolution of the solar system, stars, galaxies, and the universe. Typically Offered: Fall.

## PHYS 1040 Astronomy Lab (1 credit)

Naked eye, telescopic, and photographic observations of constellations, stars, and planets. One 2-hour lab per week. Typically Offered: Fall.

Prereqs or

**Coreqs:** PHYS 1030

## PHYS 1111 General Physics I (3 credits)

General Education: Scientific Ways of Knowing

Kinematics, forces and dynamics, conservation laws, thermodynamics, and waves. Three lectures and one recitation per week. (Carries no credit after PHYS 2110. ) Typically Offered: Fall and Spring.

**Prereqs:** Sufficient score on SAT, ACT, or math placement test as for MATH 1160, or MATH 1143 with a C or better. Required test scores can be found here: <http://www.uidaho.edu/registrar/registration/placement> It is recommended that PHYS 1111 be taken no more than 2 years after MATH 1143 or its equivalent.

## PHYS 1111L General Physics I Lab (1 credit)

Kinematics, forces and dynamics, conservation laws, thermodynamics, and waves. One 2-hour lab per week. Typically Offered: Fall and Spring.

**Prereqs:** MATH 1143

**Coreqs:** PHYS 1111

## PHYS 1112 General Physics II (3 credits)

General Education: Scientific Ways of Knowing

Electricity, magnetism, optics, and modern physics. Three lectures and one recitation per week. (Carries no credit after PHYS 2120. ) Typically Offered: Spring.

**Prereqs:** PHYS 1111

## PHYS 1112L General Physics II Lab (1 credit)

Electricity, magnetism, optics, and modern physics. One 2-hour lab per week. Typically Offered: Spring.

**Coreqs:** PHYS 1112

## PHYS 2000 Welcome to the Physics Major (1 credit)

Introductory-level discussion of topics in modern physics; introduction to physics research topics and scientific information search techniques; written and/or oral reports of a pertinent topic in current physics. Typically Offered: Fall.

## PHYS 2030 (s) Workshop (1-16 credits, max 99)

Credit arranged

## PHYS 2040 (s) Special Topics (1-16 credits, max 99)

Credit arranged

## PHYS 2110 Engineering Physics I (3 credits)

General Education: Scientific Ways of Knowing

Kinematics and dynamics, Newton's laws, work and energy, rotational dynamics, linear and angular momentum, collisions, static equilibrium, oscillations, gravity and central forces. Three lectures and one recitation per week. Typically Offered: Fall and Spring.

**Coreqs:** MATH 1170

## PHYS 2110L Laboratory Physics I (1 credit)

Kinematics and dynamics, Newton's laws, work and energy, rotational dynamics, linear and angular momentum, collisions, static equilibrium, oscillations, gravity, central forces, and thermodynamics. One 2-hour lab per week. Typically Offered: Fall and Spring.

**Coreqs:** PHYS 2110

## PHYS 2120 Engineering Physics II (3 credits)

General Education: Scientific Ways of Knowing

Electric fields and potentials, magnetic fields, capacitance and inductance, DC and AC circuits, and electromagnetic waves. Three lectures and one recitation per week. Typically Offered: Fall and Spring.

**Prereqs:** PHYS 2110

**Coreqs:** MATH 1750

## PHYS 2120L Laboratory Physics II (1 credit)

Electric fields and potentials, magnetic fields, capacitance and inductance, DC and AC circuits, electromagnetic waves, mechanical waves, and geometric optics. One 2-hour lab per week. Typically Offered: Fall and Spring.

**Coreqs:** PHYS 2120

## PHYS 2130 Engineering Physics III (3 credits)

Fluid dynamics, waves in elastic media, sound waves, temperature, heat and thermodynamics, kinetic theory, and geometric and physical optics. Three lectures and one recitation per week. Typically Offered: Spring.

**Prereqs:** PHYS 2110 Prereqs or

**Coreqs:** MATH 1750

## PHYS 2990 (s) Directed Study (1-16 credits, max 99)

Credit arranged

## PHYS 3050 Modern Physics (3 credits)

Quantum and relativity theories with applications to atomic, solid state, nuclear, and elementary particle physics. Typically Offered: Fall.

