

B.S. PHYSICS DEGREE PROGRAM

Students can obtain a Bachelor of Science degree in Physics by completing **74** credit hours in Physics, Math, Computer Science and Chemistry as indicate below. Additionally, **52** credit hours of Gen. Ed. courses need to be completed to fulfill the graduation requirement of **126** credit hours.

Twelve required physics core courses (41 credit hours): Phys. 205, 206, 211, 307, 404, 405, 406, 408, 410, 420, 440, and 450.

Seven required mathematics courses (23 credit hours): Math. 117, 118, 215, 216, 301, 314 and 405.

Four required computer science courses (14 credit hours): C.S. 130, 131, 221, and 341.

Two required chemistry courses (8 credit hours): Chem. 103 and 104.

Students enrolled in the Bachelor of Science degree in physics will also receive a minor in mathematics.

Physics core courses (12 courses) – 41 hrs

1. Phys. 205 University Physics I (4)
2. Phys. 206 University Physics II (4)
3. Phys. 211 Analog Electronics (4)
4. Phys. 307 Modern Physics (4)
5. Phys. 404 Classical Mechanics (3)
6. Phys. 405 Electricity & Magnetism (3)
7. Phys. 406 Thermal & Statistical Physics (3)•
8. Phys. 408 Mathematical Methods in Physics (3)
9. Phys. 410 Quantum Physics (3)*
10. Phys. 420 Computational Physics with Cluster Computing (4)
11. Phys. 440 Particle Physics & Cosmology (3)
12. Phys. 450 Special Topics in Physics (3)

Math courses (7 courses) – 23 hrs (19 hrs effective)

1. MATH 117 Calculus I (4) (*counted under Gen. Ed. - Mathematics*)
2. MATH 118 Calculus II (4)
3. MATH 216 Calculus III (3)
4. MATH 215 Linear Algebra (3)
5. MATH 301 Differential Equations (3)
6. MATH 314 Probability and Math. Statistics I (3)
7. MATH 405 Introduction to Numerical Analysis (3)

CS courses (4 courses) – 14 hrs

1. CS 130 Programming Fundamentals (4)
2. CS 131 Object-Oriented Paradigm (3)
3. CS 221 Logic Design (4)
4. CS 341 Interactive Computer Graphics (3)

*Chemistry courses (2 courses) – 8 hrs (*counted under Gen. Ed. - Natural Sciences*)*

1. CHEM 103 General College Chemistry I (4)
2. CHEM 104 General College Chemistry II (4)

• Chem. 308 can be substituted for Phys. 406

* Chem. 307 can be substituted for Phys. 410

Physics

Suggested Program for Bachelor of Science Degree in Physics

Freshman Year

Gen Ed Chemistry 103	4	Gen Ed Chemistry 104	4
Gen Ed Mathematics 117	4	Mathematics 118	4
Gen Ed English 101	3	Gen Ed History 116 or 117	3
Gen Ed IDC 100	1	Gen Ed IDC 101	3
Computer Science 130	4	Computer Science 131	3
	16		17

Sophomore Year

Physics 205	4	Physics 206	4
Mathematics 215	3	Gen Ed English 200	3
Gen Ed IDC 200	3	Mathematics 216	3
Gen Ed Philosophy 160	3	Mathematics 301	3
Gen Ed Economics 111	3	Gen Ed Theology	3
	16		16

Junior Year

Physics 211	4	Physics 405	3
Physics 307	4	Physics 406	3
Physics 404	3	Computer Science 221	4
Mathematics 314	3	Computer Science 341	3
	14	Gen Ed IDC 301	3
			16

Senior Year

Physics 408	3	Physics 420	4
Physics 410	3	Physics 440	3
Mathematics 405	3	Physics 450	3
Gen Ed Philosophy 301	3	Gen Ed Theology Elective	3
Gen Ed Fine Arts Elective	3	Gen Ed IDC 401	3
	15		16

General Education Requirements– (52 hours)

<i>Hrs.</i>	<i>Requirement Course</i>	<i>Options</i>
1 hr.	Freshman Focus I	DC. 100 Freshman Focus
3 hrs.	Freshman Seminar	IDC. 101 Freshman Seminar Hon. 150 Freshman Honors Seminar (Honors students only)
3 hrs.	English Composition	Eng. 101 Expository Writing
3 hrs.	Literature	Eng. 200 Reading Literature Eng. 201 The World of Texts Eng. 207 American Literature Survey I Eng. 208 American Literature Survey II Eng. 209 British Literature Survey I Eng. 210 British Literature Survey II
3 hrs.	Western Tradition	Hist. 116 Western World I (1450 – 1870) Hist. 117 Western World II (1870 – present)
3 hrs.	Fine & Performing Arts	Any 3 hour course in Art, Music or Theater (check course for pre-requisites)
3 (4) hrs.	Mathematics	Math 117 Calculus I (4)
6 (8) hrs.	Natural Sciences	Chem. 103 General College Chemistry I (4) Chem. 104 General College Chemistry II (4)
3 hrs.	Social Sciences	Econ. 111 Principles of Microeconomics
6 hrs.	Philosophy	Phil. 160 Introduction to Philosophy Phil. 301 Ethics
6 hrs.	Theology	Theo. 200 Ultimate Questions <i>and one course selected from the 300-400 level Theology courses</i>
3 hrs.	Sophomore Seminar	IDC. 200 U.S. Experience
3 hrs.	Junior Seminar	IDC. 301 Transcultural Experience <i>Since the Experience courses are designed to work as a sequence, it is essential to complete IDC. 200 before moving on to IDC. 301.</i>
3 hrs.	Senior Seminar	IDC. 401 Senior Seminar

