**PHYSICS (PHYS)**

**PHYS 8055 THE PHILOSOPHY OF SPACE EXPLORATION (3 credits)**

This course deals mainly with the justification of space exploration in the face of conflicting needs. Topics to be studied include objections to the space program and responses to them, spin-off benefits, space industrialization, planetary and interstellar exploration, space colonies, search for life elsewhere, and other related theoretical issues. (Cross-listed with PHYS 3050)

Prerequisite(s)/Corequisite(s): Graduate or permission of instructor.

**PHYS 8155 MODERN DEVELOPMENTS IN PHYSICS (3 credits)**

A resume of the most important discoveries, changes and new concepts gleaned from the last decade of research in physics. Superconductivity, lasers, masers, superfluidity, ultra large magnetic fields, space plasmas, nuclear fusion power, etc. Designed for updating physical science concepts for science majors and for science teachers. (Cross-listed with PHYS 3150)

Prerequisite(s)/Corequisite(s): PHYS 1120 or PHYS 2120.

**PHYS 8165 CURRENT TOPICS IN SCIENCE (1-3 credits)**

The subject matter of this course will generally not be presented in a standard physics course and may be of an interdisciplinary nature. The specific topics and prerequisites will be listed in the schedule. (Cross-listed with PHYS 3160)

Prerequisite(s)/Corequisite(s): Permission of instructor.

**PHYS 8206 INTRODUCTION TO QUANTUM MECHANICS (3 credits)**

This course provides an introduction to the historical development of modern physics and to the Schroedinger formulation of quantum mechanics. Specific topics will include square wells potential barriers, the simple harmonic oscillator potential and the hydrogen atom. Characteristics of multi-electron atoms, including angular momentum coupling schemes, spectra and transition rules will also be included. (Cross-listed with PHYS 4200)

Prerequisite(s)/Corequisite(s): PHYS 3250 or permission.

**PHYS 8216 QUANTUM THEORY (3 credits)**

The matrix operator formalism is covered along with philosophical implications of this approach. The methods developed will be applied to simple harmonic oscillator and hydrogen atom potentials. Raising and lowering operators, creation-annihilation operators, and first and second order perturbation theory will be discussed. (Cross-listed with PHYS 4210)

Prerequisite(s)/Corequisite(s): PHYS 4200 or permission.

**PHYS 8226 PHYSICS OF MOLECULES AND SOLIDS (3 credits)**

This course covers the various types of atomic bonding found in molecules and solids. Electronic energy levels and spectra of molecules will be discussed. Topics in solid state physics will include mechanics and thermodynamics of crystals, the scattering of waves including x-ray and neutron scattering, electron scattering and phonon and photon interactions. (Cross-listed with PHYS 4220)

Prerequisite(s)/Corequisite(s): PHYS 4200 or permission.

**PHYS 8236 SPECIAL RELATIVITY AND NUCLEAR PHYSICS (3 credits)**

This course includes a brief historical background of the development of relativity theory and the importance of the experiments performed in conjunction with it. Lorentz transformations and covariant formalism will be developed and applied to certain problems in mechanics and electricity and magnetism. The nuclear physics portion of the course will include the historical development of the concept of the nuclear atom. Theoretical models of nuclear structure will be discussed, along with the theory of alpha, beta and gamma decay. Fission and fusion discussed as time permits. (Cross-listed with PHYS 4230)

Prerequisite(s)/Corequisite(s): PHYS 4200 or permission.

**PHYS 8306 GENERAL RELATIVITY (3 credits)**

A study of general relativity theory and its leading applications. Physical motivations and conceptual foundations will be explored. Students will be guided step-by-step to mastery of the tensor analysis required by this theory. Topics covered will include the equivalence principle, recap of special relativity, tensors, curvature and geodesics, Einstein field equations, black holes, cosmology, and gravitational waves. (Cross-listed with PHYS 4300)

Prerequisite(s)/Corequisite(s): PHYS 3750 and PHYS 4230, or permission of instructor.

**PHYS 8355 ASTROPHYSICS (3 credits)**

This course introduces the fundamental of astrophysics to students with a prior knowledge of physics and mathematics. A review will be given of light and telescopes, classical and quantum mechanics and special relativity. Basic laws of physics will be applied to various topics such as: the sun, nuclear fusion and particle physics, evolution and end state of stars, interstellar medium, galaxies and cosmology. (Cross-listed with PHYS 4350)

Prerequisite(s)/Corequisite(s): PHYS 2130 or 4200 and MATH 1970. Recommended: PHYS 1350.