**Prereqs:** PHYS 2120 and PHYS 2130

## PHYS 3210 Analytical Mechanics (3 credits)

Review of single-particle kinematics and dynamics; linear oscillations; Lagrangian dynamics; orbital dynamics; motion in non-inertial systems; and space rotation of rigid bodies. Typically Offered: Fall (Even Years).

**Prereqs:** PHYS 2120

**Coreqs:** MATH 2750 and MATH 3100

## PHYS 3330 Statistical Thermodynamics (3 credits)

Cross-listed with CHEM 4950

Classical thermodynamics, entropy, thermodynamic potentials, kinetic theory, classical and quantum statistical mechanics, ensembles, partition functions, introduction to phase transitions. Typically Offered: Spring (Even Years).

**Prereqs:** CHEM 3060 or PHYS 3050

**PHYS 3410 Electromagnetic Fields I (3 credits)**

This course is designed to provide undergraduate physics majors advanced instruction in electrostatics. The specific areas which will be covered are electric fields, electric potentials, work and energy in electrostatics, the technique of using the concept of image charges to solve for the electric field and electric potential of complex charge distributions, Laplace's and Poisson's equations, electric dipoles, polarization and polarizable materials, and the electric dipole approximation. Typically Offered: Fall (Odd Years).

**Prereqs:** PHYS 2120 and MATH 2750

**PHYS 3420 Electromagnetic Fields II (3 credits)**

This course is designed to provide undergraduate physics majors advanced instruction in electrodynamics and magnetism. The specific areas that will be covered are magnetostatics, magnetic fields in matter, the vector potential, electrodynamics, the complete set of Maxwell's equations, electromagnetic waves, waveguides, electric and magnetic dipole radiation, retarded and advanced potentials, and radiation arising from accelerated charges and charge distributions. Typically Offered: Spring (Even Years).

**Prereqs:** PHYS 3410

**PHYS 3510 Introductory Quantum Mechanics I (3 credits)**

Schrodinger equation, one-dimensional systems including the free particle, bound states, potential barriers, harmonic oscillator, matrix methods, and Dirac notation; interpretations of quantum theory; quantum mechanics in three-dimensions including the hydrogen atom, angular momentum, and spin systems; identical particles; symmetries and conservation laws in quantum mechanics. Typically Offered: Spring (Odd Years).

**Prereqs:** PHYS 3050

**Coreqs:** PHYS 3710 or MATH 3300

**PHYS 3710 Mathematical Physics (3 credits)**

Cross-listed with MATH 3710

Mathematical techniques needed in upper-division physics courses, including vector analysis, matrices, Sturm-Liouville problems, special functions, partial differential equations, complex variables. Typically Offered: Fall (Even Years).

**Prereqs:** PHYS 2120 and MATH 2750

**PHYS 4000 (s) Seminar (1-16 credits, max 99)**

Credit arranged

**PHYS 4030 (s) Workshop (1-16 credits, max 99)**

Credit arranged

**PHYS 4040 (s) Special Topics (1-16 credits, max 99)**

Credit arranged

**PHYS 4110 Advanced Physics Lab (4 credits)**

Research skills, group dynamics, scientific literature research/drafting, automation, and design techniques to prepare students for post-graduate life in a physics laboratory setting. 1-hour distributed lecture time and 3-hour effective lab time per week. Some weeks require scheduling machine utilization time outside of standard class hours per student. Typically Offered: Spring (Even Years).

**Prereqs:** PHYS 3050, PHYS 2110L, and PHYS 2120L

**PHYS 4280 Numerical Methods (3 credits)**

Cross-listed with ENGR 4280, MATH 4280

Joint-listed with MATH 5290, PHYS 5280

Systems of equations, eigenvalues and eigenvectors, root finding, error analysis, numerical solution to differential equations, interpolation and data fitting, numerical integration, related topics and applications, such as fast Fourier transforms, as time and interest permits. Typically Offered: Spring.

**Prereqs:** MATH 3100; and CS 1120 or MATH 1830 or ENGR 2120 or Permission

**PHYS 4380 Biological Physics (3 credits)**

Joint-listed with PHYS 5380

Physics principles applied to biological systems including organisms, cells, and biomolecules. Techniques for studying biological systems and phenomena. Additional projects/assignments required for graduate credit.

