PHYSICS (PHYS-UH)

PHYS-UH - Physics Major Elective (1-6 Credits)
Remove Section: (to be used for substitutions and transfer credit)(to be used for substitutions and transfer credit)
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: Yes
- Bulletin Categories: Physics: Biophysics Electives

PHYS-UH 2010 Electromagnetism and Special Relativity (2 Credits)
Typically offered Fall and Spring
This course is intended to give students a deeper understanding of electricity and magnetism at the introductory level. It provides a necessary bridge between Foundations of Science 3-4 and the intermediate level course Electricity and Magnetism. The topics include derivations of divergence, gradient and curl, Stokes' Theorem, the Vector Potential, and origin of magnetic fields. The connection between electricity, magnetism, and special relativity is also explained, including time dilation, length contraction and other bizarre phenomena that occur when charges and other matter travel at velocities close to that of light.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Corequisites: Foundations of Science 3-4.
- Bulletin Categories: Physics Major: Required
- Bulletin Categories: Physics

PHYS-UH 2115 Electricity and Magnetism for Engineers (4 Credits)
Typically offered Spring
This course covers electromagnetism at the introductory and intermediate level. Electromagnetism is one of the fundamental forces underlying almost any kind of device that we use on a daily basis. Understanding electromagnetism is an indispensable element of a engineer's knowledge. The course starts from the definition of electric charge and Coulomb force and then continues with the derivation of Maxwell's equations and their applications to physical problems. The last part is dedicated to EM waves and their properties.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Engineering: Computer Engineering Required Option
- Bulletin Categories: Engineering: Electrical Engineering Required
- Bulletin Categories: Engineering: General Engineering Required Option
- Bulletin Categories: Engineering: Mechanical Engineering Required
- Bulletin Categories: Physics: Electives
- Bulletin Categories: Required Science Courses
- Crosslisted with: Engineering Common Courses (ECC)
- Crosslisted with: Engineering
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3010 Mechanics (4 Credits)
Typically offered Spring
This course concerns the analysis of the motion of physical systems subject to forces in the classical (Newtonian) framework. Classical mechanics is required to understand the physical behavior of our world and is the basis to approach quantum mechanics, statistical mechanics and particle physics. This course also provides an excellent arena within which students learn problem solving techniques. The course starts from a review of Newton's laws and moves to the Lagrangian and Hamiltonian formulations of mechanics. Topics in the course include central forces, the dynamics of rigid bodies, oscillations.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Category A (Applied Mathematics)
- Bulletin Categories: Mathematics: Electives
- Bulletin Categories: Physics Major: Required
- Bulletin Categories: Physics
- Crosslisted with: Mathematics Major: Required
- Crosslisted with: Mathematics
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3011 Electricity and Magnetism (4 Credits)
Typically offered Fall
This course covers electromagnetism at the intermediate level. Electromagnetism is one of the fundamental forces underlying almost any kind of device that we use on a daily basis. Understanding electromagnetism is an indispensable element of a physicist's knowledge. The course introduces Maxwell's equations and their applications to physical problems. Topics in the course include electrostatics, magnetostatics, currents, and the propagation of electromagnetic waves.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Physics Major: Required
- Bulletin Categories: Physics
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3012 Quantum Mechanics 1 (4 Credits)
Typically offered Fall
This course provides a rigorous mathematical introduction to quantum mechanics. Quantum mechanics is both a fundamental departure from the classical understanding of the universe and one of the foundational theories on which modern physics is based. Topics include the Schrödinger and Heisenberg description of quantum systems, application to basic atomic structure and simple boundary condition problems, quantum statistics, perturbation theory, and scattering.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Physics Major: Required
- Bulletin Categories: Physics

PHYS-UH 3013 Advanced Physics Laboratory (4 Credits)
Typically offered Spring
In this course the students assemble and perform key experiments of modern physics. Physics is an experimental science, and this course gives a unique opportunity to experience hands-on some of the phenomena that students have covered in lectures. Activities cover quantum mechanics, particle physics, optics, and atomic and nuclear physics.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: Foundations of Science 1-6.
- Bulletin Categories: Physics Major: Required
- Bulletin Categories: Physics

