

# Physics (PHYS)

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## Courses

### **PHYS 10241. Physics and Human Affairs Laboratory. 1 Hour.**

Laboratory 2 hours per week. Pre- or Corequisite: PHYS 10243. (Typically offered: Fall, Spring and Summer)

### **PHYS 10243. Physics and Human Affairs. 3 Hours.**

The great ideas of physics, together with their philosophical and social impact. Scientific topics include cosmology, relativity, quantum mechanics. Philosophical and social topics include methods and values of science, problems related to energy sources, and implications of modern weapons. Non-mathematical. Designed for non-science majors. Along with PHYS 10241, can be used to satisfy a 4-year physical science requirement for a B.A. degree. Students who have received credit in PHYS 20103 and PHYS 20203, or PHYS 20304 and PHYS 20404 cannot also receive degree credit in this course. Corequisite: PHYS 10241. (Typically offered: Fall, Spring and Summer)

### **PHYS 102H1. Honors Physics and Human Affairs Laboratory. 1 Hour.**

Laboratory 2 hours per week. Pre- or Corequisite: PHYS 102H3. (Typically offered: Fall, Spring and Summer)

This course is equivalent to PHYS 10241.

### **PHYS 102H3. Honors Physics and Human Affairs. 3 Hours.**

The great ideas of physics, together with their philosophical and social impact. Scientific topics include cosmology, relativity, quantum mechanics. Philosophical and social topics include methods and values of science, problems related to energy sources, and implications of modern weapons. Non-mathematical. Designed for non-science majors. Along with PHYS 10241, can be used to satisfy a 4-year physical science requirement for a B.A. degree. Students who have received credit in PHYS 20103 and PHYS 20203, or PHYS 20304 and PHYS 20404 cannot also receive degree credit in this course. Corequisite: PHYS 102H1. (Typically offered: Fall, Spring and Summer)

This course is equivalent to PHYS 10243.

### **PHYS 10304. Physics for Elementary Education Majors. 4 Hours.**

For elementary education majors. Physical science concepts based on state frameworks are explored in a mixed lecture/lab environment. The inquiry-based lab activities can be transferable for school classroom use. Topics covered include: scientific inquiry, motion and forces, conservation of energy, heat, light, electricity and simple circuits, and magnetism. Prerequisite: Elementary education major. Corequisite: Lab component. (Typically offered: Spring)

### **PHYS 10404. Physics for Architects I. 4 Hours.**

Algebra-based survey of physics principles including motion, force, torque, and oscillation with emphasis on architectural structural support systems. Topics include physical units, coordinates, vectors, velocity, acceleration, projectile motion, catalog of forces, free-body diagrams, rotational motion, torque, center of gravity, impulse, oscillations, static equilibrium, stability, balance, stress, strain, and material strength. Corequisite: Lab component. Prerequisite: Major in architecture or interior design or agricultural education communication & technology. (Typically offered: Fall)

### **PHYS 10504. Physics for Architects II. 4 Hours.**

Algebra-based survey of physics principles including energy, heat, acoustics, light, and electricity with emphasis on interior architectural design. Topics include kinetic and thermal energy, heat transfer, insulation, sound intensity and loudness, sound transmission loss, reverberation time, ray optics, spherical mirror images, household electricity, parallel and series circuits, and electrical safety. Corequisite: Lab component. Prerequisite: Major in architecture or interior design or agricultural education communication & technology. (Typically offered: Spring)

### **PHYS 20101. College Physics I Laboratory (ACTS Equivalency = PHYS 2014 Lab). 1 Hour.**

Laboratory 2 hours per week. Corequisite: PHYS 20103. (Typically offered: Fall and Summer)

### **PHYS 20103. College Physics I (ACTS Equivalency = PHYS 2014 Lecture). 3 Hours.**

A non-calculus survey of the principles of physics including mechanics, heat and sound. Lecture 3 hours per week and drill 1 hour per week. Corequisite: Drill component and PHYS 20101. Prerequisite: (MATH 11003 and MATH 12003) or (MATH 13004 or MATH 22003 or MATH 24004) or a score of at least 26 on the math component of the ACT exam, or a score of at least 600 on the math component of the old SAT, or 620 on the math component of the new SAT. (Typically offered: Fall and Summer)

### **PHYS 20201. College Physics II Laboratory (ACTS Equivalency = PHYS 2024 Lab). 1 Hour.**

Laboratory 2 hours per week. Corequisite: PHYS 20203. (Typically offered: Summer)

