PHYSICAL SYSTEMS IN AGRICULTURE AND NATURAL RESOURCES

See Agricultural Engineering

PHYSICS

PHY

College of Natural Science

Introductory physics courses are divided into four groups:

1) 237, 238, 239 (theory) and 257, 258, 259 (laboratory). These are for students who are taking at the same time, or who have taken, first year mathematics through college algebra and trigonometry.

2) 291, 292, 293 (theory) for students of the natural sciences who have taken Calculus I (MTH 112).

3) 291A, 292A, 293A, 287, 288, 289 (theory) for students of the physical sciences, mathematics, engineering and others taking Calculus III (MTH 214). May be taken as 287 or as 281 plus 281A, 288, or as 282 plus 282A, as 289 or 283 plus 283A.


A student may change from one group of introductory courses to another, but may not earn credit for more than one complete sequence.

Credit may not be earned for more than one of the courses PHY 294, 357 or 364.

PHY 201, 236, 301, 357 and 430 cannot be used to meet the requirements for a major in physics.

All 400 level physics courses (except 430) require PHY 289 or 293B or equivalent and MTH 215 as prerequisites.

201. The Science of Sound I: The Rock, Bass, and Oscillators

Winter. 3(4-0) or 4(4-0) Interdepartmental with the Mechanical Engineering Department.


202. The Science of Sound II

Spring. 3(4-0) or 4(4-0) 201. Interdepartmental with and administered by the Mechanical Engineering Department.


230. The Role of the Natural Sciences in Future Environments

Fall. 4(4-0) Approval of department. Interdepartmental with the departments of Entomology, Geology and Zoology and the College of Natural Sciences and administered by the College of Natural Sciences.

Physical and biological science concepts relevant to understanding of environmental issues. Options for action in areas of population size, energy and life support system. Illustrated by case studies.

237. Introductory Physics

Fall, Winter. 3(4-0) MTH 102 or 109 or 111 concurrently. Mechanics and heat.

238. Introductory Physics

Winter, Spring. 3(4-0) 237. Heat, electricity and magnetism.

239. Introductory Physics

Fall, Spring. 3(4-0) 238. Wave motion, sound, light, and modern developments.

1DC. Energy Consumption and Environmental Quality

For course description, see Interdisciplinary Courses.

257. Introductory Physics Laboratory

Fall, Winter. 1(0-2) or 237 or 281 concurrently. Mechanics and heat.

258. Introductory Physics Laboratory

Fall, Spring. 1(0-2) 238 or 282 concurrently. Heat, electricity and magnetism.

259. Introductory Physics Laboratory

Fall, Spring. 1(0-2) 239 or 283 concurrently. Wave motion, sound, light and modern developments.

281. Basic Physics I

Fall, Winter, Spring. 3 credits—Self-paced only. MTH 112. Static equilibrium, Newton's laws, power, harmonic motion, rotational motion.

281A. Physics IA

Fall, Winter, Spring. 1 credit—Self-paced only. MTH 113; PHY 281 or concurrently. Examinations of 281, plus frames of reference, special relativity, rocket equation, forced oscillations, resonances, fluid motion, numerical (computer) solutions, moments of inertia, gyroscopic motion.

282. Basic Physics II

Fall, Winter, Spring. 3 credits—Self-paced only. 281, or 281A, or 287, or 291A, or 291B, or 291.

Microscopic origin of heat flow and first law of thermodynamics, electric and magnetic forces and sources, direct currents.

282A. Physics IIA

Fall, Winter, Spring. 1 credit—Self-paced only. 281, or 281A, or 287, or 291A, or 291B; MTH 214 or approval of department. Examinations of 282 plus: entropy, transport phenomena, general relativity, electrons, atoms, molecules, solids, Maxwell's equations, electromagnetic fields, energy, alternating currents, and other electricity and magnetism applications, numerical (computer) solutions.

283. Basic Physics III

Fall, Winter, Spring. 3 credits—Self-paced only. 282, or 282A, or 287, or 292, or 292A or 292B.

Physics of sound, light, and optical instruments, wave-particle duality, radioactivity, fission and fusion, elementary particles, fundamental forces of nature.

