

# PHYSICS (PHY)

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## PHY 101 Methods, Skills, and Strategies for Physics 3

Knowledge, skills, and strategies for surviving and excelling at physics. Includes essential analytical skills, key physics ideas, problem-solving techniques, critical-thinking practice, and academic success tips.

## PHY 196 Individual Study 1-3

Individual study on a topic of personal interest, mentored by a willing faculty member. Appropriate for topics requiring no prior physics knowledge.

**Prerequisites:** Permission of instructor.

**Notes:** May be repeated for a total of 6 credit hours with permission of department.

## PHY 205 Conceptual Physics 3

Introduction to basic laws of physics made by extensive use of demonstrations. Concepts emphasized and mathematical manipulations held to a minimum.

**MAC:** MAC CritThink Nat Sci

**Prerequisites:** None.

**Notes:** No student may receive credit for this course if credit has previously been earned for PHY 211, PHY 212, PHY 291, or PHY 292. Registration in laboratory (PHY 205L) optional.

## PHY 205L Conceptual Physics Laboratory 1

The discovery approach will be used to conduct experiments in mechanics, fluids, heat, electricity and magnetism, optics and modern physics.

**Corequisites:** PHY 205 .

## PHY 211 General Physics I 4

Introduction of laws and properties of matter, sound, heat, optics, electricity, and magnetism. Algebra and trigonometry used in development of this material.

**MAC:** MAC CritThink Nat Sci

**Prerequisites:** A grade of C or better in MAT 151 or MAT 183 or MAT 184 or MAT 190 or MAT 191 or MAT 196, or permission of instructor.

**Corequisites:** PHY 211L (the attached laboratory section).

**Notes:** Laboratory is included in PHY 211 and PHY 212. No student may receive credit for PHY 211 or PHY 212 if credit has previously been earned for PHY 211A or PHY 212A or PHY 291 or PHY 292.

## PHY 211A General Physics I 4

Introduction of laws and properties of matter, sound, heat, optics, electricity, and magnetism. Algebra and trigonometry used in development of this material.

**MAC:** MAC CritThink Nat Sci

**Prerequisites:** A grade of C or better in MAT 151 or MAT 183 or MAT 184 or MAT 190 or MAT 191 or MAT 196, or permission of instructor.

**Corequisites:** PHY 211L (the attached laboratory section).

**Notes:** Laboratory is included in PHY 211 and PHY 212. No student may receive credit for PHY 211 or PHY 212 if credit has previously been earned for PHY 211 or PHY 212A or PHY 291 or PHY 292.

## PHY 211L General Physics Lab I 0

## PHY 212 General Physics II 4

Introduction of laws and properties of matter, sound, heat, optics, electricity, and magnetism. Algebra and trigonometry used in development of this material.

**MAC:** MAC CritThink Nat Sci

**Prerequisites:** A grade of C or better in PHY 211 or permission of instructor.

**Notes:** Laboratory is included in PHY 211 and PHY 212. No student may receive credit for PHY 211 or PHY 212 if credit has previously been earned for PHY 211A or PHY 212A or PHY 291 or PHY 292.

## PHY 212A General Physics II 4

Introduction of laws and properties of matter, sound, heat, optics, electricity, and magnetism. Algebra and trigonometry used in development of this material.

**MAC:** MAC CritThink Nat Sci

**Prerequisites:** A grade of C or better in PHY 211 or permission of instructor.

**Notes:** Laboratory is included in PHY 211 and PHY 212. No student may receive credit for PHY 211 or PHY 212 if credit has previously been earned for PHY 211A or PHY 212 or PHY 291 or PHY 292.

## PHY 212L General Physics Lab II 0

## PHY 291 General Physics I with Calculus 4

Introduction to the laws and properties of mechanics and heat using calculus.

**MAC:** MAC Nat Sci Data Analysis

**Prerequisites:** Grade of C or better in either MAT 191 or MAT 196.

## PHY 291L General Physics I with Calculus Lab 0

Laboratory supporting PHY 291.

**Corequisites:** PHY 291.

**Notes:** No grade is awarded with this course number. Grades are awarded with the lecture course.

## PHY 292 General Physics II with Calculus 4

Introduction to the laws and properties of electricity, magnetism, sound, and optics using calculus.

**MAC:** MAC Nat Sci Data Analysis

**Prerequisites:** Grade of C or better in PHY 291. grade of C or better in either MAT 292 or MAT 296;

**Corequisites:** Students must register concurrently for the laboratory section, PHY 292L.

**Notes:** PHY 291 and PHY 292 together constitute a one-year university physics course. No student may receive credit for this course if credit has previously been earned for PHY 212 or PHY 212A.