### **PHYS 20203. College Physics II (ACTS Equivalency = PHYS 2024 Lecture). 3 Hours.**

Continuation of PHYS 20103. Topics include electricity and magnetism, light, relativity, quantum mechanics, atomic and nuclear structure. Lecture 3 hours, drill 1 hour per week. Corequisite: Drill component and PHYS 20201. Prerequisite: PHYS 20103 or PHYS 20304 or PHYS 203H4. (Typically offered: Spring and Summer)

### **PHYS 20304. University Physics I (ACTS Equivalency = PHYS 2034). 4 Hours.**

Introduction to the principles of mechanics, wave motion, temperature and heat, with calculus. Lecture three hours per week and practicum two hours a week (included in lab component). Corequisite: Lab component. Prerequisite: MATH 24004 excluding PHYS majors. Pre- or corequisite: MATH 24004 for PHYS majors. (Typically offered: Fall, Spring and Summer)

### **PHYS 203H4. Honors University Physics I. 4 Hours.**

Introduction to the principles of mechanics, wave motion, temperature and heat, with calculus. Lecture three hours per week and practicum two hours a week (included in lab component). Corequisite: Lab component. Prerequisite: MATH 24004. (Typically offered: Fall, Spring and Summer)

This course is equivalent to PHYS 20304.

### **PHYS 20404. University Physics II (ACTS Equivalency = PHYS 2044 Lecture). 4 Hours.**

Continuation of PHYS 20304. Topics covered include electricity, magnetism, light and geometric optics. Lecture three hours per week and practicum two hours per week. Corequisite: Lab component. Prerequisite: PHYS 20304 and MATH 25004 (excluding PHYS majors). Pre- or corequisite: MATH 25004 for PHYS majors. (Typically offered: Fall, Spring and Summer)

### **PHYS 204H4. Honors University Physics II. 4 Hours.**

Continuation of PHYS 205H4. Topics covered include electricity, magnetism, light and geometric optics. Lecture three hours per week and practicum two hours per week. Corequisite: Lab component. Prerequisite: (PHYS 20304 or PHYS 203H4) and MATH 25004. (Typically offered: Spring)

This course is equivalent to PHYS 20404.

### **PHYS 20504. University Physics III. 4 Hours.**

A continuation of PHYS 20304 and PHYS 20404. Topics include waves, physical optics, thermodynamics, kinetic theory, and an introduction to quantum mechanics. Lecture 3 hours per week and practicum 2 hours per week (included in lab component). Pre- or Corequisite: MATH 26004. Corequisite: Lab component. Prerequisite: PHYS 20404. (Typically offered: Fall)

### **PHYS 3060V. Projects. 1-3 Hour.**

Individual experimental or theoretical research problems for advanced undergraduates. Prerequisite: Instructor consent. (Typically offered: Irregular) May be repeated for up to 3 hours of degree credit.

**PHYS 31103. Analytical Mechanics. 3 Hours.**

Newton's laws of motion applied to particles, systems of particles, and rigid bodies. Introduction to Hamilton's and Lagrange's equations. Pre- or Corequisite: MATH 25804. (Typically offered: Fall)

**PHYS 32103. Electronics in Experimental Physics. 3 Hours.**

DC & AC electronics, semiconductors, operational amplifiers, and digital logic circuits with lab applications in experimental physics. Corequisite: Lab component. Prerequisite: PHYS 20504 or instructor consent. (Typically offered: Spring Odd Years)

**PHYS 32703. Inquiry and Modeling in Science Education. 3 Hours.**

Study of science practices with emphasis on modeling and inquiry for learning/teaching. Includes practical, philosophical, cognitive, and disciplinary specific dimensions of doing science in academic and nonacademic settings. Includes planning and implementing multiple scientific inquiries, engaging in reflective practices, writing and presenting scientific information. Safety and ethical issues are included. Corequisite: Drill component. Prerequisite: 8 hours of PHYS courses. (Typically offered: Fall and Spring)  
This course is equivalent to BIOL 32773.

**PHYS 34503. Electromagnetic Theory I. 3 Hours.**

Basics of Electromagnetic Theory, focusing on statics and introducing Maxwell's equations. Topics covered are: vector calculus and the solution of partial differential equations by separation of variables, electrostatics, dielectric media, electric currents, magnetic fields, magnetic properties of matter, electromagnetic induction, force and energy in electrodynamics, and Maxwell's equations. Pre- or Corequisite: MATH 25804. Prerequisite: MATH 26004 and PHYS 20404. (Typically offered: Spring)

