

## 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) RB: CSE 101 or CSE 231

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

**105C Preparatory - Physics**

Summer. 1(1-0) Interdepartmental with Lyman Briggs. Administered by Lyman Briggs. RB: College Algebra

Preparation for the introductory physics sequence: mathematical concepts, notations, representations, effective problem solving techniques and study strategies.

**170 Investigations in Physics**

Fall. 3(0-6) R: Open to freshmen in the Department of Physics and Astronomy. Approval of department.

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

**183 Physics for Scientists and Engineers I**

Fall, Spring. 4(5-0) P: MTH 132 or MTH 152H or LB 118 Not open to students with credit in LB 271 or PHY 193H or PHY 231 or PHY 231C.

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

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

Fall, Spring, Summer. 4 credits. P: MTH 132 or MTH 152H or LB 118 Not open to students with credit in PHY 183 or PHY 193H or PHY 231 or PHY 231C or LB 271.

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

**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 LB 271) and (MTH 133 or MTH 153H or LB 119) Not open to students with credit in LB 272 or PHY 184B or PHY 232 or PHY 234B or PHY 294H or PHY 232C.

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

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

Fall, Spring, Summer. 4 credits. P: (PHY 183 or PHY 183B or PHY 193H) or (PHY 231 and PHY 233B) or (PHY 231C and PHY 233B) or (LB 271 and PHY 233B) RB: MTH 133 or MTH 153H or LB 119 Not open to students with credit in LB 272 or PHY 184 or PHY 232 or PHY 232C or PHY 294H.

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

**191 Physics Laboratory for Scientists, I**

Fall. 1(0-3) P: (PHY 183 or concurrently) or (PHY 183B or concurrently) or (PHY 193H or concurrently) or (PHY 231 or concurrently) or (LB 271 or concurrently) or (PHY 181B or concurrently) Not open to students with credit in LB 271L or PHY 251.

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

**192 Physics Laboratory for Scientists, II**

Spring. 1(0-3) P: PHY 191 and ((PHY 184 or concurrently) or (LB 272 or concurrently) or (PHY 184B or concurrently) or (PHY 294H or concurrently) or (PHY 232 or concurrently) or (PHY 232C or concurrently)) Not open to students with credit in LB 272L or PHY 252.

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

**193H Honors Physics I-Mechanics**

Spring. 4(4-0) P: (MTH 133 or concurrently) or (MTH 153H or concurrently) or (LB 119 or concurrently) Not open to students with credit in LB 273 or PHY 231C or PHY 183 or PHY 231.

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) RB: MTH 133 and PHY 102

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.

**213H Navigating the Universe**

Spring. 3(3-0) Interdepartmental with Integrative Studies in Physical Science. Administered by Integrative Studies in Physical Science. P: (MTH 103 or MTH 110 or MTH 116 or (LB 118 or concurrently) or (MTH 112 or concurrently) or (MTH 124 or concurrently) or (MTH 132 or concurrently) or (MTH 201 or concurrently) or (STT 200 or concurrently) or (STT 201 or concurrently)) or designated score on Mathematics Placement test RB: High school physics, high school algebra, and high school trigonometry

Philosophical and biographical history of physics. Comparing physics of fields, relativity, quantum mechanics, elementary particle physics, and cosmology to art as an alternate way of understanding and representing the world.

**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 (LB 272 or concurrently) or (PHY 234B or concurrently)) and ((MTH 234 or concurrently) or (MTH 254H or concurrently) or (LB 220 or concurrently)) Not open to students with credit in PHY 215B.

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

**215B Thermodynamics and Modern Physics**

Fall, Spring, Summer. 3 credits. P: ((PHY 184 or concurrently) or (PHY 184B or concurrently) or (LB 272 or concurrently) or (PHY 294H or concurrently) or (PHY 234B or concurrently)) and (MTH 234 or MTH 254H or LB 220) Not open to students with credit in PHY 215.

Thermodynamics, atomic physics, quantized systems, nuclear physics, solids, elementary particles. This course is given in the competency based instruction format.

**231 Introductory Physics I**

Fall, Spring. 3(4-0) P: MTH 103 or MTH 116 or LB 118 or MTH 124 or (MTH 132 or concurrently) Not open to students with credit in LB 271 or PHY 183 or PHY 183B or PHY 193H or PHY 231C.

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

**231C Introductory Physics I**

Fall, Spring. 3 credits. P: MTH 103 or MTH 116 or MTH 124 or (MTH 132 or concurrently) or LB 118 RB: MTH 116 Not open to students with credit in LB 271 or PHY 183 or PHY 183B or PHY 193H or PHY 231.

Mechanics, Newton's Laws, momentum, energy, conservation laws, thermodynamics, waves, sound. This course is an internet based course.

**232 Introductory Physics II**

Fall, Spring. 3(4-0) P: PHY 231 or PHY 231C or PHY 183 or PHY 183B or PHY 193H or LB 271 Not open to students with credit in LB 272 or PHY 184 or PHY 184B or PHY 232C.