**Prereqs:** Prereq for PHYS 4380: PHYS 2120 or PHYS 2130; Junior or Senior standing. Prereq for PHYS 5380: Graduate Standing or Permission.

**PHYS 4430 Optics (3 credits)**

Joint-listed with PHYS 5430

Geometrical optics, wave optics, and physical optics with emphasis on modern instrumentation and methods of measurement. Additional projects/assignments required for graduate credit.

**Prereqs:** Prereq for PHYS 4430: PHYS 3420. Prereq for PHYS 5430: Admission to Physics Graduate program or Permission.

**PHYS 4640 Solid State Physics (3 credits)**

Joint-listed with PHYS 5640

Crystal structure and lattice dynamics including elastic and thermal properties of solids; electron dynamics including band theory, theory of metals and semiconductors, superconductivity, magnetism; solid-state device-physics; characterization of materials; and special topics chosen by the instructor. Additional projects/assignments required for graduate credit. Typically Offered: Spring.

**Prereqs:** PHYS 3210 and PHYS 3410; or Permission

**Coreqs:** PHYS 3510 or Permission

**PHYS 4650 Nuclear and Particle Physics (3 credits)**

Joint-listed with PHYS 5650

Particle production and detection, properties and classification of particles, the quark model of hadrons, symmetries and conservation laws, interactions, grand unification, the strong interaction and nuclear forces, and models for nuclear structure and reactions. Additional projects/assignments required for graduate credit.

**Prereqs:** Prereq for PHYS 4650: PHYS 3050. Prereq for PHYS 5650: Admission to physics graduate program or Permission. Cooperative: open to WSU degree-seeking students.

**PHYS 4840 Astrophysics of Stars and Planets (3 credits)**

Joint-listed with PHYS 5840

Orbital mechanics and rocket science; planets and planetary systems; and structure and evolution of stars and star systems. Additional projects/assignments required for graduate credit. Typically Offered: Varies.

**Prereqs:** PHYS 3050 or MATH 2750; or Permission. Cooperative: open to WSU degree-seeking students.

**PHYS 4890 Relativistic Astrophysics: from Cosmology to Black Holes (3 credits)**

Joint-listed with PHYS 5890

Origins and evolution of the universe; general relativity and gravitational wave physics; structure and environments of white dwarfs, neutron stars, and black holes. Additional projects/assignments required for graduate credit. Typically Offered: Varies.

**Prereqs:** PHYS 3050 or MATH 2750, or permission Cooperative: open to WSU degree-seeking students.

**PHYS 4900 Research (0-6 credits, max 6)**

Undergraduate research or thesis. Typically Offered: Varies.

**Prereqs:** Permission of instructor

**PHYS 4920 Senior Research (1 credit)**

General Education: Capstone Experience

Undergraduate research in one of the department focus areas. Scientific communication through one presentation to the scientific community and one written report.

**Prereqs:** Junior or Senior Standing; or Permission of Instructor.

**PHYS 4980 (s) Internship (1-16 credits, max 99)**

Credit arranged

**PHYS 4990 (s) Directed Study (1-16 credits, max 99)**

Credit arranged

**PHYS 5000 Master's Research and Thesis (1-16 credits, max 99)**

Credit arranged

**PHYS 5010 (s) Seminar (0-16 credits, max 99)**

Credit arranged. Graded Pass/Fail.

**Prereqs:** Permission

**PHYS 5020 (s) Directed Study (1-16 credits, max 99)**

Credit arranged

**PHYS 5030 (s) Workshop (1-16 credits, max 99)**

Credit arranged

**PHYS 5040 (s) Special Topics (1-16 credits, max 99)**

Credit arranged

**PHYS 5210 Advanced Mechanics (3 credits)**

Classical mechanics; Lagrange's and Hamilton's principles, two-body problem, rigid body motion, special relativity, canonical transformation, Hamilton-Jacobi theory, small oscillations, and Lagrangian and Hamiltonian formulations for continuous systems and fields.

Cooperative: open to WSU degree-seeking students.

**PHYS 5280 Numerical Methods (3 credits)**

Cross-listed with MATH 5290

Joint-listed with ENGR 4280, MATH 4280

, PHYS 4280. Systems of equations, eigenvalues and eigenvectors, root finding, error analysis, numerical solution to differential equations, interpolation and data fitting, numerical integration, related topics and applications, such as fast Fourier transforms, as time and interest permits. Typically Offered: Spring.