**PHYS 8455 CLASSICAL MECHANICS (3 credits)**

Statics and dynamics of particles and rigid bodies including the equations of Lagrange and Hamilton. (Cross-listed with PHYS 8455)

Prerequisite(s)/Corequisite(s): MATH 3520 or permission.

**PHYS 8505 ELEMENTS OF ELECTRONICS (3 credits)**

The topics covered will include basic circuit theory, principles and operation of electronic devices such as diodes, transistors and integrated circuits. Application of these devices in various electronic circuits. Both analog and digital circuitry will be studied. (Cross-listed with PHYS 3500)

Prerequisite(s)/Corequisite(s): PHYS 1120 or PHYS 2120 and MATH 1970.

**PHYS 8605 THERMODYNAMICS AND STATISTICAL PHYSICS (3 credits)**

Topics include: empirical and absolute temperature, equations of state, work, heat, entropy, the four laws of thermodynamics, phase changes, thermodynamic potentials, classical and quantum statistics of an ideal gas (e.g., blackbody radiation). Possible applications to be included: Einstein theory of a solid, paramagnetism, blackbody radiation, and conduction of electrons. (Cross-listed with PHYS 3600)

Prerequisite(s)/Corequisite(s): PHYS 2120 and MATH 1970.

**PHYS 8755 ELECTRICITY AND MAGNETISM I (3 credits)**

An advanced study of electrostatics and magnetostatics, including Coulomb’s law, Gauss’ law, the scalar potential, conductors and dielectrics, electrostatic energy, special methods, electric currents, Ampere’s law, the magnetic induction, Faraday’s law, and the electromagnetic wave equation as obtained from Maxwell’s equations, with simple examples such as transmission lines and antennas. (Cross-listed with PHYS 3750)

Prerequisite(s)/Corequisite(s): MATH 1950, MATH 1960, MATH 1970, PHYS 3520, or permission.

**PHYS 8765 ELECTRICITY AND MAGNETISM II (3 credits)**

A selection of more advanced topics from electromagnetic theory, including a deeper treatment of the electromagnetic wave equations derived from Maxwell’s equations, extending to propagation, reflection, and refraction of plane waves, waves in wave guides, and radiation. Other topics covered might be magnetism and magnetic energy, plasmas, and special relativity. (Cross-listed with PHYS 3760)

Prerequisite(s)/Corequisite(s): PHYS 3750.

**PHYS 8805 OPTICS (3 credits)**

The behavior of electromagnetic radiation as formulated in the ray, wave, and quantum models. Topics will include: reflection and refraction, vergence, matrix method, optical instruments, scalar waves, electromagnetic waves, blackbody radiation, interference, diffraction, and lasers; if time permits, fiber optics and holography will also be included. (Cross-listed with PHYS 3800)

Prerequisite(s)/Corequisite(s): PHYS 1120 or PHYS 2120 and MATH 1970.
PHYS 8956 PROBLEMS IN PHYSICS (1-3 credits)
Individual laboratory and/or library work, or reading course in some field of physics. (Cross-listed with PHYS 4950, PHYS 4960, PHYS 8966)
Prerequisite(s)/Corequisite(s): PHYS 2120 and permission of instructor.

PHYS 8960 TOPICS IN THE TEACHING OF NATURAL SCIENCE (1-4 credits)
This course is for K-12 science teachers with emphasis on content appropriate to the educational standards of the State of Nebraska and the National Science Education Standards. Teaching methodologies and technologies will be integrated with the subject matter. The format varies but is that of a workshop using lecture, individual mentoring, group study, laboratory exercises and presentations. The number of credits offered will vary.
Prerequisite(s)/Corequisite(s): Permission of Instructor.

PHYS 8966 PROBLEMS IN PHYSICS (1-3 credits)
Individual laboratory and/or library work, or reading course in some field of physics. (Cross-listed with PHYS 4950, PHYS 4960, PHYS 8956)
Prerequisite(s)/Corequisite(s): PHYS 2120 and permission of instructor.