Physics

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Physics is the science of matter, motion and energy. The physics offerings are designed to provide students with basic scientific knowledge, as well as prepare them for varied goals, including graduate study, industry, teaching and engineering school.

Upon completion of the Physics program, students will be able to demonstrate the ability to:

1. Think critically and solve multi-step problems.
2. Learn new physical principles through self-guided study.
3. Communicate both orally and in written form in a style appropriate for a physicist.
4. Integrate physics into their lives with specific emphasis on moral standards and social consciousness.

Physics offers the following major programs:

1. Physics
2. General Science (Physics)
3. Applied Science (Case Western Reserve University, 3/2)

Core Fulfilling Courses

PHY 104	Physical Science
PHY 105	General Physics
PHY 107	Astronomy
PHY 108	Geology
PHY 110	Physics I (4 crs)
PHY 130	Physics for Allied Health
PHY 131	Earth & Space Science

Requirements for Physics Major
Bachelor of Science Degree

In addition to completing the core curriculum requirements, outlined on pp. 14-15 of this catalog, (plus 6 more already included in courses below) physics majors must complete the following courses:

MAT 111, 112	Calculus I, II	(8 crs)
MAT 211	Calculus III	(4 crs)
MAT 212	Ordinary Differential Equations	(3 crs)
or MAT 204	Scientific Statistics	(3 crs)
PHY 110, 120	Physics I, II	(8 crs)
PHY 121, 122	Physics Labs I, II	(2 crs)
PHY 311	Modern Physics	(4 crs)
PHY 321	Modern Physics Lab	(1 cr)
PHY 221	Mathematical Physics	(3 crs)
PHY 331, 432	Mechanics I, II	(6 crs)
PHY 341, 442	Electromagnetic Theory I, II	(6 crs)
PHY 435	A, B, C, D Advanced Lab	(4 crs)
PHY	4 Approved electives	(13-16 crs)
		(62-65 crs)

Special Notes for Physics Major:

1. In specific cases, physics requirements can be modified with faculty approval.
2. Physics majors preparing for graduate study are urged to elect CHE 110, 120, General Chemistry, and CHE 121, 122, General Chemistry Lab, and further advanced MAT courses.

Requirements for Physics Minor

Physics minors must complete four upper-division (300 or 400 level) PHY courses approved by the contact person for a minimum of 15 credits.

Requirements for General Science (Physics) Major
Degree of Bachelor of Science

This major provides a background in the physical sciences with an emphasis on Physics. In conjunction with the Teacher Preparation Program, the program offers training for a career in K-12 teaching. It also serves as an excellent course of study for those students aspiring to enter the graduate program in physical therapy.

In addition to completing the core curriculum requirements (48 credits plus 9 more already included in the courses below) outlined on pp. 14-15 of this catalog, general science (physics) majors must complete the following courses:

BIO	Approved Electives	(8 crs)
CHE 110, 120	General Chemistry I, II	(8 crs)
CHE 121, 122	General Chemistry Lab I, II	(2 crs)
MAT 111	Calculus I	(4 crs)
MAT	Approved Elective	(4 crs)
CSC	Approved Elective	(3 crs)
PHY 110, 120	Physics I, II	(8 crs)
PHY 121, 122	Physics Lab I, II	(2 crs)
PHY 311	Modern Physics	(3 crs)
PHY	Approved Electives	(17 crs)
		(59 crs)

Course Descriptions

PHY 104 Physical Science (3 crs)
The goal of this course is scientific literacy in the physical sciences for the nonscience major. The basic principles of Physics and Chemistry are studied. These principles are then applied to the fields of Geology, Astronomy and Meteorology.

PHY 105 General Physics (3 crs)
A one-semester physics course for technology majors. The course is quantitative requiring algebra and trigonometry.

PHY 107 Astronomy (3 crs)
Introduction and historical outline of astronomy and development of physical laws used to describe the solar system, space, stars, galaxies, the universe and some observational techniques.

PHY 108 Geology (3 crs)
Introduction to physical geology, internal structures of the earth, dynamical features, plate tectonics, crust and lithosphere production, balance and movement, oceans, seashore, continents, inland water and ice sheets.

PHY 110, 120 Physics I, II (8 crs)
Concepts and methods of Physics: I; Newtonian mechanics, relativity, harmonic motion, fluids and elasticity, II; thermodynamics, electricity and magnetism, circuits, wave motion, sound and optics. Calculus is taught as needed in this course. Prerequisite: MAT 108 or equivalent.

