Physics (PHYSCS)

PHYSCS 1050: Concepts in Cosmology
This course explores the development of our understanding of the origin and evolution of the Universe. We will embark on a qualitative description of the Big Bang theory, the expansion of the universe and its current structure, the cosmic microwave background radiation, the existence of dark matter and dark energy and their implications for the Universe's ultimate fate.

Credit Hours: 3
PHYSCS 1050 - MOTR ASTR 100: Astronomy

PHYSCS 1100: Science and Inventions
This course covers the history of some of the most important inventions in science and their impact on past civilizations, current advances in science and inventions, funding and policies, and critical advances in technology required for future generations.

Credit Hour: 1

PHYSCS 1150: Concepts in Physics
Introduction to fundamental concepts of physics for non-science majors. Concepts include the conservation of energy, the second law of thermodynamics, and the special theory of relativity. Students learn to reason and apply these concepts through writing assignments.

Credit Hours: 3
PHYSCS 1150 - MOTR PHYS 100: Essentials in Physics

PHYSCS 1210: College Physics I
This introductory college physics course uses algebra and trigonometry in developing some of the fundamental concepts of classical physics. Topics covered are vectors, kinematics, dynamics, gravity, momentum, energy, rotational kinematics, rotational dynamics, fluids, simple harmonic motion, waves and sound, and thermodynamics. Three lectures, one discussion, one lab weekly. Students may receive credit for PHYSCS 1210 or PHYSCS 2750, but not both.

Credit Hours: 4
Prerequisites: MATH 1100
PHYSCS 1210 - MOTR PHYS 150L: Physics I with Lab

PHYSCS 1220: College Physics II
This introductory second semester college physics course uses algebra and trigonometry in developing some of the fundamental concepts of classical physics. Topics covered include electricity and magnetism, optics and modern physics. Three lectures, one discussion, one lab weekly. Students may receive credit for PHYSCS 1220 or PHYSCS 2760, but not both.

Credit Hours: 4
Prerequisites: grade of C- or better in PHYSCS 1210

PHYSCS 2002: Topics in Physics and Astronomy- Physical Science
Study of selected topics in physics and astronomy. Subjects and earnable credit may vary from semester to semester. Course may be repeated for credit.

Credit Hour: 1-3

PHYSCS 2002H: Topics in Physics and Astronomy- Physical Science - Honors
Study of selected topics in physics and astronomy. Subjects and earnable credit may vary from semester to semester. Course may be repeated for credit.

Credit Hour: 1-3
Prerequisites: MATH 1100; Honors eligibility required

PHYSCS 2200: Life and the Universe
This course explores the connection between our everyday existence and the underlying physics' processes. Students will look at processes - essential to life - ranging from the very small (atomic level) to the very large (universe), and the many length scales in between (cellular level and human being level) as well as make connections between the laws of physics and the numbers that go into them and the prerequisites for the existence of life.

Credit Hours: 3

PHYSCS 2330: Exploring the Principles of Physics
A hands-on course covering topics in Electricity, Magnetism, Forces, Motion and Energy. Pedagogy reflects styles used in K-12 classrooms; emphasis on inquiry, concept development, quantitative applications and technology. Enrollment limited to Elementary and Early Childhood Education majors who have completed MATH 1100 or higher.

Credit Hours: 4
Prerequisites: instructor's consent required

PHYSCS 2500: The Beautiful Invisible: Exploring Physics, Fiction, and Reality
This course explores the conceptual structure of modern physics from a humanistic perspective. Rather than describing the natural world "as it is", physical science weaves some key observations in a convincing and memorable narrative. It is not within its power to explain reality, but it can make it understandable, sometimes even predictable. Due to the presence of internal and external constraints, physical theories are akin to myths, i.e., fiction created by many authors over an extended period of time. The mythical character of a theory does not diminish its scientific validity - quite the contrary. Convincing myths are not easily found and better observations demand better myths. The mythical content of the theory is not some extraneous content that we introduce for the sake of popularization, but an essential part of the science itself.

