ASTROPHYSICS & SPACE SYSTEMS (APHY-GH)

APHY-GH 6010 Astrophysical Objects (4 Credits)
Typically offered Spring
Astronomy has led to the discovery of a plethora of fascinating objects in the universe, such as star clusters, extrasolar planets, protoplanetary disks, nebulae, neutron stars, black holes, numerous types of galaxies and galaxy clusters, quasars, blazars, voids, and explosive events such as novae, supernovae, gamma-ray bursts and tidal disruption events. Astrophysics is the application of fundamental physics to understand observations of the universe, and the usage of astronomical phenomena to study physics. Various phenomena are studied, focusing 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 that will be touched on include two-body and multi-body dynamics, stellar structure and evolution, nuclear fusion interactions, stellar atmospheres, extrasolar planetary systems, winds, shocks and ionization, accretion, magnetohydrodynamic systems, condensed matter and the consequences of strong gravity, gravitational wave emission, high energy particle acceleration, and dark matter and large scale structure dynamics, and consequences of general relativity to understand warped spacetime and the description of an expanding Universe. The physical processes include mechanics, electricity and magnetism, quantum and statistical mechanics, nuclear physics, particle physics, plasma physics, hydrodynamics, and both special and general relativity.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 6011 Detectors and Telescopes (4 Credits)
Typically offered Fall
This course describes the methods of astronomical visible light observation using imaging and spectroscopy techniques. It evaluates advanced processes in radiation and matter interaction. The focus is placed on soft- and high-energy radiation detection. Topics include general characteristics of radiation detectors, charged-coupled devices (CCD), sensor architecture, semiconductor detectors, and high-precision grating spectroscopy. In addition, students will study X-ray and Gamma-ray detectors in space, Gamma-ray detectors on the ground, Cosmic ray detectors in space, Cosmic ray detectors on the ground, neutrino experiments, and experimental techniques for gravitational waves detection. Signals and their transmission and electronics data acquisition will also be discussed. Finally, advanced topics in detection and spectroscopy will be presented and discussed in the form of term papers.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 6012 Radiative Processes (4 Credits)
Typically offered Fall
Our ability to understand the cosmos depends strongly on the physical mechanism by which astronomical objects generate the “messengers,” primarily photons (light) and charged particles, we detect. Our ability to detect and measure the properties of these messengers in turn depends strongly on the physical processes by which they interact with the detectors. The physical processes by which messengers are generated and detected are strongly related to each other. This course covers the fundamental physical processes responsible for creating photons and charged particles in astrophysical sources, affecting their properties as they propagate through space, and govern their detection. During this course, students will learn the quantitative techniques needed to relate the observed radiative properties of an object to its physical properties and that of the intervening medium, the measured radiative properties of a source to its physical characteristics, as well as how to expertly and effectively communicate the connection between detector technology and scientific advancements.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 6110 Astroparticle Lab (2 Credits)
Typically offered Fall
This course is the ideal experimental complement to “Detectors and Telescopes”. The students will assemble in the laboratory acquisition systems and test them taking data with natural or artificial radiation sources. Topics include the use of photomultipliers, silicon photomultipliers, scintillators, and related electronics.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 6111 Optical Spectrometry Lab (2 Credits)
Typically offered Spring
This course focuses on modern instrumentation for 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. The lab exercises will include examples of imaging and spectroscopy applications in astronomy and other space applications 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: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 6112 Optics and Photon Detection Lab (2 Credits)
Typically offered occasionally
This course focuses on recent developments in infrared (IR) photodetection systems and their applications. It brings together a variety of engineering disciplines that are required for the construction of an IR detection system. Students will receive a thorough understanding of sophisticated infrared photodetectors as well as the main physical principles employed in the development of various detector types and understand fundamental performance constraints. Figures of merits of infrared detectors, characterization, and coupling of infrared radiation will be studied. Intrinsic and extrinsic silicon and germanium detectors, III-V detectors, HgCdTe detectors, quantum well & quantum dot infrared photodetectors, and Focal-Plane Arrays are some of the key technologies to be understood.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 6113 Radio Astronomy Lab (2 Credits)
Typically offered occasionally
Objects in the Universe emit light across the entire electromagnetic (EM) spectrum. Therefore, a complete understanding of the physical processes responsible for this emission requires characterizing its properties over a wide range of wavelengths – the longest of which fall in the radio regime. Through lectures, lab exercises, quantitative problem sets, and analysis of data, students will learn both the tools and techniques used to detect, and then quantitatively measure the properties of, the radio emission from a wide range of astronomical sources, and the physical processes believed responsible for this emission, how to apply this knowledge to actual astronomical sources, and how to expertly communicate the results of such a complex analysis.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 6114 X-Ray Astronomy Lab (2 Credits)
