

**Descriptions—Physics  
of  
Courses**

**PHYSICS**

**PHY**

**Department of Physics and  
Astronomy  
College of Natural Science**

**101. Concepts in Physics**

*Fall. 1(1-0)*

Conceptual foundations of physics emphasizing key experiments.

**102. Physics Computations I**

*Spring. 1(0-3) P: (PHY 183 or concurrently or PHY 183B or concurrently or PHY 193H or concurrently or PHY 181B or concurrently) (CSE 101 or CSE 231)*

Use of computer software to solve, analyze and graph equations and data from mechanics.

**170. Investigations in Physics**

*Fall. 3(0-6) R: Approval of department.*

Experiments in optics, electronics, sound and mechanics; analysis of data using computers, library research and oral presentations.

**181B. Basic Physics I, CBI**

*Fall, Spring, Summer. 3 credits. P: (MTH 132 or MTH 152H or LBS 118) Not open to students with credit in LBS 164 or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C, PHY 233B.*

Newton's laws of motion, conservation of momentum and angular momentum, energy conservation, thermal physics, waves, and sound. Competency based instruction.

**182B. Basic Physics II, CBI**

*Fall, Spring, Summer. 3 credits. P: (PHY 183 or PHY 183B or PHY 181B or LBS 164 or PHY 193H) or (PHY 231 or concurrently and PHY 233B) or (PHY 231B or concurrently and PHY 233B) and (MTH 133 or MTH 153H or LBS 119) Not open to students with credit in LBS 267 or PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 294H.*

Electricity and magnetism, optical phenomena, interference and diffraction of light, atomic and subatomic topics. Competency based instruction.

**183. Physics for Scientists and Engineers I**

*Fall, Spring. 4(5-0) P: (MTH 132 or MTH 152H or LBS 118) Not open to students with credit in LBS 164 or PHY 181B or PHY 183B or PHY 193H or PHY 231 or PHY 231B.*

Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, waves.

**183A. Physics I, CBI**

*Fall, Spring, Summer. 1 credit. P: (PHY 181B) Not open to students with credit in LBS 164 or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C.*

Topics from: frames of reference, special relativity, rocket equation, forced oscillations, resonances, fluid motion, numerical solutions, moments of inertia, gyroscopic motion. This course plus PHY 181B is equal to PHY 183B.

**183B. Physics for Scientists and Engineers I, CBI**

*Fall, Spring, Summer. 4 credits. P: (MTH 132 or MTH 152H or LBS 118) Not open to students with credit in LBS 164 or PHY 181B or PHY 183 or PHY 193H or PHY 231 or PHY 231B or PHY 231C.*

Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, waves. Competency based instruction.

**184. Physics for Scientists and Engineers II**

*Fall, Spring. 4(5-0) P: (PHY 183 or PHY 183B or PHY 193H or PHY 233B or PHY 183A) or (LBS 164 and PHY 233B) and (MTH 133 or MTH 153H or LBS 119) Not open to students with credit in LBS 267 or PHY 182B or PHY 184B or PHY 232 or PHY 232B or PHY 294H.*

Electricity and magnetism, electromagnetic waves, light and optics, interference and diffraction.

**184A. Physics II, CBI**

*Fall, Spring, Summer. 1 credit. P: (PHY 182B) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 294H, PHY 232C or LBS 267.*

Topics from: standing wave phenomena, atoms, electromagnetic fields, alternating currents, optics, quantum mechanics, elementary particles. This course plus PHY 182B is equivalent to PHY 184B. 182B is exactly 3/4 of 184B and 184A is the other 1/4. It is a competency based instruction course.

**184B. Physics for Scientists and Engineers II, CBI**

*Fall, Spring, Summer. 4 credits. P: (PHY 183 or PHY 183B or PHY 193H) or (PHY 181B and PHY 183A) or (PHY 231B and PHY 233B) or (LBS 164 and PHY 233B) (MTH 133 or MTH 153H or LBS 119) Not open to students with credit in LBS 267 or PHY 182B or PHY 184 or PHY 232 or PHY 232B or PHY 294H.*

Electricity and magnetism, electromagnetic waves, light and optics, interference and diffraction. Competency based instruction.

**191. Physics Laboratory for Scientists, I**

*Fall. 1(0-3) P: (PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or LBS 164 or PHY 181B) Not open to students with credit in PHY 251 or LBS 164L.*

Error analysis, exercises in motion, forces, conservation laws and some electricity & magnetism studies.