**PHYS 34603. Electromagnetic Theory II. 3 Hours.**

Basics of Electromagnetic Theory, focusing on dynamical aspects. Topics to be covered include: Time-varying electric and magnetic fields including propagation of electromagnetic plane waves in vacuum and in matter, reflection, refraction, and guided wave propagation, radiation from point charges and dipoles, and relativity and the relativistic formulation of electrodynamics. Prerequisite: PHYS 34503. (Typically offered: Fall)

**PHYS 35404. Optics. 4 Hours.**

Elements of geometrical, physical, and quantum optics. Lecture 3 hours, laboratory 2 hours. Corequisite: Lab component. Prerequisite: PHYS 20404 and MATH 25004. (Typically offered: Fall)

**PHYS 36003. Introduction to Modern Physics. 3 Hours.**

An introduction to the basic ideas of 20th century physics, with an emphasis on those that form the foundations of modern technology: quantum theory and its application to atomic, nuclear, optical and condensed matter physics. No credit is given toward a B.S. degree in physics. Prerequisite: PHYS 20203 and MATH 22003 or MATH 24004. (Typically offered: Fall)

**PHYS 36103. Modern Physics. 3 Hours.**

Introduction to special relativity, statistical physics, quantum physics, and a survey of molecules, solids, and statistical physics. Prerequisite: PHYS 20404. (Typically offered: Fall, Spring and Summer)

**PHYS 3610V. Modern Physics Laboratory. 1-3 Hour.**

Advanced experiments, projects, and techniques in atomic, nuclear, and solid state physics. Pre- or corequisite: PHYS 36103. (Typically offered: Fall) May be repeated for up to 3 hours of degree credit.

**PHYS 3620V. Introduction to Modern Physics Laboratory. 1-3 Hour.**

Experiments illustrating the development and concepts of modern physics. No credit given toward a B.S. major in physics. Prerequisite: PHYS 36003. (Typically offered: Fall)

**PHYS 392H3. Honors Colloquium. 3 Hours.**

Covers a special topic or issue, offered as part of the honors program. No more than 3 hours may be offered toward fulfillment of the requirements for the B.S. or B.A. degree in Physics. Prerequisite: Honors candidacy (not restricted to candidacy in physics). (Typically offered: Spring) May be repeated for degree credit.

**PHYS 399HV. Honors. 1-6 Hour.**

Independent study for physics students enrolled in the honors program. Prerequisite: Junior standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

**PHYS 40703. Introduction to Quantum Mechanics. 3 Hours.**

A survey of quantum mechanics from the wave mechanical point of view including the application of quantum mechanics to the simple harmonic oscillator, angular momentum, and the hydrogen atom. Required course for B.S. Physics majors. Prerequisite: PHYS 36103, MATH 26004, and MATH 25804. (Typically offered: Fall)

**PHYS 40803. Advanced Quantum Mechanics. 3 Hours.**

Advanced topics in introductory quantum mechanics including identical particles, approximation methods; time-independent perturbations theory, variational principle, time-dependent perturbations theory, and scattering. Prerequisite: PHYS 40703, MATH 26004, and MATH 25804. (Typically offered: Spring)

**PHYS 41103. Physics in Perspective. 3 Hours.**

Human implications of physics, including life's place in the universe, the methods of science, human sense perceptions, energy utilization, social impacts of technology, and the effect of physics on modern world views. Prerequisite: PHYS 36103. (Typically offered: Irregular)

**PHYS 42103. Physics of Devices. 3 Hours.**

Principles of physics applied in a selection of technologically important devices in areas including computing, communications, medical imaging, lasers, and energy utilization. Students will utilize technical journals. Prerequisite: PHYS 36103. (Typically offered: Irregular)

**PHYS 43303. Thermal Physics. 3 Hours.**

Equilibrium thermodynamics, statistical physics, and kinetic energy. Prerequisite: PHYS 36103. (Typically offered: Spring)

**PHYS 46103. Introduction to Biophysics and Biophysical Techniques. 3 Hours.**

Origins of biophysics, biological polymers and polymer physics, properties of DNA and proteins, techniques to study DNA and proteins, biological membrane and ion channels, biological energy, experimental techniques to study single DNA and proteins. Two experiments are included: (1) DNA Gel electrophoresis; (2) Measurement of double-stranded DNA melting point. Prerequisite: PHYS 36103 or consent. (Typically offered: Spring)

**PHYS 46503. Subatomic Physics. 3 Hours.**

Nuclear structure and nuclear reactions. Nature and properties of elementary particles and resonances, their interactions and decays. Phenomenological theory and discussion of experimental evidence. Prerequisite: PHYS 36103. (Typically offered: Fall Odd Years)