Typically offered occasionally
Objects in the Universe emit light across the entire electromagnetic (EM) spectrum. Therefore, a complete understanding of the physical processes responsible for this emission requires characterizing its properties over a wide range of wavelengths – including X-rays, which are typically generated under physical conditions orders of magnitude more energetic than what can be recreated on Earth. Through lectures, lab exercises, quantitative problem sets, and analysis of data, students will learn both the tools and techniques used to detect, and then quantitatively measure the properties of, the X-ray emission from a wide range of astronomical sources, and the physical processes believed responsible for this emission, how to apply this knowledge to actual astronomical sources, and how to expertly communicate the results of such a complex analysis.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7010 Research Rotation I & II (4 Credits)
Typically offered occasionally
Advanced scientific research is at the foundation of the PhD in Astrophysics and Space Science. In this class the students will be asked to select a research topic or project to be developed and actuated in collaboration with one of the research units (labs or groups) participating in the PhD program. The goal is to train students to be able to carry out independent research from the conceptualization of the problem, to the solution analysis to the actual implementation of these solutions.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: Yes
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7011 Fluid Mechanics (4 Credits)
Typically offered occasionally
Understanding the physical processes which govern the complicated behavior of fluids is critical for understanding a wide range of physical phenomena. This course will cover the complex equations believed to describe such systems, the sophisticated techniques used to solve these solutions under a variety of conditions, and the important implications of these solutions for the relevant physical situations in which these conditions occur which are applicable to a numerous areas of advanced research.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7030 Astrochemistry (4 Credits)
Typically offered occasionally
This course will provide a comprehensive, yet thorough overview of astrochemistry, focused on the formation, interaction and destruction of the chemical elements, molecules and other species found in outer space. The disciplinary focus of the lecture component is at the intersection of astronomy and chemistry. The course content addresses topics of both astrochemistry and cosmochemistry, and the study of elements and other chemical species on the Solar System scale. This course will explore the interactions between interstellar and circumstellar molecules, as well as their potential relevance and impact on the current theories of the origin of life on Earth. Together we will explore and discuss complex processes leading to the formation of molecules ranging from simple diatomic molecules to complex astrobiologically important species (amino acids,peptides, sugars, nucleobases, and other molecules) in the interstellar medium and in our Solar System – both in the gas phase (molecular clouds, star-forming regions, atmospheres of planets and their moons), and in the solid state (interstellar grains, icy planets and moons, comets). Students will apply a comprehensive understanding of these processes in order to interpret data from astronomical observations and space missions to develop realistic models of how distinct interstellar and Solar System environments are processed chemically. Current misconceptions in astrochemistry and alternative explanations will also be highlighted and discussed.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7031 Astroparticle Physics (4 Credits)
Typically offered occasionally
This course gives an overview of the high energy phenomena occurring in the universe and how we can detect their "messengers" from Earth or space. Topics include the review of the interactions of particles and radiation with matter, the astrophysical sources of neutrinos, gamma rays and gravitational waves, and dark matter. For all these phenomena, an overview of the current experimental scenario will be given.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7032 Compact Objects (4 Credits)
Typically offered occasionally
Although most stars are stable, they represent a constant battle between expansion, from the energy produced by nuclear fusion in their interiors, and collapse, due to gravity crushing the matter to the center of the star. When a star finishes burning its fuel, gravity wins the battle, and the star collapses to form a compact object. These are most commonly white dwarfs, but for massive stars, extreme and exotic compact objects are formed, namely neutron stars or black holes. In this course, the different physical properties of compact objects are discussed, and understood in terms of the fundamental physical process involved, and the reasons for their existence. The course covers stellar evolution, the different forms of stellar death and explosions in isolated and binary systems, the formation of various types of compact objects, their growth and accretion physics, winds, outflows and magnetic fields, their detectability and feedback from supermassive black holes and their influence on galaxy evolution. Numerous physical processes related to high energy astrophysics are intricately involved with compact objects – students will learn to explain these complex processes both qualitatively and mathematically. Through on-going in class discussions, presentations and independent research, students will demonstrate highly developed expert communication skills in explaining, and critiquing the appearance of behavior of compact objects and the physical processes associated with them.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7033 Foundations of Spacetime (4 Credits)