PHY 121, 122 Introductory Physics Labs I, II (2 crs)
To be taken concurrently with PHY 110-120. Experiments designed to supplement the lecture course and to provide proficiency in the methods of measurements, the analysis and presentation of data and the interpretation of results.

PHY 130 (CLS 130) Physics for Allied Health (3 crs)
General physics principles with special emphasis on gas laws, flow principles, fluidics, the use of formulae and how they apply to nuclear medicine technology and respiratory therapy.

PHY 131 Earth and Space Science (3 crs)
A course designed for students who are interested in teaching biology, chemistry, physics, or general science at the intermediate or secondary school level. Topics covered will lead to an understanding of the physical factors that effect the environment, the earth atmosphere and the solar system.

PHY 160 Engineering Orientation (1 cr ea)
A sequence of six one-credit courses, usually spread over four semesters and a summer, as career orientation in both engineering and physics. Treatment of such topics as problem analysis, computer programming and surveying.

PHY 221 Mathematical Physics (3 crs)
Supplements the mathematics background of the physics major. Topics to be covered include power series, Taylor's series, Fourier series, determinants and matrix theory, systems of linear equations, Eigenvalue-Eigenvectors, power series solution of differential equations, Legendre polynomials and Bessel functions. Prerequisite: PHY 120 and MAT 112.

PHYSICS - Recommended Course Sequence

	Freshman		Sophomore		Junior		Senior	
FALL	FYS 101	1	PHY 311	4	PHY 331	3	PHY 341	3
	PHY 110	4	MAT 211	4	PHY 435A	1	PHY 435C	1
	PHY 121	1	PHI 105	3	PHY Elective	3-4	PHY Elective	3-4
	MAT 111	4	LIT 250	3	MOL	3	Global Persp.	3
	HIS 110	3	PHY 321	1	SSC Elective	3	Elective	3
	ENG 105/110	3			SCI Core	3-4	FAS	3
	Semester total	16		15		16-18		16-17
SPRING	PHY 120	4	PHY 221	3	PHY 432 & 435B	4	PHY 442	3
	PHY 122	1	RST 106/107	3	Elective	3	PHY 435D	1
	MAT 112	4	MAT 212	3	PHY Elective	3-4	PHY Elective	3-4
	HIS 12x	3	PHI 205	3	MOL	3	Electives	6
	LIT 120	3	RST Elective	3	RST/PHI 305	3		
	Semester total	15		15		16-17		13-14
	Total Credits	31		30		32-35		29-31 125+

PHY 241, 242 Engineering Physics I, II (8 crs)
Vector operations, forces, moments, centroids, structures, friction, moments of inertia, kinetics of particles and rigid bodies in both translation and rotation, mechanical vibrations, electric charge, electric field, Gauss' law, electrical potential, capacitors and dielectrics, current, magnetic field, Ampere's law, Faraday's law.

PHY 311 Modern Physics (4 crs)
Intermediate treatment, includes: theory of relativity, wave-particle duality, atomic theory, quantum theory of the hydrogen atom, properties of matter, decay and nuclear reactions and elementary particles.

PHY 312 Electronics (4 crs)
Digital and analog electronics. Topics covered include: Boolean algebra, basic gates, flip-flops, counters, Kirchoff's equations, Thevenin's theorem, Mesh loop method, voltage divider, RC, RL and RLC circuits, diodes and power supplies, transistor circuits, op-amp circuits, 555 timer circuits, D/A and A/D converters. Two hours of lecture and four hours of lab per week. Offered every other year. Prerequisite: MAT 112.

PHY 313 Computational Physics (4 crs)
Introduces the use of a computer in numerically solving problems of scientific interest. Topics to be covered include integration, differentiation, roots, interpolation and extrapolation, systems of linear equations, differential equations and fast fourier transforms. A solid background in calculus and introductory physics is assumed. Prerequisite: PHY 110 and MAT 112.

PHY 315 Introduction to Medical Physics (3 crs)
Introduction to the field of medical physics. Topics to be covered include: radiation monitoring and safety, particle accelerators and their uses in medicine, radiation use in the treatment of cancer. This course is taught in a clinical setting and involves contact with patients. Course generally meets twice weekly for three hours at a time. Prerequisite: PHY 311.

