Physics

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An undergraduate degree in Physics serves many careers. On one level it may lead to research or teaching. On another level it provides the basic discipline necessary for a technical career in engineering. On yet another level it provides a basis for management, business, law, or politics. A physics major requires a broad background in physics, chemistry, mathematics, and communication.

CSCI 171 Introduction to Programming is recommended for all physics majors. It is also recommended that students considering graduate study in physics or a related field complete a capstone worth at least six semester hours. Furthermore, PHYS 304 Electricity & Magnetism II and PHYS 306 Quantum Mechanics II are strongly recommended for students considering graduate study in physics or a related field; PHYS 351 Astrophysics is recommended for students considering graduate study in astronomy or astrophysics.

Departmental Learning Outcomes

1. *Demonstrate a qualitative and quantitative understanding of the four major fields of physics: classical mechanics, electricity and magnetism, modern physics, and thermal physics.*
2. *Apply the key elements of scientific reasoning by designing and conducting experiments.*
3. *Communicate clearly the results of scientific inquiry, both in written and oral forms.*

Major

- B.S. Major in Physics (http://catalog.principiacollege.edu/majors-minors/physics/bs/)

Minor

- Minor in Physics (http://catalog.principiacollege.edu/majors-minors/physics/minor/)

PHYS 121 Life in the Universe 4.0 SH [GESL]
Survey course covering the basics of astrobiology. Topics include the conditions necessary to support life, terrestrial life in extreme environments, the possibilities for life in our solar system, planetary habitability, and the Drake Equation and Fermi Paradox. Includes a lab component. Math at the level of high school algebra may be expected, but is not a primary focus of the course.

PHYS 151 Descriptive Astronomy 4.0 SH [GESL]
Application of elementary scientific principles to the study of the universe. Includes laboratories and evening observation sessions using departmental telescopes. Math at the level of high school algebra and geometry may be expected.
Class Level Restriction: Freshman and Sophomore only.

PHYS 161 Physics of Musical Sound 4.0 SH [GESL]
Principles and applications of sound for all students, musically inclined or not. Sources of sound, sound wave types and propagations, and aural perceptions of sound. Extensive examples of musical instruments and how they exhibit basic concepts of acoustics. Math at the level of high school algebra and geometry may be expected. Class includes one two-hour lab per week.
Class Level Restriction: Freshman and Sophomore only.

PHYS 177 Environmental Physics 3.0 SH [GESN]
Physics governing the interaction between humanity and the environment; focuses on energy. Covers the basic physics of energy, methods of energy generation and use, and the relationship between environmental energy flows and climate. May include mathematics up to the level of high school algebra.

PHYS 199 Physics for World Leaders 3.0 SH [GESN]
The physics behind policy, technology, and the everyday: energy sources, climate, electricity, nuclear weapons, etc. Energy is emphasized throughout. Science journalism is read and evaluated. A modest amount of math at the level of "Algebra I" is used.

PHYS 201 Phys for Scientists/Engrs I 4.0 SH [GESL]
Introductory physics with calculus. Covers the major themes of physics, including mechanics, conservation laws, electricity, magnetism, waves, light, sound, relativity, early quantum theory, and thermodynamics. Laboratories approximately weekly. Emphasis on mechanics. Continues as PHYS 202, PHYS 203, and PHYS 204.
Prerequisite: Completion of or concurrent enrollment in MATH 181. CHEM 131 recommended.

PHYS 202 Phys for Scientists/Engrs II 4.0 SH [ ]
Second term in the introductory physics sequence with calculus and laboratory; further emphasis on classical mechanics.
Prerequisite: PHYS 201 and completion of or concurrent enrollment in MATH 182.

PHYS 203 Phys for Scientists/Engrs III 4.0 SH [ ]
Third term in the introductory physics sequence with calculus and laboratory; emphasis on electricity and magnetism.
Prerequisite: MATH 182 and PHYS 201.

PHYS 204 Phys for Scientists/Engrs IV 5.0 SH [ ]
Fourth term in the introductory physics sequence with calculus; emphasis on thermodynamics, wave mechanics, and mathematical methods of physics.
Prerequisite: PHYS 202 and PHYS 203.

PHYS 231 Introduction to Cosmology 3.0 SH [GESN]
The course focuses on the study of the universe as a whole. Topics include general relativity, the expansion of space, the distribution of galaxies, black holes, and the origin and fate of the universe. The emphasis is on conceptual understanding; however, math at the level of high school algebra and trigonometry is utilized.