Credit Hours: 3

PHYSCS 2750: University Physics I
First course in calculus-based physics for science and engineering students. Topics covered are vectors, translational and rotational kinematics, translational and rotational dynamics, energy, momentum, gravity, oscillations, waves, fluids and thermodynamics. Three lectures, one discussion, one lab weekly. Students may receive credit for PHYSCS 1210 or PHYSCS 2750, but not both.

Credit Hours: 5
Prerequisites: MATH 1500 or equivalent
Recommended: MATH 1700
PHYSCS 2750 - MOTR PHYS 200L: Advanced Physics I with Lab
PHYSCS 2750H: University Physics I - Honors
First course in calculus-based physics for science and engineering students. Topics covered are vectors, translational and rotational kinematics, translational and rotational dynamics, energy, momentum, gravity, oscillations, waves, fluids and thermodynamics. Three lectures, one discussion, one lab weekly. Students may receive credit for PHYSCS 1210 or PHYSCS 2750, but not both. Graded on A-F basis only.
Credit Hours: 5
Prerequisites: MATH 1500 or equivalent. Honors eligibility required
Recommended: MATH 1700

PHYSCS 2760: University Physics II
Second semester course in calculus-based physics for science and engineering students. Topics covered are electrostatics, circuits, magnetism, electromagnetic phenomena, optics, matter waves and particles and modern physics. Three lectures, one discussion, one lab weekly. Students may receive credit for PHYSCS 1220 or PHYSCS 2760, but not both.
Credit Hours: 5
Prerequisites: MATH 1700 and grade of C- or better in PHYSCS 2750
Recommended: MATH 2300

PHYSCS 2800: Undergraduate Seminar in Physics
Introduction to the Physics Department and presentation of topics of current interest in physics by faculty and students. Intended for physics majors at the freshman or sophomore level only.
Credit Hours: 2

PHYSCS 3002: Topics in Physics and Astronomy - Physical Science
Study of selected topics in physics and astronomy. Subjects and earnable credit may vary from semester to semester. May be repeated 2 for credit.
Credit Hour: 1-3
Prerequisites: PHYSCS 1210 or PHYSCS 2750

PHYSCS 3010: Introduction to Modern Astrophysics
(same as ASTRON 3010). Elements of stellar, and galactic astrophysics. Interpretation of observations and physical conditions of various astronomical objects including stars, gaseous nebula and, galaxies.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 3100: Teaching Physics
Introduces modeling and inquiry methods of teaching about force, motion, energy, electricity and magnetism. Students learn research-base physics teaching methods, including eliciting prior understanding, facilitating conceptual change, and active learning strategies.
Credit Hours: 3
Prerequisites: PHYSCS 1220 or PHYSCS 2760

PHYSCS 3150: Introduction to Modern Physics
Relativistic kinematics and Lorentz transformations; historical basis for quantum mechanics; atomic structure; physics of solids; nuclear structure and decay.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 3150W: Introduction to Modern Physics - Writing Intensive
Relativistic kinematics and Lorentz transformations; historical basis for quantum mechanics; atomic structure; physics of solids; nuclear structure and decay.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 3200: Physics of Space Explorations
The course provides an overview of the solar system, spacelfight history, a review of Newtonian physics and law of universal gravitation, the application of these laws to spacecraft launch, entry, and orbit, planetary trajectories, and other special topics. Three focused case studies of actual space missions are addressed. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 3300: Undergraduate Seminar in Physics
This undergraduate seminar provides opportunities for students to learn about topics currently in physics research. It is intended for physics majors at the freshman or sophomore level only.
Credit Hours: 3
Prerequisites: PHYSCS 2750