PHY 316 Optics (4 crs)
The electromagnetic theory of light. Interference, diffraction, resolving power of instruments, polarimetry, dispersion, absorption, scattering and reflection and an introduction to the theory of quantum radiation.

PHY 317 Thermodynamics (4 crs)
An intermediate treatment of thermodynamics: thermodynamic systems, work, equations of state, the first and second laws of thermodynamics, phase changes, entropy and thermodynamic potentials.

PHY 318 Hydrodynamics (3 crs)
An introductory course in hydrodynamics including: laminar flow, Reynolds number, flow patterns, continuity equations, the Navier-Stokes equation, vorticity and viscous flow. Prerequisite: MAT 211, PHY 244.

PHY 319 Statistical Mechanics (2 crs)
The kinetic theory of gases, transport phenomena, various statistics and distribution functions, the partition function and applications to systems.

GENERAL SCIENCE (PHYSICS) - Recommended Course Sequence

	Freshman		Sophomore		Junior		Senior		
FALL	FYS 101	1	PHY Elective	4	PHY Elective	2	PHY Elective	4	
	PHY 110	4	CHE 110	4	BIO Elective	4	RST/PHI 305	3	
	PHY 121	1	CHE 121	1	PHI 205	3	SSC Elective	3	
	MAT 111	3	LIT 250	3	MOL 102	3	Electives	6	
	ENG 105 or 110	3	RST 106/107	3	Global Persp.	3			
	HIS 110	3							
	Semester total	15		15		15		16	
SPRING	PHY 120	4	PHY 311	3	PHY Elective	4	FAS	3	
	PHY 122	1	CSC Elective	3	BIO Elective	4	PHY Elective	4	
	MAT Elective	4	CHE 120	4	RST Elective	3	Electives	9	
	LIT 120	3	CHE 122	1	MOL 111	3			
	HIS 120	3	PHI 105	3					
	Semester total	14		15		14		16	
	Total Credits	29		30		29		31	121

PHY 321 Modern Physics Lab (1 cr)
An introduction to the experiments which shaped 20th century physics. Experiments include electron defraction, h/e, interferometry, x-ray defraction, H spectroscopy and radioactive decay experiments. This lab is meant to be taken concurrently with PHY 311. Both written and oral reports will be required.

PHY 331 Mechanics I (3 crs)
Newtonian mechanics, motion of a particle in one, two and three dimensions, the motion of a system of particles, oscillations, gravitation, moving coordinate systems and Lagrange's equations of motion.

PHY 341 Electromagnetic Theory I (3 crs)
Electrostatics, electric fields in matter, magnetic fields and Maxwell's equations.

PHY 421, 422 Mathematical Physics I, II (8 crs)
Supplements the mathematics background of the physics major. I: Taylor's series, Fourier series, Fourier integrals, determinants, matrix theory, Lagrange's equations, Hamilton's principle, partial differentiation, calculus of variations and the gamma, beta and error functions. II: Bessel functions, Legerdre polynomials and introduction to tensor analysis, solutions of the wave equation and elements of the theory of complex variables.

PHY 432 Mechanics II (3 crs)
Continuation of PHY 331. Hamilton's equations of motion, approximations, central forces, rigid bodies and waves. Prerequisite: PHY 331.

PHY 435 A, B, C, D Advanced Lab (1 cr each)
A four semester sequence of advanced physics labs for junior and senior physics majors. Lab topics include nuclear physics, x-rays, crystallography, vacuum techniques, thin film deposition, classical mechanics and the classic modern physics experiments. Both written and oral reports will be required.

PHY 442 Electromagnetic Theory II (3 crs)
Continuation of PHY 341. Electrodynamics, electromagnetic waves, radiation, elastic media, elastic waves in three dimensions and heat flow. Prerequisite: PHY 431.

PHY 451, 452 Quantum Mechanics I, II (8 crs)
Heisenberg uncertainty relation, deBroglie's postulate, wave function, time dependent and independent Schrodinger equation, tunneling effect, linear harmonic oscillator, commutators, transition probabilities, Schrodinger and Dirac representations. II: Particle in a central potential, one and multi-electron atoms, spin, addition of angular momenta, approximation methods, fine and hyperfine structure of hydrogen atom and scattering theory.

PHY 486-489 Thesis (variable)
A research topic requiring a detailed report and oral defense. Prerequisite: Senior standing.