283A. Physics IIIA

Fall, Winter, Spring. 1 credit—Self-paced only. 282, or 282A, or 287, or 292, or 292B; MTH 214 or approval of department. Examinations of the 283 material, plus topics in: spectral origins and analysis, optics, standing wave phenomena, diffraction, quantum mechanics, numerical (computer) solutions, models.
287. Principles of Physics
Fall, Winter, Spring. 4(5-0) MTH 113. Mechanics.

288. Principles of Physics
Fall, Winter, Spring. 4(5-0) or 287; MTH 214 or approval of department. Heat and thermodynamics, electricity and magnetism.

291A. Honors Physics IA
Fall, Winter, Spring. 1 credit—Self-paced only. MTH 113; PHY 281A or 287. Subjects and topics as in 287, generally on a more advanced level and less generally prescribed.

291B. Honors Physics IB
Fall, Winter, Spring. 5 credits—Self-paced only. MTH 115. Combined course, equivalent to 287 plus 291A.

291A. Honors Physics IIA
Fall, Winter, Spring. 1 credit—Self-paced only. MTH 214; PHY 281A, or 287, or 291A, or 291B, or 291. Subjects and topics as in 287, generally on a more advanced level and less closely prescribed.

291B. Honors Physics IIIB
Fall, Winter, Spring. 5 credits—Self-paced only. MTH 214; PHY 281A, or 287, or 291A, or 291B, or 291. Combined course, equivalent to 287 plus 291A.

292. Physics II
Fall. 4(5-0) 291; MTH 215 or concurrently. Continuation of 291. Electricity and magnetism with some special relativity.

293. Physics III
Winter. 4(5-0) 292. Continuation of 292. Wave physics including optics.

293A. Honors Physics IIIA
Fall, Winter, Spring. 1 credit—Self-paced only. MTH 215; PHY 282A, or 287, or 292A, or 292B. Subjects and topics as in 292, generally on a more advanced level and less closely prescribed.

293B. Honors Physics IIIB
Fall, Winter, Spring. 5 credits—Self-paced only. MTH 215; PHY 282 and 283A, or 283, or 292A, or 292B. Combined course, equivalent to 289 plus 293A.

294. Physics IV
Spring. 4(5-0) 293 or 289. Continuation of 293. Introduction to quantum physics.

297. Principles of Physics Laboratory
Fall, Winter. 1(0-2) 291, or 287, or 291B or 292 or concurrently. Mechanics.

298. Principles of Physics Laboratory
Winter, Spring. 1(0-2) 292, or 288, or 292B, or 293 or concurrently. Wave motion, sound, light and modern developments.

301. Bohr and Einstein: The Concept of Nature in Our Day
Fall. 3(3-0) Juniors. Basic contemporary ideas about the natural world and their significance for man presented through study of the lives of Niels Bohr (quantum theory) and Albert Einstein (relativity theory).

304. Special Problems
Fall, Winter, Spring. 1 to 5 credits. May re-enroll for a maximum of 5 credits. Approval of department.

310. Calculus Concepts in Physics
Fall, Winter, Spring. 5(5-0) 237, 238, 239; MTH 214. A transition course to prepare students who had non-calculus introductory physics for updation courses. Discussions and problems in mechanics, electricity and magnetism, wave motion and modern physics. Familiarity with non-calculus introductory physics is assumed.

357. Topics in Contemporary Physics
Spring. 4(4-0) One year of general college physics. Atomic and nuclear physics, cosmic rays and elementary particles, nuclear energy, new theoretical concepts. Recommended for prospective high school teachers.

364. Introduction to Modern Physics I
Fall, Winter, Spring. 3(3-0) 293 or 293B or approval of department. Atomic structure; wave and particle aspects of radiant energy; optical and X-ray spectra.

365. Introduction to Modern Physics II
Winter, Spring. 3(3-0) 294. Nuclear, molecular, solid state and elementary particle physics. Special emphasis is given to applications such as reactors, superconductors, semi-conductors, fusion reactions, particle accelerators, etc.