**PHYS 47103. Solid State Physics. 3 Hours.**

Crystal structure, diffraction and symmetry. Lattice vibrations, elasticity and optical properties. Electronic structure, band theory, transport and magnetism. Course emphasizes applications and current topics in semiconductors, optics and magnetism. Pre- or Corequisite: PHYS 40703. (Typically offered: Spring Even Years)

**PHYS 47304. Introduction to Laser Physics. 4 Hours.**

A combined lecture/laboratory course covering the theory of laser operation, laser resonators, propagation of laser beams, specific lasers such as gas, solid state, semiconductor and chemical lasers, and laser applications. Prerequisite: PHYS 35404. (Typically offered: Spring)

**PHYS 47703. Introduction to Optical Properties of Materials. 3 Hours.**

A course covering crystal symmetry optical transmission and absorption, light scattering (Raman and Brillouin) optical constants, carrier mobility, and polarization effects in semi-conductors, quantum wells, insulators, and other optically important materials. Prerequisite: PHYS 35404. (Typically offered: Spring)

**PHYS 4880V. Selected Topics in Physics. 1-3 Hour.**

Selected topics in experimental or theoretical physics at the advanced level. (Typically offered: Irregular) May be repeated for up to 9 hours of degree credit.

**PHYS 4980V. Senior Thesis. 1-6 Hour.**

Senior Thesis. (Typically offered: Fall, Spring and Summer)

**PHYS 49901. Physics Senior Seminar. 1 Hour.**

Student mastery of the principles of physics are assessed by means of a research paper, a presentation on the research topic, and a reflection essay over coursework completed as part of the physics degree. A quantitative assessment examination will also be administered. Satisfies the Fulbright College writing requirement. (Typically offered: Fall, Spring and Summer)

**PHYS 5000V. Laboratory and Classroom Practices in Physics. 1-3 Hour.**

The pedagogy of curricular materials. Laboratory and demonstration techniques illustrating fundamental concepts acquired through participation in the classroom as an apprentice teacher. (Typically offered: Fall) May be repeated for up to 3 hours of degree credit.

**PHYS 50101. Introduction to Current Physics Research Seminar. 1 Hour.**

This seminar course introduces new Physics graduate students to the faculty of the Physics department and their current research efforts. In addition, the students will be introduced to scientific ethics, and learn communication skills. (Typically offered: Fall)

**PHYS 5020V. Individual Study in Advanced Physics. 1-4 Hour.**

Guided study in current literature. (Typically offered: Fall and Spring) May be repeated for up to 4 hours of degree credit.

**PHYS 50401. Journal Club Seminar. 1 Hour.**

In this seminar, the students will present talks based on published research articles. The goal of the course is to develop oral communication skills in the students. Effective literature search techniques will also be covered. (Typically offered: Spring)

**PHYS 50703. Mathematical Methods for Physics. 3 Hours.**

This course merges the mathematics required in classical mechanics, electrostatics, magnetostatics, and quantum mechanics into a single course. The goal is to develop physics problem-solving skills, a strong mathematical foundation, and a more unified picture of physics. (Typically offered: Fall)

**PHYS 50903. Applications of Group Theory to Physics. 3 Hours.**

Application of group theory to topics in physics, especially to atomic/molecular and solid-state physics. Prerequisite: PHYS 50703. (Typically offered: Irregular)

**PHYS 51003. Advanced Mechanics. 3 Hours.**

Dynamics of particles and rigid bodies. Hamilton's equations and canonical variables. Canonical transformations. Small oscillations. Prerequisite: PHYS 50703. (Typically offered: Fall)

**PHYS 51101. Research Techniques Through Laboratory Rotations. 1 Hour.**

Graduate students will be introduced to detailed operational aspects of two Physics research laboratories through extensive observation of those laboratory's operations during a six week rotation through each lab. Planning for starting a research project in the summer will take place in the final three week rotation period. (Typically offered: Spring)

**PHYS 52103. Statistical Mechanics. 3 Hours.**

Classical and quantum mechanical statistical theories of matter and radiation. Prerequisite: PHYS 54103. (Typically offered: Spring)

**PHYS 52603. Experiment and Data Analysis. 3 Hours.**

This course is devoted to learning some of the frequently used experimental techniques and methods by which experimental data are analyzed to extract quantitative information on physical parameters. Students will perform experiments, analyze data, and write lab reports. Prerequisite: PHYS 54103. (Typically offered: Fall)

**PHYS 53103. Advanced Electromagnetic Theory I. 3 Hours.**

Electrostatics, boundary-value problems in electrostatics, electrostatics in a medium, magnetostatics, and Faraday's Law. (Typically offered: Spring)

**PHYS 53203. Advanced Electromagnetic Theory II. 3 Hours.**

Maxwell equations, conservation laws, wave propagation, waveguides, radiating systems, scattering, special relativity, and radiation by moving charges. (Typically offered: Fall)

**PHYS 53603. Scientific Computation and Numerical Methods. 3 Hours.**

An introduction to numerical methods used in solving various problems in engineering and the sciences. May not earn credit for this course and MATH 43503 or MATH 43603. (Typically offered: Fall Even Years)  
This course is cross-listed with MATH 53603.