**192. Physics Laboratory for Scientists, II**

*Spring. 1(0-3) P: (PHY 191) and (PHY 184 or PHY 182B or PHY 184B or PHY 294H or PHY 232 or PHY 232B or LBS 267) Not open to students with credit in PHY 252 or LBS 267L.*

Electric and magnetic fields, circuits, wave optics, modern physics.

**193H. Honors Physics I—Mechanics**

*Spring. 3(4-0) P: (MTH 133 or concurrently or MTH 153H or concurrently or LBS 119 or concurrently) Not open to students with credit in PHY 183 or PHY 183B or PHY 231 or PHY 231B or LBS 164 or PHY 181B.*

Mechanics and waves.

**201. Physics Computations II**

*Fall. 1(0-3) P: (PHY 184 or concurrently or PHY 184B or concurrently or PHY 294H or concurrently) (PHY 102) RB: (MTH 133)*

Computer methods to analyze and visualize physics problems. Tools used will include programming languages (Fortran) and mathematical software (Mathematica, etc).

**205. Directed Studies**

*Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Approval of department.*

Guided individualized study in an area of physics.

**215. Thermodynamics and Modern Physics**

*Fall, Spring. 3(4-0) P: (PHY 184 or concurrently or PHY 184B or concurrently or PHY 294H or concurrently or LBS 267 or concurrently or PHY 234B or concurrently) and (MTH 234 or MTH 254H or LBS 220) Not open to students with credit in PHY215B.*

Thermodynamics, atomic physics, quantized systems, nuclear physics, solids, elementary particles.

**215B. Thermodynamics and Modern Physics, CBI**

*Fall, Spring, Summer. 3 credits. P: (PHY 184 or concurrently or PHY 184B or concurrently or LBS 267 or concurrently or PHY 294H or concurrently or PHY 234B or concurrently) and (MTH 234 or MTH 254H or LBS 220) Not open to students with credit in PHY 215.*

Thermodynamics, atomic physics, quantized systems, nuclear physics, solids, elementary particles. Competency based instruction.

**231. Introductory Physics I**

*Fall, Spring. 3(4-0) P: (MTH 103 or MTH 116 or LBS 117 or MTH 124 or MTH 132 or concurrently) Not open to students with credit in LBS 164 or PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231B or PHY 231C.*

Mechanics, Newton's Laws, momentum, energy, conservation laws, thermodynamics, waves, sound.

**231B. Introductory Physics I, CBI**

*Fall, Spring, Summer. 3 credits. P: (MTH 103 or MTH 116 or LBS 117 or MTH 124 or MTH 132 or concurrently) Not open to students with credit in LBS 164 or PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231C.*

Mechanics, Newton's laws, momentum, energy, conservation laws, thermodynamics, waves, sound. Competency based instruction.

**231C. Introductory Physics I, Virtual University**

*Fall, Spring. 3 credits. P: (MTH 116) Not open to students with credit in PHY 181B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or LBS 164.*

Mechanics, Newton's Laws, momentum, energy, conservation laws, thermodynamics, waves, sound. Offered using CD and WWW technology.

**232. Introductory Physics II**

*Fall, Spring. 3(4-0) P: (PHY 231 or PHY 231B or PHY 181B or PHY 183 or PHY 183B or LBS 164 or PHY 193H or PHY 231C) Not open to students with credit in PHY 184 or PHY 184B or PHY 232B or LBS 267 or PHY 182B.*

Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics.

**232B. Introductory Physics II, CBI**

Fall, Spring, Summer. 3 credits. P: (PHY 231 or PHY 231B or PHY 231C or PHY 181B or PHY 183B or PHY 193H or LBS 164) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C, PHY 294H or PHY 182B or LBS 267.

Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics. Competency based instruction.

**232C. Introductory Physics II, Virtual University**

Fall, Spring. 3 credits. P: (PHY 182B or PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C or LBS 164) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 294H or LBS 267.

Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics. Offered using CD and WWW technology.

**233B. Calculus Concepts in Physics I, CBI**

Fall, Spring, Summer. 2 credits. P: (PHY 231) and (MTH 132 or MTH 152H or LBS 118) Not open to students with credit in PHY 183 or PHY 193H.

Kinematics, dynamics, applications of Newton's laws. Competency based instruction. PHY 231B plus PHY 233B is equivalent to PHY 183B.