PHYS-UH 3014 Statistical Mechanics and Thermodynamics (4 Credits)
Typically offered Spring
This course is about the behavior of macroscopic systems composed of many particles. Phenomena like the behavior of polyatomic gases, magnetism, thermal radiation, phase changes and many others can be understood through statistical mechanics. Topics include the relation of entropy to probability and energy to temperature, the laws of thermodynamics, Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics, equations of state for simple gases, and chemical and magnetic systems, and elementary theory of phase transitions.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Biology: Biophysics Electives
- Bulletin Categories: Chemistry: Biophysics Electives
- Bulletin Categories: Physics Major: Required
- Bulletin Categories: Physics
- Crosslisted with: Biology Major: Required
- Crosslisted with: Biology
- Crosslisted with: Chemistry Major: Required
- Crosslisted with: Chemistry
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3090 Research Seminar in Physics (2 Credits)
Typically offered Spring
The research seminar provides students with an overview of the diverse multidisciplinary research areas that have captured the interest and fascination of NYUAD physicists and others in related fields. Through exposure to NYUAD faculty research, students will identify areas of interest for their own capstone research and develop and write an in-depth research proposal over the course of the semester. The final capstone proposal is due at the end of the seminar series so that students can begin the Capstone Project in the fall semester of their senior year. All science majors are expected to take this course in their junior year.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Physics Major: Required
- Bulletin Categories: Physics

PHYS-UH 3211 General Relativity (4 Credits)
Typically offered occasionally
General Relativity is currently the leading description for gravity. This topic is important for determining the evolution and fate of the universe, to the motion of small objects in the Solar System and the Earth, and is perhaps the best tested theory in all of physics. This course will involve learning the basic mathematical framework of general relativity (including differential geometry and field equations), as well as applications to various topics in astronomy and astrophysics.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: MATH-UH 2010.
- Bulletin Categories: Physics: Astrophysics Electives
- Bulletin Categories: Physics: Electives
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3213 Computational Physics (4 Credits)
Typically offered occasionally
This course focuses on fields of current research interest where numerical techniques provide unique physical insight. In fact, modern physics needs computers to solve problems and simulate systems. Topics are chosen from various branches of physics and engineering, including numerical solution of ordinary and partial differential equations, eigenvalue problems, Monte Carlo methods in statistical mechanics, dynamical systems, fluid dynamics, radiative transfer, and chaos.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Engineering Crosslisted Courses
- Bulletin Categories: Engineering: Mechanical Engineering Electives
- Bulletin Categories: Physics: Astrophysics Electives
- Bulletin Categories: Physics: Electives
- Crosslisted with: Engineering Common Courses (ECC)
- Crosslisted with: Engineering
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3214 Astrophysics (4 Credits)
Typically offered occasionally
This course is about the application of fundamental physics to understand observations of the universe, and the usage of astronomical phenomena to study physics. The course draws on all areas of physics. This not only includes mechanics, electricity and magnetism, quantum and statistical mechanics, but also nuclear physics, particle physics, optics, plasma physics, hydrodynamics, and both special and general relativity. This class focuses on a subset of important physical systems and concepts that have wide applicability to studying the universe as well as other areas of physics. Topics may include depending on student interests: generation and propagation of light, two-body and multi-body dynamics, stellar structure and evolution, stellar atmospheres, winds, shocks, accretion, and the consequences of strong gravity.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Physics: Astrophysics Electives
- Bulletin Categories: Physics: Electives

PHYS-UH 3215 Introduction to Detector Electronics (2 Credits)
Typically offered Spring
This is an introductory course meant to provide the basics for an understanding of the electronics needed to acquire and process a signal coming from some of the most common detectors used in physics experiments. The course is structured in 7 seminar-style meetings (75 min) and 7 laboratory sessions (160 min). Topics include: passive and active filters, transmission lines, charge and voltage amplification, analog to digital conversion and time to digital conversion. All the topics will be approached from the experimental physics standpoint.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Physics: Astrophysics Lab Electives
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3217 Multi-wavelength Astronomy (4 Credits)
Typically offered occasionally
Astronomy is about the observation and study of what exists beyond the Earth's atmosphere. Until the 20th century, that meant only the use optical telescopes, but starting with the discovery of cosmic radio waves in 1931, the rest of the electromagnetic spectrum has begun to be available to astronomers. This course is indispensable to students that want to pursue a career in astronomy or astrophysics or simply want to know more about objects and processes taking places outside our planet. The course covers all the different wavelengths now open to astronomy: radio, microwave, infrared, optical, X-ray, and gamma-ray, and their respective detection technologies and analysis methods. Emission mechanisms, sources, and primary science questions relevant to each observing band will also be addressed.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: Foundations of Science 1-4.
- Bulletin Categories: Physics: Astrophysics Electives
- Bulletin Categories: Physics: Electives