**PHYS 5330 Statistical Mechanics (3 credits)**

Ensembles, partition functions, classical and quantum statistics renormalization group, criticality, scaling, interacting systems, and simulation.

**Prereqs:** PHYS 3330 Cooperative: open to WSU degree-seeking students.

**PHYS 5380 Biological Physics (3 credits)**

Joint-listed with PHYS 4380

Physics principles applied to biological systems including organisms, cells, and biomolecules. Techniques for studying biological systems and phenomena. Additional projects/assignments required for graduate credit.

**PHYS 5410 Electromagnetic Theory I (3 credits)**

Analytical tools and techniques describing electromagnetic phenomena, particularly Maxwell's equations, electrostatic and magnetostatic systems, including currents and their interactions and boundary value problems.

**Prereqs:** PHYS 3420 Cooperative: open to WSU degree-seeking students.

**PHYS 5420 Electromagnetic Theory II (3 credits)**

Further examinations of the analytical tools and techniques that describe electromagnetic phenomena, particularly electrodynamics, the general theory of emission, propagation and absorption of electromagnetic waves, and the relativistic formulation of electrodynamics.

**Prereqs:** PHYS 5410 Cooperative: open to WSU degree-seeking students.

**PHYS 5430 Optics (3 credits)**

Joint-listed with PHYS 4430

Geometrical optics, wave optics, and physical optics with emphasis on modern instrumentation and methods of measurement. Additional projects/assignments required for graduate credit.

**PHYS 5500 Quantum Mechanics I (3 credits)**

Fundamental concepts, base kets and matrix representation, position and momentum space; Schroedinger and Heisenberg picture, Schroedinger's wave equation and solutions; and theory of angular momentum.

**Prereqs:** PHYS 3510 Cooperative: open to WSU degree-seeking students.

**PHYS 5510 Quantum Mechanics II (3 credits)**

Theory of angular momentum continued; symmetries in quantum mechanics; approximation methods, time-dependent and time-independent perturbation theory, applications to atomic systems; and radiation theory and theory of scattering.

**Prereqs:** PHYS 5500 Cooperative: open to WSU degree-seeking students.

**PHYS 5640 Solid State Physics (3 credits)**

Joint-listed with PHYS 4640

Crystal structure and lattice dynamics including elastic and thermal properties of solids; electron dynamics including band theory, theory of metals and semiconductors, superconductivity, magnetism; solid-state device-physics; characterization of materials; and special topics chosen by the instructor. Additional projects/assignments required for graduate credit. Typically Offered: Spring.

**Coreqs:** PHYS 3510 or Permission

**PHYS 5650 Nuclear and Particle Physics (3 credits)**

Joint-listed with PHYS 4650

Particle production and detection, properties and classification of particles, the quark model of hadrons, symmetries and conservation laws, interactions, grand unification, the strong interaction and nuclear forces, and models for nuclear structure and reactions. Additional projects/assignments required for graduate credit. Cooperative: open to WSU degree-seeking students.

**PHYS 5710 Mathematical Methods of Physics (3 credits)**

Methods and problems.

**Prereqs:** Permission Cooperative: open to WSU degree-seeking students.

**PHYS 5840 Astrophysics of Stars and Planets (3 credits)**

Joint-listed with PHYS 4840

Orbital mechanics and rocket science; planets and planetary systems; and structure and evolution of stars and star systems. Additional projects/assignments required for graduate credit. Typically Offered: Varies. Cooperative: open to WSU degree-seeking students.

**PHYS 5890 Relativistic Astrophysics: from Cosmology to Black Holes (3 credits)**

Joint-listed with PHYS 4890

Origins and evolution of the universe; general relativity and gravitational wave physics; structure and environments of white dwarfs, neutron stars, and black holes. Additional projects/assignments required for graduate credit. Typically Offered: Varies. Cooperative: open to WSU degree-seeking students.

**PHYS 5980 (s) Internship (1-16 credits, max 99)**

Credit arranged

**PHYS 5990 (s) Research (1-16 credits, max 99)**

Credit arranged

**PHYS 6000 Doctoral Research and Dissertation (1-45 credits, max 99)**

Credit arranged