**234B. Calculus Concepts in Physics II, CBI**

Fall, Spring, Summer. 2 credits. P: (PHY 232 or PHY 232B) and (MTH 133 or concurrently or MTH 153H or concurrently or LBS 119 or concurrently)

Electricity and magnetism. Competency based instruction. PHY 232B plus PHY 234B equals PHY 184B.

**251. Introductory Physics Laboratory I**

Fall, Spring, Summer. 1(0-3) P: (PHY 231 or PHY 231B or LBS 164 or PHY 181B or PHY 183 or PHY 183B or PHY 231C or PHY 193H) (MTH 103) Not open to students with credit in PHY 191 or LBS 164L.

Laboratory exercises involving simple mechanical systems.

**252. Introductory Physics Laboratory II**

Fall, Spring, Summer. 1(0-3) P: (PHY 251 or PHY 191 or LBS 164L) and (PHY 232 or PHY 232B or PHY 232C or PHY 182B or PHY 184 PHY 184B or PHY 294H or LBS 267) Not open to students with credit in PHY 192 or LBS 267L.

Laboratory exercises involving simple electromagnetic and optical systems.

**294H. Honors Physics II-Electromagnetism**

Fall. 3(4-0) P: (PHY 193H) and (MTH 234 or concurrently or MTH 254H or concurrently or LBS 220 or concurrently) Not open to students with credit in PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 182B or LBS 267.

Electricity and magnetism, electromagnetic waves and optics.

**305. Directed Studies**

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. P: (PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 294H or LBS 267) R: approval of department.

Guided individualized study in an area of physics.

**321. Classical Mechanics I**

Spring, Summer. 3(3-0) P: (PHY 184 or PHY 184B or PHY 294H) and (PHY 215 or PHY 215B) and (MTH 235 or MTH 255H or LBS 220)

Newtonian point particles. Oscillations. One-particle chaos. Central-force motion. Systems of particles.

**351B. Computational Physics, CBI**

Fall, Spring, Summer. 3 credits. P: (PHY 215 or PHY 215B) (CSE 131 or CSE 230)

Computer applications in physics research: printer graphics, Schroedinger equation solution, physics-symbol processing, physics information retrieval. Analysis of typical research data. Competency based instruction.

**357B. Topics in Contemporary Physics (CBI)**

Fall, Spring, Summer. 3 credits. P: (PHY 215 or PHY 215B) (PHY 184 or PHY 184B or PHY 294H or PHY 234B or LBS 267) R: Not open to students in the Department of Physics and Astronomy.

Atoms and nuclei, weak decay interaction, weak bosons, strong interaction, conservation laws, quarks and gluons. Competency based instruction.

**390. Physics Journal Seminar**

Spring. 1(3-0) P: Completion of Tier I writing requirement. R: Open only to juniors in the Physics major.

Written and oral reports on selected articles in the current literature. Critique of presentations by peers.

**405. Directed Studies**

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 5 credits in all enrollments for this course. P: (PHY 184 or PHY 184B or PHY 232 or PHY 232B or PHY 232C or PHY 294H or LBS 267) R: Approval of department.

Guided independent study of special topics for seniors and some graduate students.

**410. Thermal and Statistical Physics**

Spring. 3(3-0) P: (PHY 471)

Equilibrium statistical mechanics and thermodynamics, kinetic theory, phase transformations.

**422. Classical Mechanics II**

Fall. 3(3-0) P: (PHY 321)

Hamiltonian and Lagrangian mechanics. Non-inertial frames. Coupled oscillations. Continuous systems.

**423B. Special Relativity, CBI**

Summer. 3 credits. P: (PHY 321) RB: Some understanding about electric and magnetic fields.

Concepts of special relativity applied to coordinate transformations, mechanics, and electrodynamics. Competency based instruction.

**425B. Mathematical Physics, CBI**

Summer. 3 credits. RB: Calculus through differential equations. Some experience with complex variables.

Fourier series and complex variables as applied to problems in quantum mechanics, electrodynamics, and mechanics. Competency based instruction.

**431. Optics I**

Fall. 3(2-3) P: (PHY 192) and (PHY 184 or PHY 184B or PHY 234B or PHY 183A or PHY 294H) and (PHY 215 or PHY 215B) and completion of Tier I writing requirement.

Lenses, aberrations, apertures, and stops. Diffraction, interferometry, spectroscopy, fiber optics.

SA: PHY 331

**432. Optics II**

Spring. 3(2-3) P: (PHY 431)

Experimental projects involving advanced topics in optics. Holography, spatial filtering, study of physical systems using optical devices.