368. Elementary Solid State Physics I
Winter. 3(3-0) 294. Crystal structure and binding; lattice dynamics, specific heat, thermal conductivity; free electron theory of metals, conductivity, optical properties; elementary band theory; Hall effect, effective masses in metals and semi-conductors.

369. Elementary Solid State Physics II
Spring. 3(3-0) 294. Ferroelectricity, paramagnetism, ferromagnetism, antiferromagnetism, domain walls; point defects, and dislocations in metals, formation and motion energies, internal friction, radiation damage.

392. Physics II Laboratory
Fall. 1(0-3) 287 or 291B or concurrently. Experiments in classical mechanics and electricity and magnetism.

393. Physics III Laboratory
Winter. 1(0-3) 289, or 292B, or 293 or concurrently. Experiments in wave motion and optics.

394. Physics IV Laboratory
Spring. 1(0-3) 287 or 291B, or 294 or concurrently. Experiments in general and modern physics.

400H. Honors Work
Fall, Winter, Spring. Variable credit.

404. Special Problems
Fall, Winter, Spring. 1 to 5 credits. Approval of department.

419. Physical Phenomena and Electronic Instrumentation I
Fall, Winter. 4(3-2) 289 or 293B; MTH 115. Interdepartmental with the Electrical Engineering Department.

420. Physical Phenomena and Electronics Instrumentation II
Spring. 3(2-3) 419. Noise and its characterization. Typical electronics instruments are analyzed in detail. A reliable instrument that uses a physical effect is developed by the student.

427. Intermediate Mechanics
Fall. 3(3-0) 299 or 293B; MTH 215. Statics and dynamics of a particle and of rigid bodies; linear and non-linear oscillations; gravitation from a field point of view; transformation properties of physical quantities; introduction to mathematical techniques of theoretical physics.

428. Advanced Mechanics
Spring. 3(3-0) 428. Advanced methods of theoretical mechanics; generalized coordinates; Lagrange's and Hamilton's equations; the wave equation, theory of vibrations.
430. Introduction to Radioactivity and Radioisotope Techniques
Fall, Summer. 2(2-0) or 3(3-0) One year each of general college chemistry and physics. Interdepartmental with the Department of Chemistry.
First 7 weeks. Elementary nuclear processes and properties with emphasis on radioactivity, its measurement, and its interaction with matter. Effects of radiation on chemical and biological systems. Applications of nuclear technology, safety and environmental factors. Lab 3 weeks. Fundamentals of nuclear models, reactions and decay mechanisms. Basic principles of nuclear reactors and accelerators.

431. Laboratory for Radioactivity and Radioisotope Techniques
Fall, Summer. 1(0-3) CEM 161, 430 concurrently. CEM 162 recommended. Interdepartmental with the Department of Chemistry. Introduction to nuclear instrumentation. Experimental techniques for application of radioisotopes to problems in chemistry, the life sciences, and physics.

438. Optics
Fall. 4(3-0) 280 or 293B; MTH 215. Geometrical optics including Fermat’s Principle, reflection, refraction, mirrors, thin lenses, thick lenses, aberrations, and the effects of apertures and stops, interference.

447. Electricity and Magnetism I
Winter. 4(3-0) 448. Eighteen credits in physics, including 289 or 293B; MTH 215. Advanced study of electromagnetic phenomena; electrostatic potentials from Laplace’s and Poisson’s equations; effects of dielectric and magnetic materials; magnetic fields and potentials; induced e.m.f.; Maxwell’s equations; electromagnetic radiation and waves.

448. Electricity and Magnetism II
Spring. 4(3-0) 447. Continued of 447.

457G. Advanced Physics Laboratory (General)
(457.) Fall. 3(1-4) 15 credits in physics including 280 or 293B. Experiments in modern physics of historical interest and in general physics research techniques. Emphasizes experimental methods and proper treatment of data. Independent work encouraged.

457N. Advanced Physics Laboratory (Nuclear)
(457.) Winter of odd-numbered years, Spring of even-numbered years. 3(1-4) 15 credits in physics including 280 or 293B. Experiments in nuclear physics. Detection of nuclear radiation and determination of nuclear properties. Emphasizes research methods and proper treatment and interpretation of data. Independent work encouraged.