A. Physics Course Descriptions

Phys. 101, 102 General Physics I, II (Advanced Placement only) (3, 3)

Introduction to classical theories of mechanics, electromagnetism, and heat, as well as modern theories of special relativity, quantum mechanics, and the nucleus. Application of physical principles to biology is emphasized.

Phys. 105 Introduction to Astronomy (3)

The early history of astronomy; origin of modern astronomy; modern methodology, structure and origins of the solar system; the earth, moon and planets; comets, meteorites and asteroids; life in the universe. Three hours lecture, and two hours laboratory. (Prerequisite: One year of high school algebra). *Every fall.*

Phys. 106 Exploration of the Universe (3)

The stars and distances; the sun; the birth, youth, middle age and death of stars; supernovae; pulsars and other neutron stars; stellar black holes; structure of milky way galaxy; galaxies; quasars; cosmology; the Big Bang theory; past and future of the universe. Three hours lecture, and two hours laboratory. (Prerequisite: One year of high school algebra). *Every spring.*

Phys. 110 Electrical Principles (3)

Fundamentals, Ohm's law, power and resistor, series and parallel circuits, network analysis, AC generation, inductance, capacitance, AC circuits. Three hours lecture; three hours laboratory, and one hour recitation. (Prerequisite: One year of high school algebra). *Fall, as required.*

Phys. 201 College Physics I (4)

This is an algebra-based introductory physics course. The basic principles, concepts and methods of physics are emphasized. Subject matter include a wide range of topics in classical mechanics (vectors, motion in one and two dimensions, Newton's laws of motion, work, energy, momentum, collisions, rotational motion, and gravitation), as well as heat, thermodynamics, waves and sound. Selected applications of above topics will also be discussed. Three hour lecture, two hour laboratory, and one hour recitation. Knowledge of algebra and basic trigonometry is expected. This course is approved for General Education. (Prerequisite: Two years of high school algebra or Math. 116.) *Every fall.*

Phys. 202 College Physics II (4)

Continuation of College Physics I (PHYS 201) course covering a wide range of topics in electricity, magnetism, light, geometrical optics, and wave optics. The basic principles, concepts and methods are emphasized. Selected applications of above topics will also be discussed. Three hour lecture, two hour laboratory, and one hour recitation. Knowledge of algebra and basic trigonometry is expected. This course is approved for General Education. (Prerequisite: Phys. 201) *Every spring.*

Phys. 205 University Physics I (4)

This is a calculus-based physics course aimed at science, mathematics and engineering students. Subject matter include a wide range of topics in classical mechanics (vectors, motion in one and two dimensions, Newton's laws of motion, work, energy, momentum, collisions, rotational motion, and gravitation), as well as heat, thermodynamics, waves and sound. Selected applications of above topics will also be discussed. This course is approved for General Education. Three hour lecture, two hour laboratory, and one hour recitation. (Prerequisite: Math. 117) *Every fall.*

Phys. 206 University Physics II (4)

Continuation of University Physics I (PHYS 205) course covering a wide range of topics in electricity, magnetism, light, geometrical optics and wave optics. Selected applications of above topics will also be discussed. This course is approved for General Education. Three hour lecture, two hour laboratory, and one hour recitation. (Prerequisite: Phys. 205 or permission of instructor.) *Every spring.*

Phys. 211 Analog Electronics (4)

Diodes, transistors, DC biasing BJT, BJT small-signal analysis, multistage systems, OP-amps, digital ICs, and oscillators. Three hours lecture, two hours laboratory, and one hour recitation. (Prerequisite: Phys. 110 or Phys. 202 or Phys. 206 or permission of instructor.) *As required.*

Phys. 214 Health Science Physics (4)

This is an algebra based course *designed for students interested in the Health Science industry.* Subjects studied include the following: (1) Classical mechanics: covering vectors, motion in one and two dimensions, force, work, momentum, energy, and gravity; (2) Fluid mechanics: thermal energy, heat transfer, first law of thermodynamics, wave propagation, waves on strings, sound waves; (3) Reflection and refraction of light; (4) Coulomb's Law, electric field and potential; (5) Magnetism, and (6) Simple AC and DC circuits. Three hours lecture, two hours laboratory and one hour recitation. (Prerequisite: Two years of high school algebra or Math 116). *Every spring.*

