ASTRONOMY (ASTR)

ASTR 1810 Introduction to Astronomy: The Magnificent Universe 3 cr
(Lab required) This introductory astronomy course surveys our magnificent Universe. The topics covered in this course outline the properties of stars and planets that can be observed and the physics necessary to interpret these observations. It also includes an introduction to galaxies and cosmology. Using lectures and laboratory sections, it provides an astronomy background and introduction to the scientific method. It ranges from introductory physical background to considering current research problems. This course is taught with algebra and trigonometry used frequently. May not be held with the former PHYS 1810.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: (one of Physics 40S, PHYS 0900 (P), PSKL 0100 (P), PHYS 1018, or equivalent) and (one of Pre-calculus Mathematics 40S (70% or better), Applied Mathematics 40S (70% or better), MSKL 0100, MATH 1018, or equivalent). It is strongly recommended that students attain a minimum of 70% as the average of their marks in Physics 40S and Pre-calculus Mathematics 40S.
Equiv To: PHYS 1810
Attributes: Science, Recommended Intro Courses

ASTR 1830 Life in the Universe 3 cr
This descriptive, general interest course explores the topic of life in the universe. Some of the following topics will be covered. (1) Some astronomy fundamentals (gravity, light). (2) The solar system (an introduction to the solar system, the formation of the solar system, the origin of life on Earth, extremophiles, the conditions needed for life, possible locations for life in the solar system). (3) Exoplanets (discovery methods, properties of detected Exoplanets, the Habitable Zone). (4) Star system formation (pre-stellar disks, planetary migration). (5) The Interstellar medium (nebulae, molecular clouds). (6) Our Milky Way galaxy as an environment for life and the Drake Equation. (7) The Search for Extra Terrestrial Intelligence (SETI). This course is qualitative with simple arithmetic and trigonometry used occasionally. May not be held with the former PHYS 1830.
Equiv To: PHYS 1830
Attributes: Science, Recommended Intro Courses

ASTR 2000 Foundations of Astrophysics 3 cr
This course covers the foundations of astrophysics, with emphasis on the core physical principles and processes that govern astronomical phenomena. The course emphasizes how the physics of matter, radiation, gravity, magnetic fields, and the interaction between light and matter can be used to understand a range of astrophysical phenomena, including fundamental processes, fascinating energetic objects, and topics at the forefront of modern research.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: (one of PHYS 1070, PHYS 1071, or PHYS 2152) or (a "C+" or better in PHYS 1030 or PHYS 1031) and (one of MATH 1232, MATH 1690, MATH 1700, MATH 1701, MATH 1710, or the former MATH 1730) or permission of the department. ASTR 1810 is recommended.
Attributes: Science

ASTR 2070 Observational Astronomy Techniques 3 cr
(Lab Required) Students will learn the basic astronomy tools and practical concepts pertaining to observational astronomy. Lecture topics include spectroscopy, the optics of mirrors and lenses relevant to telescopes, types of telescopes, and factors that affect the quality of astronomical observations. The practical aspects include observational project development, and hands-on telescope experience using the University of Manitoba's Ewen Campus Observatory (ECO) and the Glenlea Astronomical Observatory (GAO) as well as smaller 8-inch portable telescopes. May not be held with the former PHYS 2070.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: (one of PHYS 1070, PHYS 1071, or PHYS 2152) or (a "C+" or better in PHYS 1030 or PHYS 1031) and (one of MATH 1232, MATH 1690, MATH 1700, MATH 1701, MATH 1710, or the former MATH 1730) and (one of ASTR 1810, the former PHYS 1810, ASTR 1830, the former PHYS 1830, or ASTR 2000) or permission of the department.
Mutually Exclusive: PHYS 2070
Attributes: Science

ASTR 3070 Observational Astronomy Project 3 cr
(Lab Required) Students will learn to develop and execute an observational research project. Students will choose their research topic with the constraint that the data be collected using the University of Manitoba's Astronomical Observatory at Glenlea Astronomical Observatory and the Ewen Campus Telescopes. The optical observational data will be supplemented by archival data from professional research telescopes such as the Hubble Space Telescope, Chandra X-ray Observatory and others. The course covers the determination of observational constraints, the use of filters, methods of data analysis, and interpretation of results. The research project will be written into a report and presented.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ASTR 2070 or the former PHYS 2070 or permission of the department.
Attributes: Science