## PHY 292L General Physics II with Calculus Lab 0

Laboratory supporting PHY 292.

**Corequisites:** PHY 292.

**Notes:** No grade is awarded with this course number. Grades are awarded with the lecture course.

## PHY 294 Introduction to Computational Physics Laboratory 1

Introduction to computational techniques used in physics and engineering. Use of software to solve problems in physics and astronomy, including simulation of interesting physical situations.

**Prerequisites:** Grade of C or better in PHY 292. or grade of C or better in PHY 291 and concurrent registration in PHY 292; Pr. or Coreq.: PHY 292.

**PHY 296 Individual Study 1-3**

Individual study on a topic of personal interest, mentored by a willing faculty member. Appropriate for topics comparable to PHY 291/PHY 292 in level and requiring some prior physics knowledge.

**Prerequisites:** Permission of instructor.

**Notes:** May be repeated for a total of 6 credit hours with permission of department.

**PHY 311 Intro to Experimental Methods 3**

Selected experiments with emphasis on laboratory techniques, methods of data analysis, knowledge of instrumentation, and the writing of laboratory reports. Intended to prepare students for research and advanced laboratory work.

**CIC:** CIC College Writing

**Prerequisites:** Grade of C or better in PHY 292. or permission of instructor;

**Corequisites:** PHY 321. Corequisite need not be taken concurrently. prior completion is adequate.

**PHY 321 Introduction to Modern Physics 3**

Fundamental concepts and principles of special relativity and quantum mechanics. Topics include frames of reference, the nature of spacetime, relativistic dynamics, classical wave models, the photon model of light, wave-particle duality, quantum spin, quantum paradoxes, the Schrodinger equation, atomic spectra, and nuclear physics.

**Prerequisites:** Grade of C or better in PHY 292. or permission of instructor.

**PHY 321L Modern Physics Laboratory 1**

Performance of atomic, nuclear, and solid state physics experiments and analysis of data in a quantitative and scientific manner. Simple computer programs used to study the concepts of error and least-square-fit techniques.

**Prerequisites:** Completion of or current registration in PHY 321. Pr. or Coreq.: PHY 321.

**PHY 323 Mechanics 3**

Mathematical treatment of classical kinematics and dynamics of a particle in a uniform field, in oscillatory motion and simple motions of systems of particles. Analytical and numerical techniques of problem solution stressed.

**Prerequisites:** Grade of C or better in PHY 292. or permission of instructor;

**Corequisites:** MAT 390. MAT 394 or MAT 396; or permission of instructor. Corequisites need not be taken concurrently; prior completion is adequate.

**PHY 325 Electricity and Magnetism I 3**

A study, developing and using techniques of vector algebra and calculus, of topics in the theory of static electric and magnetic fields including the divergence and Stokes' theorems and the law of Gauss, Biot-Savart, and Ampere. Application to the properties of conductors, dielectric, and magnetic materials.

**Prerequisites:** Grade of C or better in PHY 292, MAT 390, and either of MAT 394 or MAT 396.

**PHY 325L Electricity and Magnetism Laboratory 1**

Performance of electricity and magnetism and electronic experiments with analysis of these basic phenomena as applied to research laboratory.

**Prerequisites:** Completion of or concurrent registration in PHY 325.

**Corequisites:** PHY 325 (if not satisfied as a prerequisite)

**PHY 327 Thermal Physics 3**

Understanding the properties of bulk matter via classical thermodynamics, entropy, and statistical reasoning applied to the quantum mechanical properties of its constituents.

**Prerequisites:** Grade of C or better in PHY 321.

**PHY 331 Experimental Physics 1**

Advanced courses in laboratory techniques as involved in special laboratory problems.

**PHY 333 Selected Topics 1-3**

Primarily intended for those who are not physical science majors. Topics vary with instructor and with semester. Contemporary topics may include subjects such as analysis of physical resources, their inherent energy limitations and new sources of energy (such as solar, geothermal, etc.); development and adaptation of nuclear energy to electric power plants and armaments systems and the ensuing environmental and political problems. No previous science course required. Interested students should inquire at Physics and Astronomy Department office for further details. Selected topics for science majors may also be given upon request.

**PHY 351 Intro to Computational Physics 3**

Introduction to computational methods used in physics and engineering, including computational simulation of physical systems, numerical solution of mathematical problems, and familiarity with scientific programming tools.

**Prerequisites:** Grade of C or better in PHY 292 and grade of C or better in CSC 120, or permission of instructor.

**Corequisites:** PHY 321, or permission of instructor. Corequisite need not be taken concurrently. prior completion is adequate.

**PHY 395 Computational Physics Laboratory II 1**

Use of numerical methods and computational models to simulate and investigate the behavior of various physical systems, including ODE integration, PDE mesh relaxation, and/or Monte Carlo methods.