Phys. 307 Modern Physics (4)

This course covers the development of modern physics. Topics include, Special theory of relativity; Lorentz transformation; blackbody radiation; photo-electric effect; Compton effect; introduction to quantum mechanics; the Schrödinger equation; particle in a Box; finite square-well potential; tunneling through a barrier; simple harmonic oscillator; the Hydrogen atom; selected topics from Atomic, Solid-State, Nuclear, and Particle Physics will also be covered. Three hours lecture, three hours laboratory, and one hour recitation. (Prerequisite: Phys. 206, Math. 117 and Math. 118 or permission of instructor.) *As required.*

Phys. 404 Classical Mechanics (3)

This course studies classical mechanics at an advanced level. Topics covered include Lagrange's equations, the central force problem, the dynamics of a system of particles, the motion of rigid bodies, Hamilton's equations, and the dynamics of oscillating systems. (Prerequisite: Phys. 206 and Math. 118). Three hours lecture and one hour recitation. *As required.*

Phys. 405 Electricity & Magnetism (3)

This course studies electricity and magnetism at an advanced level. Topics covered include electrostatic fields in the presence of conductors, dielectric materials, magnetic fields due to steady currents in the presence of magnetic field; mathematical theories leading to Maxwell's equations are also developed and used extensively. (Prerequisite: Phys. 206 and Math. 118). Three hours lecture and one hour recitation. *As required.*

Phys. 406 Thermal & Statistical Physics (3)

This course studies thermal and statistical physics at an advanced level. Topics covered include a study at the advanced level of physical phenomena that depend on temperature, heat, entropy, the three laws of thermodynamics as applied to various systems, thermodynamic potentials, equations of state, and various applications to simple and multi-component systems. This course also covers selected topics in statistical mechanics. (Prerequisite: Phys. 206 and Math. 118). Three hours lecture and one hour recitation. *As required.*

Phys. 408 Mathematical Methods in Physics (3)

This course studies the application of various mathematical techniques to advanced problems in physics. Topics include methods of complex variables, curvilinear coordinates, infinite series, the calculus of residues, integral transforms, Green's functions, eigenvalues, Fourier and Laplace Transforms. (Prerequisite: Phys. 206 and Math. 216). Three hours lecture and one hour recitation. *As required.*

Phys. 410 Quantum Physics (3)

This course studies the basic postulates (concepts and formalism) of non-relativistic quantum mechanics. Topics include the Schrödinger Equation and its applications including the simple harmonic oscillator, the square well, barrier potential, the hydrogen atom, orbital and spin angular momenta, matrix representation of two level systems. The representation of physical quantities by mathematical operators will be introduced and applied to a limited number of exactly solvable problems. Approximation methods will be developed for dealing with time independent problems. (Prerequisite: Phys. 206 and Math. 118). Three hours lecture and one hour recitation. *As required.*

Phys. 420 Computational Physics with Cluster Computing (4)

This course introduces students to the computational methods and algorithmic approaches used in physics in a wide variety of topics. This course is designed to provide training in computer modeling and simulation of physical systems in the areas of classical, statistical, modern and quantum physics, including numerical techniques and Monte-Carlo methods. Students will be expected to build a Beowulf Cluster from PCs, carry out cluster benchmark studies and write both sequential and parallel programs (using the MPI middleware) in C++/Fortran on a Linux platform. Some of the computational projects may involve analyses and visualization of large datasets using the GEANT Monte-Carlo and the ROOT data analyses packages. (Pre-requisite: Phys. 307, Math. 216 and C.S. 131). Three hours lecture, and three hour lab. *As required.*

Phys. 440 Particle Physics & Cosmology (3)

This course studies particle physics and cosmology. Topics include: the Quark Model and the Classification of Hadrons, SU(N) Group Representation, Symmetries, Conservation Laws, Feynman Diagrams, Particle Decay Mechanisms, Quantum-Chromodynamics (QCD), Electroweak Interactions, the Standard Model, Particle Accelerators and Detectors, the Big Bang theory and the Early Universe, Grand Unified Theories (GUTs), Supersymmetry (SUSY), Superstring/M theory and the Unification of Forces, Dark Matter, Dark Energy and the Accelerating Universe. (Pre-requisite: Phys. 307, Math. 216 and C.S. 131). Three hours lecture and one hour recitation. *As required.*

Phys. 450 Special Topics in Physics (3)

Selected topic(s) in physics of special interest to the student will be taught, beyond what is normally covered in the undergraduate physics curriculum. Students will be expected to write a final report and give a presentation in front of the department faculty. (Pre-requisite: Phys. 307, Math. 216 and C.S. 131). Three hours lecture. *As required.*

B. Math Course Descriptions