**PHYS 54103. Quantum Mechanics I. 3 Hours.**

Non-relativistic quantum mechanics; the Schrodinger equation; the Heisenberg matrix representation; operator formalism; transformation theory; spinors and Pauli theory; the Dirac equation; applications to atoms and molecules; collision theory; and semiclassical theory of radiation. (Typically offered: Fall)

**PHYS 54203. Quantum Mechanics II. 3 Hours.**

Continuation of PHYS 54103 Prerequisite: PHYS 54103. (Typically offered: Spring)

**PHYS 56103. Introduction to Biophysics and Biophysical Techniques. 3 Hours.**

Origins of biophysics, biological polymers and polymer physics, properties of DNA and proteins, techniques to study DNA and proteins, biological membrane and ion channels, biological energy, experimental techniques to study single DNA and proteins. Two experiments are included: (1) DNA Gel electrophoresis; (2) Measurement of double-stranded DNA melting point. (Typically offered: Spring)

**PHYS 56503. Subatomic Physics. 3 Hours.**

Nuclear structure and nuclear reactions. Nature and properties of elementary particles and resonances, their interactions and decays. Phenomenological theory and discussion of experimental evidence. (Typically offered: Fall Odd Years)

**PHYS 57103. Condensed Matter Physics I. 3 Hours.**

The course covers the Drude theory and the Sommerfeld theory of metals, crystal lattices, reciprocal lattices, X-ray diffraction, Bloch's theory of electrons in periodic potential, formation of band gap, lattice vibration, and cohesive energy in solids. Prerequisite: PHYS 54103. (Typically offered: Fall)

**PHYS 57304. Laser Physics. 4 Hours.**

A combined lecture/laboratory course covering the theory of laser operation, laser resonators, propagation of laser beams, specific lasers such as gas, solid state, semiconductor and chemical lasers, and laser applications. (Typically offered: Spring Odd Years)

**PHYS 57503. Applied Nonlinear Optics. 3 Hours.**

Topics include: practical optical processes, such as electro-optic effects, acousto-optic effects, narrow-band optical filters, second harmonic generation, parametric amplification and oscillation, and other types of nonlinear optical spectroscopy techniques which are finding current practical applications in industry. (Typically offered: Irregular)

**PHYS 57703. Introduction to Optical Properties of Materials. 3 Hours.**

This course covers crystal symmetry optical transmission and absorption, light scattering (Raman and Brillouin) optical constants, carrier mobility, and polarization effects in semi-conductors, quantum wells, insulators, and other optically important materials. (Typically offered: Spring Even Years)

**PHYS 57803. Physics of 2D Materials. 3 Hours.**

Introduction to the structures of all known layered materials, followed by mechanical, electronic, spin, optical, and topological properties of two-dimensional materials. Discussion of theoretical concepts and examination of experimental manifestations of those concepts are interwoven throughout the semester. Knowledge of solid state physics is required. Pre- or Corequisite: PHYS 54103. (Typically offered: Irregular)

**PHYS 5880V. Selected Topics in Physics. 1-3 Hour.**

Selected topics in experimental or theoretical physics at the advanced level. (Typically offered: Irregular) May be repeated for up to 6 hours of degree credit.

**PHYS 6000V. Master of Science Thesis. 1-6 Hour.**

Master of Science Thesis. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

**PHYS 65103. Theoretical Biophysics. 3 Hours.**

Introduction to biology as a complex system, networks and information theory, negative and positive feedback systems, gene regulation, noise, and noise propagation, cell signaling pathways, intercellular interactions, and emergence of cooperativity in biological systems. Prerequisite: PHYS 56103. (Typically offered: Fall Even Years)

**PHYS 67103. Condensed Matter Physics II. 3 Hours.**

The course covers surface physics, physics of homogeneous and inhomogeneous semiconductors, dielectric and ferroelectric physics, defects in crystals, spin interaction and magnetic properties, superconductivity, and band structure calculation. Prerequisite: PHYS 57103 and PHYS 54103. (Typically offered: Spring Even Years)

**PHYS 7000V. Doctoral Dissertation. 1-18 Hour.**

Doctoral Dissertation. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.