PHYS-UH 3218 Forensic Science (4 Credits)
Typically offered occasionally
This course consists of laboratory work and lecture. The goal in the lab is to determine what happened in a staged crime scene and identify the murderer. For that, clues left at the staged crime scene and beyond are analyzed using a combination of advanced scientific techniques (biological, chemical, and physical) typically used in forensics. In the lecture part of the course, the modern science and technology behind the techniques of forensic analysis are explored in depth. These tools of forensics are rooted in the fields of physics, physical chemistry, chemical physics, analytical chemistry, chemistry, biochemistry, and biology. Examples include light microscopies, scanning electron microscopy and materials analysis, x-ray spectroscopies, various spectroscopies used for molecular identification such as infrared and Raman spectroscopies, mass spectroscopy and chromatography, electrophoresis, forensic serology, DNA sequencing, and next generation techniques.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: Foundations of Science 1-4.
- Bulletin Categories: Physics: Electives

PHYS-UH 3219 Biological Physics: From single molecules to the cell (4 Credits)
Typically offered Spring
In this course students explore how biophysical approaches expanded our understanding of cellular processes beyond what is accessible using traditional techniques. Emphasis will be put on biologically relevant questions that state-of-the-art single molecule biophysical techniques were able to address. Topics include: biopolymer mechanics, protein-nucleic acid interaction, protein structure and dynamics, membrane dynamics, cytoskeletal dynamics, motor proteins, cell shape and motility, cell communication and cell-cell interaction, tissue mechanics. Understanding these processes will be framed within the realm of equilibrium and non-equilibrium statistical mechanics. Examples of single molecule experiments that allowed testing and extending concepts of statistical physics will be discussed.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: Foundations of Science 6 or Instructor approval.
- Bulletin Categories: Biology: Biophysics Required
- Bulletin Categories: Chemistry: Biophysics Required
- Bulletin Categories: Engineering Crosslisted Courses
- Bulletin Categories: Engineering: Bioengineering SCIENCE Electives
- Bulletin Categories: Physics: Biophysics Required
- Bulletin Categories: Physics: Electives
- Crosslisted with: Biology Major: Required
- Crosslisted with: Biology
- Crosslisted with: Chemistry Major: Required
- Crosslisted with: Chemistry
- Crosslisted with: Engineering Common Courses (ECC)
- Crosslisted with: Engineering
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3220 Imaging and Spectroscopy Lab (2 Credits)
Typically offered Spring
This course focuses on modern instrumentation for the UV, optical and infrared imaging and spectroscopy. We will cover the principles of operation of CCD and CMOS detectors, diffraction grating spectrographs, including their design and applications. Students will gain hands-on experience in data acquisition, processing, calibration and analysis. A comprehensive understanding of advanced imaging and spectroscopic technologies would allow students to contribute to research projects in a great variety of scientific or engineering fields. For the Physics students with specialization in Astronomy, this course will cover topics specific to modern space-based and ground-based telescopes. The lab exercises will include examples of imaging and spectroscopy applications in astronomy with emphasis on low signal to noise data. However, the course material is broader in scope and the data acquisition, reduction and analysis skills the students will gain are transferable skills for imaging and spectroscopy in general.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: Foundations of Science 5-6.
- Bulletin Categories: Engineering Crosslisted Courses
- Bulletin Categories: Engineering: Electrical Engineering Electives
- Bulletin Categories: Physics: Astrophysics Lab Electives
- Bulletin Categories: Physics: Electives
- Crosslisted with: Engineering Common Courses (ECC)
- Crosslisted with: Engineering
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3221 Radio Imaging and Time Series Lab (2 Credits)
Typically offered occasionally
This is a hands on course on the practical application of the wave and optics concepts of Foundations of Science 5-6 physics within a radio astronomy context and expands on the data analysis and other lab skills acquired in the scope of Foundations of Science 2 Physics Lab. It is complementary to the Advanced Physics Lab. The course has two main components. The first component focuses on practical single dish antenna and receiver knowledge with application to the time series analysis of pulsars and bright point sources. The second focuses on arrays of antennas used together as an interferometer, with imaging of compact and extended sources. In both components, the students will gain hands-on experience in observation design, data acquisition, processing, calibration and analysis.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Physics: Astrophysics Lab Electives
- Bulletin Categories: Physics: Electives