PHYSCS 3700: Introduction to Methods in Mathematical Physics
The course discusses the application of mathematical techniques that students need for upper-level physics courses. Topics include: applications of complex variables, second-order linear differential equations with applications to AC circuits, matrices/linear algebra, calculus of variations, Fourier transforms and vector analysis.
Credit Hours: 3
Prerequisites: PHYSCS 2760 and MATH 2300

PHYSCS 4020: Astrophysical Techniques
The course provides an overview of the solar system, spacelfight history, a review of Newtonian physics and law of universal gravitation, the application of these laws to spacecraft launch, entry, and orbit, planetary trajectories, and other special topics. Three focused case studies of actual space missions are addressed. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: ASTRON 3010

PHYSCS 4050: Electronic Laboratory
This upper-level undergraduate laboratory course familiarizes students with the foundations and techniques of electronics design, with emphasis on data acquisition and processing. Topics: circuits with discrete and integrated circuits, active and passive filters, amplifiers, power supplies, instrumentation and interfacing. Integrated lectures and labs. Graded on A-F basis only.
Credit Hours: 4
Prerequisites: PHYSCS 2760

PHYSCS 4060: Advanced Physics Laboratory I
This upper-level undergraduate laboratory course familiarizes students with the methods and procedures of experimental physics at an advanced level. The course covers principles of magnetism, graphic programming and interface techniques, weak-signal detection, and some modern physics discoveries such as, magneto-optical Kerr effect, digital holography and gamma-ray spectroscopy. Students work on research projects in the areas of condensed matter physics, materials science, modern spectroscopy, superconductivity, and quantum physics.
Credit Hours: 3
Prerequisites: PHYSCS 3150

PHYSCS 4080: Major Themes in Classical Physics
Introduction to classical physics: mechanics, electromagnetism and thermodynamics, emphasizing the unity and the connections between different parts of it.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 4080W: Major Themes in Classical Physics - Writing Intensive
Introduction to classical physics: mechanics, electromagnetism and thermodynamics, emphasizing the unity and the connections between different parts of it.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 4100: Electricity and Magnetism I
Mathematical preliminaries, properties of charge distributions at rest and in motion, the field concept, introduces electromagnetic radiation.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 4102: Topics on Physics and Astronomy-Biological/Physical/Mathematics
Organized study of selected topics. Subjects and earnable credit may vary from semester to semester. Departmental consent for repetition.
Credit Hour: 1-3
Prerequisites: PHYSCS 2760 or instructor's consent

PHYSCS 4110: Light and Modern Optics
Interaction of light with matter, spectroscopic techniques, wave optics, interferometry, multilayer films, polarization, non-linear optics, design of optical instruments, matrix methods, waveguides, fiber optics, acousto-optic and photo-elastic modulation. Includes both lectures and laboratory.
Credit Hours: 4
Prerequisites: PHYSCS 2760

PHYSCS 4120: Introduction to Thermodynamics
Development of the concepts of temperature, heat, work, entropy, enthalpy and free energy. Applications to gases, liquids and solids. Statistical methods.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 4140: Mechanics
Development of fundamental concepts, principles of mechanics using mathematical methods. Many problems used.
Credit Hours: 3
Prerequisites: PHYSCS 2760

PHYSCS 4180: Solar System Science
(same as GEOL 4180, ASTRON 4180; cross-leveled with GEOL 7180). Investigates physical states, interior structures and comparative geology of solar systems bodies: planets, moons, asteroids, comets, sun. Solar system formation and evolution.
Credit Hours: 3
Prerequisites: PHYSCS 3150

PHYSCS 4190: Physics and Chemistry of Materials
(same as NU_ENG 4319, BIOL_EN 4480 and CHEM 4490). This course will cover fundamental and applied aspects relating to the Physics, Chemistry and Biology of materials with special emphasis on Nanoscience and Nanomedicine. Consists of lectures and experiments in Nanoscience.
Credit Hours: 3
Prerequisites: PHYSCS 2760 and CHEM 1320 or equivalent, or instructor's consent