**440. Electronics**

Spring. 4(3-3) P: (PHY 192) and (MTH 235 or concurrently or MTH 255H or concurrently or LBS 220 or concurrently) and (PHY 184 or concurrently or PHY 184B or PHY 294H or LBS 267) and completion of Tier I writing requirement.

Concepts of electronics used in investigating physical phenomena. Circuits, amplifiers, diodes, LEDs, transistors.

**451. Advanced Laboratory**

Fall. 3(1-6) P: (PHY 440) and completion of Tier I writing requirement. R: Completion of Tier I writing requirement.

General research techniques, design of experiments, and the analysis of results based on some historical experiments in modern physics.

**452. Advanced Projects Laboratory**

Spring. 3(0-6) P: (PHY 451 and PHY 431)

A projects laboratory that builds on optics, electronics and advanced lab courses.

**471. Quantum Physics I**

Fall. 3(3-0) P: (PHY 215 or PHY 215B) and (PHY 321 or concurrently) and (MTH 235 or MTH 255H or LBS 220)

Schroedinger equation, hydrogen atom, harmonic oscillator, and other one-dimensional systems.

**472. Quantum Physics II**

Spring. 3(3-0) P: (PHY 471) RB: A Mathematics course on Boundary-Value Problems

Matrix formulation of quantum mechanics, perturbation theory, scattering.

**480. Computational Physics**

Spring of even years. 3(3-0) P: (CSE 131 or CSE 230)

Applications of scientific computational techniques to solutions of differential equations, matrix methods, and Monte Carlo methods used in physics.

**481. Electricity and Magnetism I**

Fall. 3(3-0) P: (MTH 234 or MTH 254H or LBS 220) R: Open only to juniors or seniors or graduate students.

Electrostatics, dielectrics, magnetic fields of steady state currents, Faraday law of induction.