PHYS 283 Advanced Laboratory 4.0 SH [ ]
Laboratory requirement for physics majors. Experiments in acoustics, optics, electrical measurement, spectroscopy, nuclear physics, and gravitation. Emphasis on techniques of measurement.
Prerequisite: PHYS 203.

PHYS 301 Classical Mechanics 3.0 SH [ ]
Advanced course in analytic mechanics, including analysis of systems of forces, acceleration, momentum, and energy. Emphasis on dynamics, including space and orbital mechanics. Full use is made of differential equations and vector analysis wherever appropriate.
Prerequisite: PHYS 203 and MATH 283; MATH 284 strongly recommended. Offered in alternate years.
Class Level Restriction: Junior and Senior only.

PHYS 303 Electricity & Magnetism I **3.0 SH** **[ ]**
Advanced course in electricity and magnetism, including electro-statics, magnetic induction, magnetostatics, and electromagnetic waves. Basic laws of Gauss, Ampere, Faraday, and Maxwell in their differential form. Vector analysis and differential equations are used throughout. Emphasis on solving boundary value problems, such as those appropriate to fields at interfaces between two media.
Prerequisite: PHYS 203 and MATH 283; MATH 284 and MATH 355 strongly recommended. Offered in even years.
Class Level Restriction: Junior and Senior only.

PHYS 304 Electricity & Magnetism II **3.0 SH** **[ ]**
Continuation of PHYS 303. Applications in astrophysics and ham radio will be included. Offered in even years.
Prerequisite: PHYS 303.
Class Level Restriction: Junior and Senior only.

PHYS 305 Quantum Mechanics I **3.0 SH** **[ ]**
A first year course in quantum mechanics. Topics may include wave functions, barrier potentials, harmonic oscillator, quantized angular momentum, hydrogen atom, perturbation theory, atoms and identical particles. Applications chosen from astrophysics, statistical mechanics, solid state physics, atomic physics, molecular physics, particle physics and nuclear physics.
Prerequisite: PHYS 203 and MATH 182.
Class Level Restriction: Junior and Senior only.

PHYS 306 Quantum Mechanics II **3.0 SH** **[ ]**
Continuation of PHYS 305.
Prerequisite: PHYS 305.
Class Level Restriction: Junior and Senior only.

PHYS 307 Statistical Mechanics **3.0 SH** **[ ]**
A study of the application of classical and quantum mechanics to many-bodied systems. Explores the relationship between statistical mechanics and modern thermodynamics, fluid mechanics, solid state physics, and plasma physics. This course will develop the basic equations and concepts of statistical mechanics. Both classical and quantum distribution functions will be used to calculate the macroscopic properties of a system based on the detailed behavior of the microsystem.
Prerequisite: MATH 283, PHYS 203, PHYS 204.
Class Level Restriction: Junior and Senior only.

PHYS 351 Astrophysics **3.0 SH** **[ ]**
Advanced course applying the laws of physics to astronomical phenomena. Star formation and evolution, formation of planetary systems, large-scale evolution, and eventual fate of the universe will be covered.
Prerequisite: MATH 283, PHYS 203.
Class Level Restriction: Junior and Senior only.

PHYS 352 Computational Physics **3.0 SH** **[ ]**
Application of computer modeling to complex physical systems. Subjects include numerical integration, the Monte Carlo method, genetic and simulated annealing algorithms, chaotic systems, fluid flow, and gravitational scattering. Of special interest to computer science students.
Prerequisite: CSCI 171, MATH 283, PHYS 203.
Class Level Restriction: Junior and Senior only.

PHYS 391 Vehicular Dynamics **3.0 SH** **[ ]**
Advanced survey of the physical principles underlying the design and performance of automobiles. Topics include driving kinematics, aerodynamics, load transfer, and engine thermodynamics. Calculus-level mathematics should be expected. Does not include field program.
Prerequisite: PHYS 202.
Class Level Restriction: Junior and Senior only.

PHYS 392 Vehicular Dynamics with IFE 4.0 SH [ ]

Advanced survey of the physical principles underlying the design and performance of automobiles. Topics include driving kinematics, aerodynamics, load transfer, and engine thermodynamics. Calculus-level mathematics should be expected. Includes an international field program in a country with a rich automotive tradition.

Prerequisite: PHYS 202.

Class Level Restriction: Junior and Senior only.

PHYS 401 Research 1.0-6.0 SH [ ]

Experimental or theoretical research under faculty supervision. May receive a star (*) grade, with final grade being assigned upon completion of the project. May be offered for variable credit from one to six semester hours. May be repeated multiple times, but only six semester hours may be used to fulfill major or minor requirements.

Class Level Restriction: Junior and Senior only.