Typically offered occasionally
This course is a mathematically rigorous introduction to some of the central conceptual questions about the nature of spacetime arising within the foundations of physics. Should spacetime be understood as a 'thing' or 'entity' that exists in the same sense as matter, or is it rather better understood as somehow derivative or constructed---as cognitive scaffolding that is useful in formulating theories but which doesn't exist in the same sense as the physical entities posited by those theories? Does this distinction exhaust the available options? We will look at a variety of attitudes one might take towards the nature of spacetime, and consider both how our best physical theories bear on those attitudes and how those attitudes in turn bear on our best physical theories. To familiarize ourselves with the central positions, arguments, and lines of reasoning, we will start in the classical regime before extending the discussion to relativity theory. Along the way we will consider how the issues evolve, what new interpretive questions arise, and the implications that this set of conceptual debates has for the development of future physics.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7034 General Relativity (4 Credits)
Typically offered occasionally
This is an advanced graduate course that presents, develops, and analyzes the foundations of Einstein's theory of General Relativity. Exploring the fundamentals of the force of gravity, with emphasis on modern perspectives, we will explore spacetime and the value of the predictions of the theory developed by Albert Einstein. Topics covered in the first half of the course include modern applied differential geometry, tensor analysis, curved spacetime, curvature, the Principle of Equivalence, Classical Field Theory, and the stress-energy tensor, as well as the foundations of General Relativity and derivation of Einstein's equation from fundamental action principles. The second half of the course explores the physical consequences, applications, and experimental tests of Einstein's theory in the context of Astrophysics and Cosmology: black holes, neutron stars, and Solar System tests of gravitation. Students will develop comprehensive, deep, and overarching knowledge of the theory of relativity at the frontier of the discipline. This class lays the foundations for further investigations in black hole theory, quantum gravity, and cosmology.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7035 High Energy Astrophysics (4 Credits)
Typically offered occasionally
This course covers high energy processes and their application to astrophysical systems and phenomena. How processes, including synchrotron radiation, bremsstrahlung, Thomson and Compton scattering, particle acceleration, pair production, and accretion, contribute to emission from white dwarfs, neutron stars and pulsars, supernovae and supernova remnants, pulsar wind nebulae, gamma ray bursts, X-ray binaries, active galactic nuclei (AGN), and galaxy clusters, will be discussed.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7036 Numerical Methods in Astrophysics (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 astrophysics, including numerical solution of ordinary and partial differential equations, eigenvalue problems, Monte Carlo methods in statistical mechanics, dynamical systems, fluid dynamics, and radiative transfer
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7037 Observational Cosmology (4 Credits)
Typically offered occasionally
For a few years now, cosmology has a standard model. By this term, we mean a consistent theoretical background which is at the same time simple and broad enough to offer coherent explanations for the vast majority of cosmological phenomena. The course will start presenting the concepts that define the cosmological landscape. It will explain the fundamental assumption of homogeneity and isotropy on which cosmology is based, along with the main equations that govern the cosmic expansion. It will then present and discuss several different cosmological observations, including large scale structure, CMB, weak lensing, galaxy clusters, galaxy clustering, focusing on their results on the evolution of the Universe and its contents. It will then address the questions about the origin and the future of the Universe and the structures it contains.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7038 Planetary Formation and Evolution (4 Credits)
Typically offered occasionally
This course will present an overview of planetary formation and evolution, with particular focus on extrasolar systems. We will begin with a review of the solar system and the basic properties of extrasolar planetary systems. We will then study the formation and evolution of the host star in the context of the early stages of planet formation. We will focus on the evolution of the protoplanetary disk and its influence on planet growth and stability. Next we will explore planet formation and evolution of both gas-giant planets and terrestrial planets, including gravitational interactions and structural evolution. Finally, we will explore planetary atmospheres, focusing primarily on characterized extrasolar atmospheres. We will understand the underlying dynamics, radiative transfer, and observational constraints. Students will gain knowledge of several numerical techniques throughout the course by both developing a few numerical models of their own and also utilizing available numerical packages. The goal of the course is for students to become familiar with the current state of the art in the theory of planet formation and evolution. They should be able to understand content and context of current articles in the field and be prepared for introductory research in the field.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7039 Quantum Gravity and Cosmology (4 Credits)