## Descriptions—Physics of Courses

- 482. Electricity and Magnetism II**  
*Spring. 3(3-0) P: (PHY 481) RB: A Mathematics course on Boundary-Value Problems.*  
Maxwell's equations, scalar and vector potentials, electromagnetic plane waves.
- 490. Senior Thesis**  
*Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 5 credits in all enrollments for this course. P: (PHY 390) and completion of Tier I writing requirement.*  
Design, carry out, and analyze an original experiment or computation. A written and oral report is required.
- 491. Atomic, Molecular, and Condensed Matter Physics**  
*Fall. 3(3-0) P: (PHY 471 and PHY 410) and completion of Tier I writing requirement.*  
Many-electron atoms. Molecules, crystal structure, lattice dynamics. Band models of metals and semiconductors. Transport properties.
- 492. Nuclear and Elementary Particle Physics**  
*Spring. 3(3-0) P: (PHY 471) and completion of Tier I writing requirement. (PHY 472)*  
Properties of nuclei, nuclear models, nuclear reactions. High-energy accelerators. Weak, electromagnetic and strong interactions. Symmetries and conservation laws. Elementary particle spectrum, quarks, gluons.
- 800. Research Methods**  
*Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course.*  
Design and setup of experiments in various faculty research areas. Data collection and analysis. Study and practice of theoretical methods.
- 810. Methods of Theoretical Physics**  
*Fall. 3(3-0)*  
Theoretical methods used in classical mechanics, quantum mechanics, electrodynamics, and statistical mechanics.
- 820. Classical Mechanics**  
*Fall. 3(3-0)*  
Two-body central force problem, Hamilton's principle, Lagrangian and Hamiltonian equations of motion, variational methods, small oscillations, classical fields.
- 825. Epidemiologic Modeling**  
*Spring of odd years. 3(3-0) Interdepartmental with Epidemiology. Administered by Epidemiology. P: EPI 810, STT 422. R: Approval of department.*  
Mathematical modeling of epidemics. Stochastic and chaotic systems approaches. Applications through personal computer software.  
SA: HM 825
- 831. Statistical Mechanics**  
*Spring. 3(3-0)*  
Equilibrium statistical mechanics and thermodynamics. Boltzmann transport equations and hydrodynamics. Brownian and Langevin motion.
- 832. Topics in Statistical Mechanics (MTC)**  
*Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P: (PHY 831)*  
Advanced topics in statistical matter physics and nuclear physics.
- 841. Classical Electrodynamics I**  
*Spring. 3(3-0) P: (PHY 810)*  
Electrostatics, magnetostatics, time-varying fields and Maxwell's equations. Gauge transformations. Poynting's theorem and conservation laws.
- 842. Classical Electrodynamics II**  
*Fall. 3(3-0) P: (PHY 841 and PHY 810 or concurrently)*  
Plane electromagnetic waves, polarization states, reflection, refraction. Wave guides and resonant cavities. Radiating systems, dipole fields, radiated power. Special theory of relativity.
- 850. Electrodynamics of Plasmas**  
*Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering; Astronomy and Astrophysics.. Administered by Electrical and Computer Engineering. P: ECE 835 or PHY 488.*  
Plasma kinetic and macroscopic plasma transport theory. Electromagnetic wave propagation and charged particle diffusion processes in plasma. Electromagnetic energy absorption via elastic and inelastic collisions. Dc, rf, and microwave discharges.
- 851. Quantum Mechanics I**  
*Fall. 3(3-0) R: Open only to graduate students in the College of Engineering or College of Natural Science.*  
Axioms of quantum and wave mechanics, applications to spherically symmetric potentials. Hydrogen atom, harmonic oscillator, matrix mechanics, angular momentum theory, rotations.
- 852. Quantum Mechanics II**  
*Spring. 3(3-0) P: PHY 851.*  
Approximation methods, perturbation theory, atomic physics applications, scattering theory, identical particles, Pauli principle, Bose and Einstein statistics, Hartree-Fock approximation, collisions of identical particles, radiation.
- 853. Advanced Quantum Mechanics**  
*Fall. 3(3-0) P: PHY 852.*  
Quantum description of relativistic particles and fields. Dirac equation, interpretation of negative energy states, Lagrangian field theory, quantization of free fields, interactions, perturbation theory, S-matrix, and Feynman rules.
- 854. Quantum Electrodynamics**  
*Spring of odd years. 3(3-0) P: PHY 853.*  
Application of quantum field theory to the interaction of electrons and photons: pair annihilation, Compton scattering. Bound states, renormalization theory.
- 861. Beam Physics**  
*Spring of odd years. 3(3-0) P: PHY 820, PHY 841.*  
Particle accelerator theory and design.
- 871. Condensed Matter Physics**  
*Spring. 3(3-0) P: PHY 852.*  
Structure and vibrations of solids. Electrons in solids, electron gas, Bloch's theorem. Cohesion. Electron states in solids. Electronic properties of solids, electron transport, conductivity, semiconductors. Cooperative phenomena.
- 881. Subatomic Physics**  
*Fall. 3(3-0) P: PHY 851.*  
Application of conservation laws and physical principles to basic quantum mechanical problems in MeV energy range and femtometer size range. Application to nuclear data.
- 891. Elementary Particle Physics**  
*Spring. 3(3-0) P: PHY 853.*  
Nonabelian gauge theory, spontaneously broken gauge theory, electroweak interaction, QCD, W and Z boson coupling to quarks and leptons, charm, top and bottom quarks, particle generations.
- 899. Master's Thesis Research**  
*Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Open only to graduate students in Physics.*
- 905. Special Problems**  
*Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Physics and Astronomy.*  
In-depth study of a topic in physics or in astrophysics and astronomy.
- 962. Topics in Beam Physics (MTC)**  
*Fall, Spring, Summer. 3 credits. A student may earn a maximum of 12 credits in all enrollments for this course. P: PHY 861.*  
Selected topics in accelerator physics.
- 972. Topics in Condensed Matter Physics (MTC)**  
*Fall, Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P: PHY 831, PHY 852, PHY 871.*  
Advanced topics in many-body problems, disordered solids, superfluidity superconductivity magnetism, or macroscopic systems.
- 980. Advanced Reading in Physics**  
*Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department.*
- 982. Topics in Nuclear Physics (MTC)**  
*Fall, Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P: PHY 852, PHY 881.*  
Heavy ion reactions or nuclear structure.
- 992. Quantum Chromodynamics (MTC)**  
*Fall. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P: PHY 891.*  
Hadron-hadron interactions, interaction of hadrons with leptons.
- 999. Doctoral Dissertation Research**  
*Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to graduate students in Physics.*

## PHYSIOLOGY

## PSL

Department of Physiology  
College of Human Medicine  
College of Natural Science  
College of Osteopathic Medicine  
College of Veterinary Medicine

- 101. Current Issues in Physiology**  
*Fall. 2(2-0) Not open to students with credit in PSL 250 or PSL 431 or PSL 432.*  
Physiological bases of health issues of broad social significance, and new approaches for the treatment of specific disorders.