457S. Advanced Physics Laboratory (Solid State)
(457.) Spring of even-numbered years. 3(1-4) 15 credits in physics including 280 or 293B. Experiments in low temperature and solid state physics. Emphasizes research methods and proper treatment and interpretation of data. Independent work encouraged.

491. Introduction to Quantum Mechanics
Fall. 3(2-0) or 3(3-0) 494 or 364; MTH 215. Schrödinger wave equation and its applications; angular momentum; one electron atom; moments and spin; perturbation methods; absorption and emission of radiation; atomic and molecular structure.

492. Introduction to Quantum Mechanics II
Winter. 3(3-0) 491. Continued of 491.

493. Introduction to Quantum Mechanics III
Spring. 3(3-0) 492. Continued of 492.

497. Introduction to Elementary Particle Physics
Fall. 3(3-0) 364 or 365. Nonequivalent positions in a system. Weak, electromagnetic and strong interactions. High energy accelerators and techniques in experimental high energy physics.

498. Introduction to Nuclear Physics
Spring. 3(3-0) 364 or 365. Interactions of nuclear radiations with matter; properties of nuclei; alpha, beta, gamma decay; nuclear models; nuclear reactions and elementary applications of scattering theory; reactors, accelerators; introduction to high-energy physics.

500. Research Methods
Fall, Winter, Spring, Summer. 2(2-0) May re-enroll for a maximum of 6 credits. Beginning graduate students. Interdepartmental with the Department of Astronomy and Astrophysics.

817. Techniques of Theoretical Physics
Fall. 3(3-0) Graduate students; or approval of department. Application of contour integration to physical problems. Basic concepts in the theoretical formulation of quantum mechanical systems; solution of physical problem using Green’s Functions, the delta function, series, integral transforms.

827. Theoretical Physics I
Summer of odd-numbered years. 3(3-0) 498 or approval of department. Vector analysis, mechanics of a particle and of systems of particles. Lagrange’s equations, Hamiltonian methods, rotational motion.

828. Theoretical Physics II
Summer of even-numbered years. 3(3-0) 498 or approval of department. Special relativity, Maxwell’s equations, electrodynamics and electromagnetic waves.

829. Theoretical Physics III
Winter. 3(3-0) Approval of department. Principles of thermodynamics; topics in kinetic theory; introduction to statistical mechanics.
860. General Relativity and Cosmology I
Fall of even-numbered years. 3(3-0) 855 or approval of department. Interdepartmental with the Department of Astronomy and Astrophysics.
Conceptual foundations of general relativity theory; elements of tensor calculus; Riemann-Christoffel curvature tensor; the field equations; experimental tests; special solutions; the extension to cosmology.

861. General Relativity and Cosmology II
Winter of odd-numbered years. 3(3-0) AST 860. Interdepartmental with the Department of Astronomy and Astrophysics.
Relativistic cosmology: the model universes; steady-state theory; observational evidence and possibilities for decision among models; current problems.

867. Quantum Mechanics IV
Fall. 3(3-0) 852.
Transformation theory and invariance principles; the rotation group and theory of angular momentum; Wigner-Eckart theorem and applications.

868. Relativistic Quantum Mechanics
Winter. 3(3-0) 857.
Relativistic equations of motion; Dirac equation; free particle solutions and Lorentz transformation properties; interaction with electromagnetic fields; quantization of scalar, electromagnetic and Dirac fields.

869. Quantized Fields
Spring. 3(3-0) 866.
Heisenberg representation, S-matrix reduction formulæ, Feynman rules, quantum electrodynamics; topics from many-body theory.

877. Equilibrium Statistical Mechanics
Fall. 3(3-0) Approval of department. Ensembles, partition functions, thermodynamic potentials with applications to simple thermodynamics; topics from many-body theory.

878. Nonequilibrium Statistical Mechanics
Winter. 3(3-0) 877.
Time-dependent Liouville equation, Bloch equation, and master equation, with application to relaxation processes and atomic, molecular, and nuclear systems.