PHYSCS 4230: Scanning and Transmission Electron Microscopy and Microanalysis
(cross-leveled with PHYSCS 7230). This course is designed for senior undergraduate/graduate students. This course covers the basic principles and practical considerations using SEM, TEM, EDS, and EELS in the characterization of materials. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 3150 and instructor's consent

PHYSCS 4250: Stellar Astrophysics
(same as ASTRON 4250). Basic astrophysics of stable and unusual stars, stellar systems. Investigates stellar dimensions, radiation, spectra, energy, evolution, populations; interstellar medium, stellar motions and aggregation.
Credit Hours: 3
Prerequisites: ASTRON 3010

PHYSCS 4310: Physics in Cell and Developmental Biology
(same as BIO_SC 4310). Discusses the role of physical mechanisms in specific cellular and developmental processes and phenomena, in particular those characterizing the embryonic stage of multicellular organisms. Each process and phenomenon is first described in biological terms and then within a physical model, with special emphasis on the interplay between the two descriptions.
Credit Hours: 3
Prerequisites: PHYSCS 2760 and BIO_SC 2300 or instructor's consent

PHYSCS 4350: Galactic Astronomy
(same as ASTRON 4350). Observational properties of normal galaxies and clusters of galaxies, Seyfert and emission-line structure and dynamics of galaxies; interacting galaxies, quasi-stellar objects. Introduction to cosmology.
Credit Hours: 3
Prerequisites: PHYSCS 3010 or ASTRON 3010
Recommended: PHYSCS 4140

PHYSCS 4360: Extragalactic Astronomy
(same as ASTRON 4360; cross-leveled with ASTRON 7360, PHYSCS 7360). This course introduces students to the most basic knowledge of extragalactic astronomy, starting from Milky Way and extending to the
most distant universe. Topics covered will include galaxy morphology and classification, groups and clusters of galaxies, active galactic nuclei, and galaxy formation and evolution.

**PHYSCS 4390: Problems in Physics**
Problems in Physics
Credit Hours: 3
Prerequisites: ASTRON 3010

**PHYSCS 4410: Analysis of Biological Macromolecules and Biomaterials**
This interdisciplinary, team-taught course introduces basic concepts and experimental techniques for studying bio-macromolecules and biomaterials. A Problem Based Learn/Writing Intensive approach uses four modules: Proteins, membranes, cellular interactions and biomaterials.
Credit Hours: 3
Prerequisites: PHYSCS 2760

**PHYSCS 4420: Introduction to Biomedical Imaging**
This course offers a broad introduction to medical imaging. Topics to be covered include the physics basics and instrumentation of X-ray, CT, PET, SPECT, ultrasound, MRI, and optical imaging, as well as recent developments in biomedical imaging.
Credit Hours: 3
Prerequisites: PHYSCS 2760

**PHYSCS 4450: Introduction to Cosmology**
Develops the physical concepts necessary for understanding the major recent discoveries in cosmology, such as the acceleration of the universe and dark energy. No prior knowledge of general relativity is assumed. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 3150 or equivalent

**PHYSCS 4460: Interstellar Medium**
(same as ASTRON 4460). The course discusses observational properties and physical and chemical processes occurring in the interstellar medium. Topics include interstellar diffuse and molecular clouds, HII regions, dust grains, interstellar chemistry, star formation, supernova remnants, and interstellar shock waves.
Credit Hours: 3
Prerequisites: ASTRON 3010

**PHYSCS 4500: Computational Biological Physics**
(cross-leveled with PHYSCS 7500). Provides a practical introduction (hands-on approach) to the study of the structure and function of biomolecular systems by employing computational methods and theoretical concepts familiar from the physical sciences.
Credit Hours: 3
Prerequisites: PHYSCS 2760 or instructor's consent