Typically offered occasionally
The goal of this course is to introduce applied aspects of quantum gravity to give answers on the short-distance behavior of gravitational interactions. Probing the high-energy and high-curvature regimes of gravitating systems can shed some light on fundamental problems of classical gravity such as the initial big-bang singularity, the cosmological constant problem and the physics at and beyond the Planck scale. On the other hand, it can give vital information on the early-time inflationary evolution of our Universe and might shed some light on dark matter and energy. The course will not delve into conceptual and philosophical aspects but rather serve as a practical toolkit for students who want to see how quantum effects change the classical picture on cosmology, with tangible predictions. These include gravitational waves, the Hawking effect, the Casimir effect, and the Unruh effect. We will also work out the quantization of classical cosmological models.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7040 Theory of Galaxy Formation (4 Credits)
Typically offered occasionally
This course prepares the student for state-of-the-art research in galaxy formation and evolution. The course focuses on the physical processes underlying the formation and evolution of galaxies in a LCDM cosmology. Topics include Newtonian perturbation theory, the spherical collapse model, formation and structure of dark matter haloes (including Press-Schechter theory), the virial theorem, dynamical friction, cooling processes, theory of star formation, feedback processes, elements of stellar population synthesis, chemical evo- lution modeling, AGN, and supermassive black holes. The course also includes a detailed treatment of statistical tools used to describe the large-scale distribution of galaxies and introduces the student to the concepts of galaxy bias and halo occupation modeling. During the final lectures we will discuss a number of outstanding issues in galaxy formation, and the students will present and discuss their term paper on a current topic in the field of galaxy formation & evolution.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7060 Human-Computer Interaction and Tangible Interfaces (4 Credits)
Typically offered occasionally
The course covers the fundamental concepts of psychological principles of human-computer interaction, evaluation methods, usability engineering, user-centered design and prototyping, interaction paradigms and models, tangible interfaces that provide physical interaction with digital information. Topics covered include: graphical user interface design and evaluation, multimodal interaction design (touch, gesture, gaze, spatial audio, natural language, etc.), virtual reality, and spatial displays. In addition to lectures, students will work on assignments and a term project to design, implement, and evaluate interactive systems for space applications based on knowledge culled from the covered class material and research.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7061 Radiation Transport (4 Credits)
Typically offered occasionally
The objective of the course is to address comprehensive, deep and overarching knowledge of the transport of radiation, and to master modeling, analysis, and numerical techniques for computing transport, as well as inferring system properties from sparse detector readings. The cosmos is primarily observed and mapped by detecting and assessing the electromagnetic radiation spectrum from objects of interest. Detectors, either terrestrial or located in space, are usually far from the source and the radiation has to travel large distances to reach the detectors. This course will cover the transport of radiation through various media such as interstellar dust, planetary atmospheres and oceans, and others, both from a fundamental physical / mathematical modeling perspective and numerical solution / simulation methods. Fundamentals of the highly complex scattering and absorption processes that attenuate and scatter electromagnetic signals will also be covered. Mathematical and numerical techniques to map the properties and characteristics of the system from limited detector readings will be studied and evaluated. Both steady and time-varying radiation will be addressed. This course builds on the fundamental course “Radiative Processes” that covered the physical processes governing the emission and absorption of radiation.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7062 Space Economy and Sustainability (4 Credits)
Typically offered occasionally
This course prepares the student for state-of-the-art knowledge on the space economy and sustainability. Outer space affairs are highly interdisciplinary, and in need of cross-cutting competencies. Space and non space technologies and related skills are on the rise, as it is the integration between new frontier technologies such as AI, robotics, biotechnologies, etc and the three main space technologies, namely Earth Observation, geolocation and satcoms. On the side of sustainability, we will look at sustainability in space and sustainability on earth applying space research, technologies and applications. Space can benefit agriculture, public health, education, disaster management, smart cities, food and water security, and/or climate variables monitoring. The Space economy is expected to become a trillion dollar economy by 2040 (report from Bank of America), and “made in space” may exist soon. The democratization of space implies an increasing access to space and brings with it the need to maintain the safety, security and sustainability of outer space activities in the long term, in the framework of a space traffic coordination mechanism and a stable global governance in the field, to ensure a commercial safe space environment. Sustainability, green economy and space economy are therefore strictly interconnected and represent one of the pillars to ensure a reliable future for humanity. During the final lectures we will discuss a number of outstanding issues, and the students will present and discuss their term paper on a current topic in the field of space economy and sustainability.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7063 Space Instrumentation (4 Credits)