879. Quantum Statistical Mechanics
Spring. 3(3-0) 878.
Green’s function techniques with application to transport theory, superconductivity, magnetism.

899. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

929. Elementary Particle Physics
Spring. 3(3-0) 929.
Selected current topics, partial wave amplitudes and Regge poles; current algebra and weak interactions.

937. Molecular Structure and Spectra I
Fall of odd-numbered years. 3(3-0) 937 or concurrently.
Structure and spectra of diatomic molecules.

938. Molecular Structure and Spectra II
Winter of even-numbered years. 3(3-0) 937.
Structure and spectra of polyatomic molecules.

939. Molecular Structure and Spectra III
Spring of even-numbered years. 3(3-0) 938.
Advanced topics in vibration-rotation theory of polyatomic molecules.

947. Solid State Physics I
Fall. 3(3-0) 939 and 840.
Crystal symmetry, crystal bonding, lattice vibrations and specific heat, one-electron theory; Hartree-Fock equation, Brillouin zones.

948. Solid State Physics II
Winter. 3(3-0) 947.
Effective mass approximation, Exchange and correlation corrections, Theory of conductivity and related effect, metal and semiconductors.

949. Solid State Physics III
Spring. 3(3-0) 948.
Ionic crystals. Imperfections in crystals, plastic deformations, color centers. Optical properties. Refractometry, transistors, selected topics.

957. Nuclear Physics I
Fall. 3(3-0) 867.
Nucleon-nucleon scattering, nuclear sizes and shapes, multipole moments; shell model; collective states.

958. Nuclear Physics II
Winter. 3(3-0) 957.
Experimental methods and instrumentation; nuclear reactions; inelastic scattering and particle transfer.

959. Nuclear Physics III
Spring. 3(3-0) 958.
Many-body methods in nuclear physics; Bethe-Goldstone equation; effective interaction; nuclear models.

984. Advanced Readings in Physics or Astronomy
Fall, Winter, Spring, Summer. Variable credit. Interdepartmental with the Department of Astronomy and Astrophysics.

987. Advanced Topics in Physics
Fall, Winter, Spring. 3(3-0) or 4(4-0)
In any one term this course will be devoted to a single topic, such as advanced quantum theory, quantum electrodynamics, specialized topics in solid state physics, statistical mechanics, relativity theory and cosmology.

989. Waves and Radiations in Plasmas
Fall of even-numbered years. 3(3-0)
850. Interdepartmental with the Astronomy Department and Electrical Engineering and administered by Electrical Engineering.
Plasma oscillations; interactions electromagnetic fields with plasma, wave propagation in magnetostatic media; plasma sheath; radiation of electric source in incompressive and compressive plasmas; electromagnetic waves; magneto-hydrodynamics; research topics in plasmas.

999. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

PHYSIOLOGY
College of Human Medicine
College of Natural Science
College of Osteopathic Medicine
College of Veterinary Medicine

240. Introductory Physiology
Fall, Summer. 4(3-2) Sophomore or approval of department.
Survey of the physiology of the circulatory system, excretion, nervous system and special senses, digestion, metabolism and endocrinology.

323. Physiology, Anatomy, and Hygiene of the Eye
Fall. Summer of even-numbered years. 3(3-2) 240; Elementary Education or Special Education major, or approval of department.
Basic course in anatomy, physiology, and hygiene of the visual system; includes discussion of normal visual functioning and abnormal visual functioning, with methods of correction and education implications.

331. Human Physiology
Winter. 4(3-2) ANT 316; CEM 132, or approval of department.

332. Human Physiology
Spring. 4(3-2) 331.

401. Comparative Physiology I
Fall. 4(3-4) 340 or B.S. 212 and CEM 132. Interdepartmental with Department of Zoology.
A comparison of osmoregulation, digestion, respiration, and other physiological processes in a wide range of organisms.

402. Comparative Physiology II
Winter. 4(3-0) 401 or approval of department. Interdepartmental with and administered by the Department of Zoology.
A comparison of sensory, motor, endocrine and other integrative mechanisms in animals.