PHYS-UH 3222 X Ray Astronomy Lab (2 Credits)
Typically offered Spring
While humans can only (by definition) see optical light, interstellar objects emit light across the entire electromagnetic spectrum. X-ray photons are emitted by some of the most energetic objects in the Universe: plasmas with temperatures of millions of degrees, and charged particles traveling nearly at the speed of light interacting with magnetic fields. In this course, students will learn about the different classes of astronomical sources, how modern satellites detect and measure the properties of X-ray photons, and how to analyze and interpret the data from such instruments.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: Foundation of Science 5-6: Physics.
- Bulletin Categories: Physics: Astrophysics Lab Electives
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics

PHYS-UH 3260 Special Topics in Physics (4-5 Credits)
Typically offered occasionally
This course covers advanced topics in physics and astrophysics. Possible subjects are: cosmology, planetary systems, compact objects, galaxy formation, radio-astronomy, experimental particle physics. The topic may vary each semester, reflecting the research areas of faculty and based on the students' interest.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
- Bulletin Categories: Physics: Electives

PHYS-UH 4001 Capstone Project in Physics 1 (4 Credits)
Typically offered Fall and Spring
The senior capstone experience in Physics requires students to engage in a long-term, mentored learning experience that culminates in a piece of original research and/or scientific theory. The specific project is developed during their junior year as part of the Research Seminar in Physics.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: PHYS-UH 3090.
- Bulletin Categories: Physics: Capstone

PHYS-UH 4002 Capstone Project in Physics 2 (4 Credits)
Typically offered Fall and Spring
This course is a continuation of Capstone Project in Physics 1. During the Capstone Project in Physics 2, the proposed work comes to fruition in the form of a research paper along the lines of those in leading journals in the field. Students also participate in a capstone research symposium during which they present their work orally.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: PHYS-UH 4001.
- Bulletin Categories: Physics: Capstone

PHYS-UH 4212 Quantum Mechanics 2 (4 Credits)
Typically offered Spring
In this course, the quantum mechanical framework, introduced in Quantum Mechanics, is taken to a more advanced level. This course is indispensable to understand the origin of a wide range of atomic and elementary particle phenomena and to learn fundamental techniques used throughout physics. Students will explore time-independent and dependent perturbation theory, the variational principle, the WKB approximation, the adiabatic approximation, scattering processes. Applications of these formalisms to problems in atomic physics, nuclear physics, or astrophysics will also be explored.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: PHYS-UH 3012.
- Bulletin Categories: Physics: Electives

PHYS-UH 4215 Particle Physics (4 Credits)
Typically offered occasionally
Particle physics is the study of the fundamental constituents of matter and their interactions. It represents an indispensable tool for students wanting to pursue a career in high-energy physics, astrophysics, or are simply curious about the basic constituents of our world. The course introduces the experimental underpinnings and the theoretical developments of elementary particle physics. Topics include the discovery of elementary particles, symmetries found in nature, and relativistic formulation of quantum mechanics, leading up to the 'Standard Model'. Recent discoveries and theories beyond the Standard Model may also be discussed.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: PHYS-UH 3012.
- Bulletin Categories: Physics: Electives

PHYS-UH 4216 Nuclear Astrophysics (4 Credits)
Typically offered occasionally
This course is an introduction to understand the stellar evolution through nuclear reactions that enable nucleons to synthesize into different atoms. Topics discussed include nuclear models, especially the shell model, and nuclear reactions where notions of reaction cross section and rates are addressed. experimental concepts on nuclear reactions and detection techniques will also be tackled. In the second part of the course, the different nuclear burning stages a star can experience are introduced and at the end the astroparticle aspect is surveyed.
Grading: Ugrd Abu Dhabi Graded
Repeatable for additional credit: No
Prerequisites: PHYS-UH 3012.
- Bulletin Categories: Physics: Astrophysics Electives
- Bulletin Categories: Physics: Electives
- Crosslisted with: Physics Major: Required
- Crosslisted with: Physics