Typically offered occasionally
Developing instrumentation systems for space requires multidisciplinary knowledge that bridges science to engineering, starting from formulating a science enquiry, then deriving the measurement specifications, and finally developing the instrument to meet the set specifications. This course introduces instrumentation for space applications, linking the science goals to measurement requirements, selecting the method of measurement, and defining the key characteristic of the instrument. The course covers three fundamental elements to building space instruments: (1) understanding the space environment and how it influences the design and performance of the instrument, (2) knowledge of basic detectors, their principle of operation, capabilities and limitations, and (3) familiarity with measurement techniques and the capabilities of existing instruments. A term project will be utilized to explore specific instrumentation applications in space.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7064 Space Robotics (4 Credits)
Typically offered occasionally
This class provides an overview for robot manipulators typically encountered in space applications. These can be either fixed to the ground or in a moving platform (spacecraft). The course covers: (1) homogeneous transformations, (2) Denavit-Hartenberg coordinate frame description, (3) Manipulator kinematics, (4) Manipulator dynamics, (5) Motion planning, (6) Motion control, (7) Force control, (8) Floating-base manipulators, (8) Flexible-link manipulators, (9) Robot simulation. The course targets robot arms employed in space applications and the term project will be used to explore the aforementioned issues.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7065 Spacecraft Dynamics and Control (4 Credits)
Typically offered occasionally
This class provides an overview for orbital mechanics and spacecraft dynamics and control. The two-body and three-body problems are analyzed, leading to parabolic, elliptical and rectilinear orbits. Lambert's problem is examined in transferring orbits between specified points. Relative motion and rendezvous, Rigid Body dynamics with applications to rocket dynamics with payloads and staging along with impulsive control, Satellite Attitude Dynamics, Rocket vehicle dynamics and control
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7066 Teleoperation (4 Credits)
Typically offered occasionally
This course presents the latest development in the field of teleoperation systems, with special emphasis on haptic teleoperation in space. Teleoperation systems with haptic interfaces allow humans to feel and physically manipulate virtual and remote environments. These systems have applications in many areas, including computer-assisted and simulated surgery, exploration of hazardous or remote environments, micro/nano manipulation, education and entertainment. The course is organized into lectures, readings and discussions on classical and current topics in teleoperation, and a term project. Through the lectures, readings, and discussion, students will learn to think critically about prior work presented in the teleoperation literature as well as their own work. Through the project, students will create/recreate an advanced teleoperation system involving haptic interaction.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7067 Turbulence (4 Credits)
Typically offered occasionally
Turbulence is commonly observed in everyday phenomena such as surf, fast flowing rivers, billowing storm clouds, or smoke from a chimney, and most fluid flows occurring in nature or created in engineering applications are turbulent. This course presents the complex properties of turbulence: Random vortical fluctuating structures over a large range of length- and time-scales. We will analyze the importance of turbulent mixing and transport of momentum in practical flows. Students will be exposed to the complex theoretical, numerical and experimental techniques used to describe and quantify the effects of turbulence. Particular attention will be given to applications of turbulence theory in astrophysics, including stellar physics and fluid-dynamics.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: No
- Crosslisted with: Astrophysics and Space Systems PhD

APHY-GH 7090 Dissertation Research: Astrophysics and Space Systems (4-9 Credits)
Typically offered occasionally
The Qualifying Examination marks the student's formal entry into dissertation research under the supervision of a thesis advisor. The dissertation research credits are an independent study performed by the student with a meeting schedule that will be agreed on by mentor and student. The PhD thesis is the coronation of the PhD journey of every student. Students will be asked to write a comprehensive thesis that will not only present the results of the PhD work done in the program but also situate it in the current direction of the chosen research field with particular attention to possible long term outcomes of the performed research. Students may earn up to 9 credits per semester for research towards the PhD Thesis, up to a maximum of 30 credits. After a student has reached 30 credits then Maintenance of Matriculation will be utilized to maintain full-time registration as needed until the PhD defense is completed. Note: This course is repeatable for credits.
Grading: Grad Abu Dhabi Graded
Repeatable for additional credit: Yes
- Bulletin Categories: Astrophysics Space PhD: Required
- Crosslisted with: Astrophysics and Space Systems PhD