**PHYSCS 4510: Single Molecule Biophysics**
(same as BIOCHM 4510; Cross-leveled with PHYSCS 7510). The course provides an overview of the biophysics of enzymes, nucleic acids and the cytoskeleton. Topics covered will include diffusion, molecular motors, polymerization and the cytoskeleton and the polymer properties of nucleic acids and microtubules
Credit Hours: 3
Prerequisites: PHYSCS 2760

**PHYSCS 4520: Introduction to Biophysics**
This course introduces the study of biological systems from the perspective of a physicist. Students will learn how to relate the structure of a particular system and its constituents to its function. The treatment of molecular and cellular phenomena will be based on physical principles quantified through the necessary analytical tools. Prominent biophysical methods and their fundamental operating principles will also be discussed. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 1220 or PHYSCS 2760 or instructor's consent

**PHYSCS 4550: Cosmochemistry**
(same as ASTRON 4550). Cosmic dust, stardust, spectra, energy, interstellar medium, meteorites, astromineralogy.
Credit Hours: 3
Prerequisites: ASTRON 3010

**PHYSCS 4600: Semiconductor Optics**
It is an introductory-level course in the field of optical processes in semiconductors (both inorganic and organic) and solid-state optoelectronics, designed both for graduate and undergraduate students of Physics, Chemistry and Electrical Engineering. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 3150

**PHYSCS 4620: Introduction to Materials Science**
This course on the science and technology of materials explores the interrelationship between processing, structure, properties (electrical, optical, magnetic), and performance. Observable properties of materials will be used to explore and understand the consequences of atomic- and molecular-level events. Structure-property correlations, including electronic, thermal, and mechanical properties, will be presented for different classes of materials including nanoscale materials. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 3150

**PHYSCS 4650: Modern Condensed Matter Physics**
Introduces the basic concepts and gives an overview of the latest developments of modern condensed-matter physics as the forefront of (nano) science and technology. Combines lectures and computational laboratory, where students use and develop interactive computer simulations. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 3150 or instructor's consent
PHYSCS 4800: Introduction to Quantum Mechanics I
Foundations of wave mechanics; wave packets; Schrödinger equation and I-D problems; operators and eigenfunctions, spherically symmetric systems.
Credit Hours: 3
Prerequisites: PHYSCS 3150 and MATH 4100

PHYSCS 4810: Introduction to Quantum Mechanics II
Review of quantum mechanics and units, forms of radiation, radiation detectors, spacetime symmetries, internal symmetries, nuclear structure and form factors, low-energy nuclear models, recent developments.
Credit Hours: 3
Prerequisites: PHYSCS 4800 or equivalent

PHYSCS 4850: Computational Methods in Physics
Use of modern computational techniques in solving a wide variety of problems in solid state, nuclear, quantum and statistical physics.
Credit Hours: 3
Prerequisites: PHYSCS 4800 or instructor's consent

PHYSCS 4950: Undergraduate Research in Physics
Special studies for advanced undergraduate students in physics covering subjects not included in courses regularly offered. Departmental consent for repetition.
Credit Hour: 1-3
Prerequisites: instructor's consent

PHYSCS 4960: Senior Thesis in Physics
Special studies for senior undergraduate students in physics. The course requires an oral or poster presentation, or faculty-guided writing of a senior thesis involving independent research.
Credit Hours: 3
Prerequisites: instructor's consent and 3 units of PHYSCS 4950. Departmental consent required for repetition

PHYSCS 4985: Issues in Modern Physics and Engineering
Students are expected to write a major paper on a selected topic from modern physics or engineering. The paper will review the current state of the experimental and theoretical research on the topic at a level appropriate to their peers.
Credit Hours: 3
Prerequisites: PHYSCS 3150

PHYSCS 7020: Astrophysical Techniques
Elements of modern astronomical instruments, observations and analysis, with the emphasis in the optical regime. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 3150 and instructor's consent