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

**232C Introductory Physics II**

Fall, Spring. 3 credits. P: PHY 231 or PHY 231C or PHY 193H or LB 271 Not open to students with credit in LB 272 or PHY 184 or PHY 184B or PHY 232 or PHY 294H.

Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics. This course is an internet based course.

**233B Calculus Concepts in Physics I**

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

Kinematics, dynamics, applications of Newton's laws. PHY 231B plus PHY 233B is equivalent to PHY 183B. This course is given in the competency based instruction format.

**234B Calculus Concepts in Physics II**

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

Electricity and magnetism. PHY 232 (or PHY232C) plus PHY 234B equals PHY 184. This course is given in the competency based instruction format.

**251 Introductory Physics Laboratory I**

Fall, Spring, Summer. 1(0-2) P: (PHY 231 or concurrently) or (PHY 231B or concurrently) or (LBS 271 or concurrently) or (PHY 183 or concurrently) or (PHY 183B or concurrently) or (PHY 231C or concurrently) or (PHY 193H or concurrently) RB: MTH 103 Not open to students with credit in LBS 271L or PHY 191.

Laboratory exercises involving simple mechanical systems.

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- 252 Introductory Physics Laboratory II**  
Fall, Spring, Summer. 1(0-2) P: (PHY 251 or PHY 191 or LB 271L) and ((PHY 232 or concurrently) or (PHY 232C or concurrently) or (PHY 184 or concurrently) or (PHY 184B or concurrently) or (PHY 294H or concurrently) or (LB 272 or concurrently)) Not open to students with credit in LB 272L or PHY 192.  
Laboratory exercises involving simple electromagnetic and optical systems.
- 294H Honors Physics II-Electromagnetism**  
Fall. 4(4-0) P: PHY 193H and ((MTH 234 or concurrently) or (MTH 254H or concurrently) or (LB 220 or concurrently)) Not open to students with credit in LB 274 or PHY 184 or PHY 184B or PHY 232 or PHY 232C.  
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 272 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 or LB 272) and ((PHY 215 or concurrently) or (PHY 215B or concurrently) and ((MTH 234 or concurrently) or (MTH 254H or concurrently) or (LB 220 or concurrently))  
Newtonian point particles. Oscillations. One-particle chaos. Central-force motion. Systems of particles.
- 390 Physics Journal Seminar**  
Spring. 1(3-0) P: Completion of Tier I writing requirement. R: Open only to juniors or seniors in the Department of Physics and Astronomy or Lyman Briggs School.  
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 272 R: Approval of department.  
Guided independent study of special topics.
- 410 Thermal and Statistical Physics**  
Spring. 3(3-0) P: PHY 471  
Equilibrium statistical mechanics and thermodynamics, kinetic theory, phase transformations.
- 415 Methods of Theoretical Physics**  
Spring. 4(4-0) Interdepartmental with Lyman Briggs. Administered by Lyman Briggs. P: ((MTH 234 or concurrently) or (LB 220 or concurrently) or (MTH 254H or concurrently)) and (LB 273 or PHY 183 or PHY 193H) and (LB 274 or PHY 184 or PHY 294H) RB: (MTH 235 or concurrently) or (MTH 255H or concurrently) or (MTH 340 or concurrently) SA: LBS 415  
Mathematical methods applied to physical problems in mechanics, electromagnetism, and thermodynamics. Multiple integration, vector calculus, Fourier series, ordinary and partial differential equations, eigenvector problems, coordinate transformations, and complex analysis. Newtonian mechanics, rigid body dynamics, heat flow, electrostatics, harmonic motion, and waves.
- 422 Classical Mechanics II**  
Fall. 3(3-0) P: PHY 321  
Hamiltonian and Lagrangian mechanics. Non-inertial frames. Coupled oscillations. Continuous systems.
- 431 Optics I**  
Fall. 3(2-3) P: ((PHY 192 or LB 272L) and completion of Tier I writing requirement) and (PHY 184 or PHY 184B or PHY 234B or PHY 294H or LB 272) and (PHY 215 or PHY 215B)  
Lenses, aberrations, apertures, and stops. Diffraction, interferometry, spectroscopy, fiber optics.
- 440 Electronics**  
Spring. 4(3-3) P: (PHY 192 or LB 272L) and ((MTH 235 or concurrently) or (MTH 255H or concurrently) or (LB 220 or concurrently)) and ((PHY 184 or concurrently) or (PHY 184B or concurrently) or (PHY 294H or concurrently) or (LB 272 or concurrently))  
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  
General research techniques, design of experiments, and the analysis of results based on some historical experiments in modern physics.
- 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 LB 220)  
Schrödinger 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) RB: 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 LB 220 R: Open to juniors or seniors or graduate students.  
Electrostatics, dielectrics, magnetic fields of steady state currents, Faraday law of induction.
- 482 Electricity and Magnetism II**  
Spring. 3(3-0) P: PHY 481 RB: A Mathematics course on Boundary-Value Problems. R: Open to juniors or seniors or graduate students.  
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 R: Open to seniors in the Department of Physics and Astronomy or in the Chemical Physics major or in the Bachelor of Arts in Physics or in the Bachelor of Science in Physics or in the Physics and Geophysics major. Approval of department.  
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 RB: 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.