**PHY 396 Individual Study 1-3**

Individual study on a topic of personal interest, mentored by a willing faculty member. Appropriate for topics comparable to 300-level physics courses and requiring solid knowledge of introductory physics.

**Prerequisites:** Permission of instructor.

**Notes:** May be repeated for a total of 6 credit hours with permission of department.

**PHY 401 Physics Senior Seminar 1**

Topics from current physics literature, and presentations by students, faculty and guest lecturers. Oral reports on research topics. Attendance at weekly seminars required.

**Prerequisites:** PHYS major. senior standing;

**Notes:** Required of all Physics majors. Grade: Pass/Not Pass (P/NP).

**PHY 402 Conceptual Physics for Teachers 3**

The basic laws of physics are introduced by extensive use of demonstrations. Concepts are emphasized and mathematical manipulation is minimal. Teaching materials and strategies are developed.

**PHY 411 Experimental Physics II 3**

Experiments investigating electrical phenomena, modern physics, and current faculty research. This course builds on experience from PHY 311. Intended to prepare students for graduate school or careers in research and development.

**Prerequisites:** PHY 311, PHY 323, and PHY 325.

**PHY 412 Electronics for Scientists 3**

Electronic circuits useful for measurement, signal processing, and control. This course is especially designed to meet needs of experimental scientists.

**Prerequisites:** Grade of C or better in MAT 390, PHY 292, PHY 311, and PHY 351. or permission of instructor.

**PHY 419 Advanced Laboratory 1-3**

Methods and techniques of electronic connection between computer and other devices and programming methods to facilitate use of the computer as a laboratory instrument are introduced. Assembly language used primarily.

**CIC:** CIC College Writing

**Prerequisites:** Grade of C or better in PHY 311 and PHY 351, or permission of instructor.

**PHY 420 Selected Topics in Physics 3**

A topic of special interest is studied in depth.

**PHY 421 Quantum Mechanics 3**

Formal development of the postulates and methods of quantum mechanics and its application to a variety of one-dimensional and three-dimensional physical systems and phenomena, including the hydrogen atom, multiparticle systems, quantum tunneling, and scattering.

**Prerequisites:** Grade of C or better in PHY 321, MAT 390, and MAT 396.

**PHY 423 Analytical Mechanics 3**

Classical laws of particle motion are extended to the treatment of general motion of a rigid body, noninertial reference frames, generalized coordinates, normal coordinates, and to topics and techniques based on calculus of variations.

**Prerequisites:** Grade of C or better in PHY 323 and MAT 390.

**PHY 431 Astrophysics 3**

Stellar evolution through study of white dwarves and black holes; galaxy structure and cosmology. Observational project will use Three College Observatory. Intended as follow-up to introductory astronomy and physics.

**Prerequisites:** Grade of C or better in PHY 321, PHY 323, PHY 325, PHY 327, and PHY 351. or permission of instructor.

**PHY 443 Biophysics 3**

Introduction to cellular biophysics, with emphasis on the physical properties of membranes, including membrane transport mechanisms and electrical properties of membranes.

**Prerequisites:** BIO 355. CHE 111 and CHE 114; MAT 191; PHY 211 and PHY 212 (or PHY 291 and PHY 292); or permission of instructor;

**Notes:** Same as BIO 443.

**PHY 453 Analytical Methods for Physics 3**

Mathematical methods applied to diverse physics topics such as power series expansions, complex numbers, curvilinear coordinate systems, ordinary and partial differential equations, Lagrange multipliers, orthonormal basis expansions, and functional transformations.

**Prerequisites:** Grades of C or better in PHY 321, PHY 323, MAT 390, and either of MAT 394 or MAT 396.

**PHY 495 Research Experience in Physics 1-3**

A significant research project directed by faculty member. Student must submit written proposal, develop approved written plan, and deliver formal report of results.

**PHY 496 Individual Study 1-3**

Individual study on a topic of personal interest, mentored by a willing faculty member. Appropriate for advanced or specialized topics requiring solid knowledge of core (300-level) physics.

**Prerequisites:** Permission of instructor.

**Notes:** May be repeated for a total of 6 credit hours with permission of department.

**PHY 543 Biophysics 3**

Introduction to cellular biophysics, with emphasis on the physical properties of membranes, including membrane transport mechanisms and electrical properties of membranes.

**Prerequisites:** BIO 355, CHE 114, MAT 191, and either PHY 211 with PHY 212 or PHY 291 with PHY 292. or permission of instructor;

**Notes:** Same as PHY 543.

**PHY 608 Modern Physics for Teachers 3**

Recent developments in physics.