PHYSCS 7085: Problems in Physics
Laboratory work involving study of literature of special experiments in physics. Introduces research methods.
Credit Hour: 1-99

PHYSCS 7110: Light and Modern Optics
Interaction of light with matter, spectroscopic techniques, wave optics, interferometry, multilayer films, polarization, nonlinear optics, design of optical instruments, matrix methods, waveguides, fiber optics, acousto-optic and photoelastic modulation. Includes both lectures and laboratory.
Credit Hours: 4
Prerequisites: PHYSCS 4800 or equivalent

PHYSCS 7180: Solar System Science
(same as GEOL 7180 and ASTRON 7180; cross-leveled with GEOL 4180 and ASTRON 4180). Investigates physical states, interior structures and comparative geology of solar systems bodies: planets, moons, asteroids, comets, sun. Solar system formation and evolution.
Credit Hours: 3
Prerequisites: PHYSCS 1220 or PHYSCS 2760 or instructor's consent

PHYSCS 7230: Scanning and Transmission Electron Microscopy and Microanalysis
(cross-leveled with PHYSCS 4230). This course is designed for senior undergraduate/graduate students. This course covers the basic principles and practical considerations using SEM, TEM, EDS, and EELS in the characterization of materials. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: PHYSCS 3150 and instructor's consent

PHYSCS 7360: Extragalactic Astronomy
(same as ASTRON 7360; cross-leveled with PHYSCS 4360, ASTRON 4360). This course introduces students to the most basic knowledge of extragalactic astronomy, starting from Milky Way and extending to the most distant universe. Topics covered will include galaxy morphology and classification, groups and clusters of galaxies, active galactic nuclei, and galaxy formation and evolution.
Credit Hours: 3
**Physics (PHYSCS)**

**PHYSCS 7400: Physics of Electronic Devices**
(cross-leveled with PHYSCS 4400). This course is designed for graduate students of Physics and Electrical Engineering who have an interest in learning the basic physical idea underlying the operation of electronic devices. The course consists of lectures, handout lecture notes, problem sets, two mid-term and one final exam.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 2760 or PHYSCS 7400 (cross-leveled with PHYSCS 4400).

**PHYSCS 7410: Analysis of Biological Macromolecules and Biomaterials**
This interdisciplinary, team-taught course introduces basic concepts and experimental techniques for studying bio-macromolecules and biomaterials. A Problem Based Learn/Writing Intensive approach uses four modules: proteins, membranes, cellular interactions and biomaterials.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 3150 or equivalent

**PHYSCS 7420: Introduction to Biomedical Imaging**
(same as BIOL_EN 7420). This course offers a broad introduction to medical imaging. Topics to be covered include the physics basics and instrumentation of X-ray CT, PET, SPECT, ultrasound, MRI, and optical imaging, as well as recent developments in biomedical imaging.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 2760

**PHYSCS 7450: Introduction to Cosmology**
Develops the physical concepts necessary for understanding the major recent discoveries in cosmology, such as the acceleration of the universe and dark energy. No prior knowledge of general relativity is assumed. Graded on A-F basis only.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 3150 or PHYSCS 7450 (cross-leveled with PHYSCS 4550, ASTRON 4550).

**PHYSCS 7500: Computational Biological Physics**
(cross-leveled with PHYSCS 4500). Provides a practical introduction (hands-on approach) to the study of the structure and function of biomolecular systems by employing computational methods and theoretical concepts familiar from the physical sciences.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 1220 or PHYSCS 2760 or instructor's consent

**PHYSCS 7510: Single Molecule Biophysics**
(same as BIOCHM 7510; cross-leveled with PHYSCS 4510). The course provides an overview of the biophysics of enzymes, nucleic acids and the cytoskeleton. Topics covered will include diffusion, molecular motors, polymerization of the cytoskeleton and the polymer properties of nucleic acids and microtubules.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 2760

**PHYSCS 7550: Cosmochemistry**
(same as ASTRON 7550; cross-leveled with PHYSCS 4550, ASTRON 4550). Cosmic dust, Stardust, spectra, energy, interstellar medium, meteorites, astromineralogy.