ASTR 3180 Stars 3 cr
This course provides an overview of the physics of stars, including all phases of stellar evolution: from star formation, to the main-sequence phase, to star death, to the formation of degenerate or compact remnants such as white dwarfs, neutron stars and black holes. Topics include radiative transfer, stellar structure and atmosphere, nuclear fusion, stellar evolution, degenerate stars, and other exotic forms of compact stellar remnants. May not be held with the former PHYS 3180.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ASTR 2000 or permission of the department.
Equiv To: PHYS 3180
Attributes: Science

ASTR 3230 The Phenomenology of Galaxies 3 cr
This course investigates galaxies from the perspective of recent observational data, exploring characteristics that theories have yet to explain. Topics include sources of their radiation, such as stars, gas and dust; their structure and kinematics, which indicate the existence of dark matter; and their formation and evolution, which has implications for cosmological studies. May not be held with the former PHYS 4230.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: ASTR 2000 or permission of the department. ASTR 2070 or ASTR 3180 is recommended.
Mutually Exclusive: PHYS 4230
Attributes: Science

ASTR 4020 Cosmology and Black Holes 3 cr
Topics include static solutions of Einstein's equations, gravitational waves, static models for stars (white dwarfs, neutron stars), dynamic models for stars (Birkhoff theorem, black holes), and cosmology (Robertson-Walker metric, Friedmann equations). Further topics discussed in the course are cosmic inflation, dark matter and energy, as well as large-scale structure of the universe. May not be held with the former PHYS 4020.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisite: PHYS 4010.
Equiv To: PHYS 4020
Mutually Exclusive: ASTR 7020
Attributes: Science

ASTR 4100 High-Energy Astrophysics 3 cr
This course provides an overview of the field of high-energy astrophysics and of high-energy missions, with emphasis on X-ray and gamma-ray astrophysical sources and relevant radiation processes. Radiation and high-energy processes include synchrotron radiation, bremsstrahlung, Inverse Compton scattering, pion decay, and particle acceleration. Astrophysical sources include accreting compact objects, supernovae and their remnants, gamma-ray bursts, and clusters of galaxies. The course can include topics relevant to nuclear astrophysics and will train students in writing observing proposals for high-energy facilities. May not be held with PHYS 4300 when the topic is "High-Energy Astrophysics".
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: (PHYS 2386 or the former PHYS 2380) and PHYS 2600 and PHYS 3670. ASTR 2000 is recommended.
Mutually Exclusive: ASTR 7100, PHYS 4300
Attributes: Science

ASTR 4200 Radio Astronomy 3 cr
This course will provide an introduction to observational radio astronomy and processes in radio astrophysics. Topics will include: an introduction to radio astronomy; basic radiative transfer; blackbody radiation and radiation from an accelerated charge; radio telescopes, receivers, and interferometers; thermal continuum sources (e.g., HII regions); non-thermal continuum sources (e.g., radio galaxies); pulsars; and spectral-line sources (e.g., the 21 cm line, radio recombination lines, and rotational energy transitions in simple molecules). May not be held with PHYS 4300 when the topic taught is "Radio Astronomy."
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: (PHYS 2386 or the former PHYS 2380) and PHYS 2600 and PHYS 3670. ASTR 2000 is recommended.
Mutually Exclusive: ASTR 7200, PHYS 4300
Attributes: Science

ASTR 4400 Magnetohydrodynamics, Astrophysical Plasmas, and the Interstellar Medium 3 cr
This course develops a theoretical understanding of interstellar magnetic fields for a diverse range of astrophysical objects, processes, and phenomena. The theoretical aspects of magnetohydrodynamics (MHD), including waves, shocks, instabilities, and turbulence are discussed. MHD and plasma physics are applied to the magneto-ionic interstellar medium of our galaxy, including supernova remnants. Magnetic fields in molecular clouds and cores are examined, with emphasis on their role in star formation. The course also develops a theoretical foundation for the physics of cosmic ray diffusion and acceleration.
PR/CR: A minimum grade of C is required unless otherwise indicated.
Prerequisites: PHYS 3630 and PHYS 3670.
Mutually Exclusive: ASTR 7400
Attributes: Science