**Credit Hours:** 3
**Prerequisites:** ASTRON 3010

**PHYSCS 7650: Modern Condensed Matter Physics**
Introduces the basic concepts and gives an overview of the latest developments of modern condensed matter physics as the forefront of (nano) science and technology. Combines lectures and computational laboratory, where students use and develop interactive computer simulations. Graded on A-F basis only.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 3150 or instructor's consent

**PHYSCS 7750: Interstellar Medium**
The course discusses observational properties and physical and chemical processes occurring in the interstellar medium. Topics include interstellar diffuse and molecular clouds, HiI regions, dust grains, interstellar chemistry, star formation, supernova remnants, and interstellar shock waves.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 1220

**PHYSCS 7850: Computational Methods in Physics**
Use of modern computational techniques in solving a wide variety of problems in solid state, nuclear, quantum and statistical physics. Graded on A-F basis only.

**Credit Hours:** 3
**Prerequisites:** PHYSCS 4800 or instructor's consent

**PHYSCS 8040: Study of Techniques of Teaching College Physics**
Objectives, methods and problems related to teaching college physics. Some credit in this course is required for all students teaching physics. May repeat for 3 hours maximum.

**Credit Hours:** 1-3
**Prerequisites:** instructor's consent. Departmental consent for repetition

**PHYSCS 8090: Research in Physics**
Graduate research. Graded on S/U Basis only.

**Credit Hours:** 1-99

**PHYSCS 8101: Topics of Physics and Astronomy**
Organized study of selected topics. Subjects and earnable credit may vary from semester to semester.

**Credit Hours:** 1-3
**Prerequisites:** instructor's consent. Departmental consent for repetition

**PHYSCS 8110: Physics for High School Teachers I**
This is a physics course designed primarily for high school teachers. Topics include motion, forces, Newton's Laws, electricity, k and magnetism. The course uses research based pedagogical methods utilizing inquiry, modeling, and hands-on techniques. Graded on A-F basis only.

**Credit Hours:** 4
Prerequisites: instructor's consent

PHYSCS 8130: Physics for High School Teachers 3
This is a physics course designed primarily for high school teachers. Topics include modern physics and history of science. The course uses research based pedagogical methods utilizing inquiry, modeling, and hands-on techniques. Graded on A-F basis only.

Credit Hours: 2
Prerequisites: instructor's consent

PHYSCS 8150: Condensed Matter Physics I
Crystal structure, reciprocal lattice, phonons, neutron and x-ray scattering, free electron theory of metals, Fermi surfaces, energy bands, static properties of solids, semiconductors, devices, and quantum structures, optical properties, excitons, introduction to magnetism and superconductivity.

Credit Hours: 3
Prerequisites: PHYSCS 4800 or equivalent

PHYSCS 8160: Condensed Matter Physics II
The basic Hamiltonian, Phonons, theory of the electron gas, second quantization, Hartree and Hartree-Fock approximation, local-density method, tight-binding theory, electron-electron interaction and screening, Fermi liquid theory, transport properties, impurities, Green's function's, Localization, Quantum Hall effect, magnetism, superconductivity.

Credit Hours: 3
Prerequisites: PHYSCS 8150

PHYSCS 8301: Topics in Astronomy and Astrophysics
(same as ASTRON 8301). Selected topics from solar system, stellar, galactic and extragalactic astronomy and astrophysics. May be repeated to a maximum of six hours.

Credit Hours: 3
Prerequisites: PHYSCS 8150

PHYSCS 8310: College Science Teaching
(same as ASTRON 8310, BIO_SC 8724 and LTC 8724). Study of learner characteristics, teaching strategies, and research findings related to teaching science at the post-secondary level.

Credit Hours: 3
Prerequisites: instructor's consent

PHYSCS 8350: Science Outreach: Public Understanding of Science
(same as BIO_SC 8725 and AN_SC 8725) This course is aimed at promoting public understanding and appreciation of science. The students will develop presentations that increase awareness of the impact of science on many aspects of our daily lives.

Credit Hours: 1-2

PHYSCS 8410: Concepts in Nanoscale Materials: Interdisciplinary Science
This interdisciplinary course covers basic concepts in nanoscale materials, their characterization, and how and why they differ from conventional bulk materials. The course focuses on neutron scattering methods and uses lectures, problem-based modules, and writing assignments.

Credit Hours: 3
Prerequisites: PHYSCS 3150 and instructor's consent

PHYSCS 8550: Stellar Structure and Evolution
(same as ASTRON 8550). Reviews of atomic and molecular spectra. Investigates quantum radiation law, emission and absorption processes, radiation transfer theory, continuous and discrete line spectra of stars, stellar composition.

Credit Hours: 3
Prerequisites: PHYSCS 4250, PHYSCS 4800, or instructor's consent

PHYSCS 8610: Classical Mechanics
The interplay of dynamics and symmetry, Hamilton's principle and Noether's theorem, Lagrangian, Hamiltonian, Hamilton-Jacobi theories of mechanics in special relativity. Rigid body motion, small oscillation, canonical transformations and fields as continuous mechanical systems.

Credit Hours: 3
Prerequisites: PHYSCS 8620 or instructor's consent

PHYSCS 8640: Electrodynamics II
Electromagnetic wave propagation, reflection, refraction, wave guides, cavities antennas and diffraction, tensors, special relativity, the Lorentz group, dynamics of relativistic particles and fields radiation by moving charges, retardation, bremsstrahlung. Additional topics may include magnetohydrodynamics and plasma physics.

Credit Hours: 3
Prerequisites: PHYSCS 8620 or instructor's consent

PHYSCS 8660: Methods in Mathematical Physics
Concentrates on mathematical techniques used in modern physics. Infinite series, functions of a complex variable, differential equations, Fourier series and integral, etc.

Credit Hours: 3
Prerequisites: PHYSCS 8620 or instructor's consent

PHYSCS 8680: Thermodynamics and Statistical Mechanics
Thermodynamics as applied in physics, chemistry; laws of distribution; statistical methods of study matter, radiation.

Credit Hours: 3
Prerequisites: PHYSCS 8610 or instructor's consent

PHYSCS 8700: Non-Equilibrium Statistical Mechanics
This course provides an introduction to the theoretical and mathematical description of classical stochastic systems with examples from biophysics and condensed matter physics.

Credit Hours: 3
Prerequisites: PHYSCS 8710 or concurrently
Prerequisites: PHYSCS 8680 or consent of instructor

PHYSCS 8710: Quantum Mechanics I
Non-relativistic quantum theory in Hilbert space. States and self-adjoint observables, unitary time evolution in various pictures, the path-integral, identical particles, Fock space, angular momentum and some perturbation theory.

Credit Hours: 3
Prerequisites: PHYSCS 8610

PHYSCS 8720: Quantum Mechanics II
More perturbation theory, variational methods, semi-classical methods and application to radiation theory, linear response theory and rudiments of relativistic quantum mechanics including the Klein-Gordon equation and the Dirac equation.

Credit Hours: 3
Prerequisites: PHYSCS 8710

PHYSCS 8820: Relativity and Gravitation
Special and general theories of relativity. Discussion of accelerated observers and the principles of equivalence. Einstein's gravitational field equations, black holes, gravitational waves and cosmology.

Credit Hours: 3
Prerequisites: PHYSCS 8610, PHYSCS 8620

PHYSCS 9090: Research in Physics
Research leading to Ph.D. dissertation. Graded on a S/U basis only.

Credit Hour: 1-99
Prerequisites: PhD candidacy has been established