ASTR - ASTRONOMY

ASTR100 Introduction to Astronomy (3 Credits)
An elementary course in descriptive astronomy, especially appropriate for non-science students. Topics include the Sun, Moon, planets, stars, and nebulæ, galaxies, and evolution of the Universe.
Credit Only Granted for: ASTR100, ASTR101, or ASTR120.

ASTR101 General Astronomy (4 Credits)
Descriptive astronomy, appropriate for non-science majors. Sun, moon, planets, stars, nebulæ, galaxies and evolution. Laboratory exercises include use of photographic material, computer simulations, and standard laboratory equipment.
Credit Only Granted for: ASTR100, ASTR101, or ASTR120.

ASTR120 Introductory Astrophysics - Solar System (3 Credits)
For students majoring in astronomy or with a strong interest in science. Topics include development of astronomy, planetary orbits, electromagnetic radiation, telescopes as well as constituents and origin of the solar system (planets, satellites, comets, asteroids, meteoroids, etc.).
Prerequisite: Must have completed or be concurrently enrolled in MATH140.
Restriction: Must not have completed ASTR101 or ASTR100.
Credit Only Granted for: ASTR100, ASTR101, or ASTR120.

ASTR121 Introductory Astrophysics II - Stars and Beyond (4 Credits)
For students majoring in astronomy or with a strong interest in science. Includes instrumentation, stellar properties, stellar evolution, structure of the galaxy, other galaxies, large scale structure, Big Bang Theory, and future of the universe.
Prerequisite: ASTR120 and MATH140; or permission of CMNS-Astronomy department.

ASTR220 Collisions in Space - The Threat of Asteroid Impacts (3 Credits)
Appropriate for non-science majors. Worried? Can't sleep? Collisions in Space will evaluate the threat of asteroid impacts with the Earth using knowledge of asteroid characteristics and orbits. The merits of possible defense plans will be discussed, as well as the budgetary and political concerns associated with implementing any such plan.
Restriction: Must not be in Astronomy program.
Additional Information: Course is open to Astronomy and Planetary Sciences minors.

ASTR230 The Science and Fiction of Planetary Systems (3 Credits)
Have you ever wondered if humans will ever terraform Mars or Europa so we could live there without a spacesuit? Has it ever crossed your mind how lucky you are that you live on a water-rich planet with an oxygen-rich atmosphere? Have you ever suspected novelists and scriptwriters of creating ridiculous planets that violate scientific laws? Does the fate of our planet's thin biosphere keep you up at night? How common is life in the Universe? These are difficult questions, but armed with the right information, you can answer all of them. The Science and Fiction of Planetary Systems will help you develop a deeper understanding of why planets are the way they are. Along the way, you'll see examples of mistakes made in classic science fiction movies, novels and short stories and get the chance to invent your own plausible planets!
Prerequisite: Must have math eligibility of MATH115 or higher; or MATH113.

ASTR288 Special Projects in Astronomy (1-3 Credits)
Independent study, short research projects, and assisting with faculty research and teaching under special supervision.
Prerequisite: Permission of CMNS-Astronomy department.
Repeatable to: 6 credits.

ASTR300 Stars and Stellar Systems (3 Credits)
Designed primarily for non-science majors. Study of stars-types, properties, evolution, and distribution in space; supernovae, pulsars, and black holes.
Prerequisite: ASTR100 or ASTR101; and completion of the CORE Distributive Studies requirement in Mathematics and Sciences or General Education Fundamental Studies requirement in Mathematics. Or permission of CMNS-Astronomy department.

ASTR305 Astronomy and the Media (3 Credits)
Although science plays a central role in modern life, the media can present scientific discoveries and thought as too complex and arcane for intelligent laypeople to understand. This has the effect of excluding non-scientists from this important intellectual discourse and sometimes of even manipulating their views. This course uses astronomy (and other science) news stories to give students the tools and motivation to critically evaluate scientific news for themselves, enabling them to use the media to keep abreast of science throughout their lives.

ASTR310 Observational Astronomy (4 Credits)
Introduction to current optical observational techniques, with brief coverage of infrared, ultraviolet, and x-ray techniques. Statistics, spherical trigonometry time, catalogs, geometrical and physical optics, telescopes, and optical instruments. Effects of the atmosphere. Practical work at the observatory using a CCD camera. Some nighttime observing sessions.
Prerequisite: ASTR121; and (PHYS171 or PHYS161). Or permission of CMNS-Astronomy department.
Restriction: Must be in Astronomy program.

ASTR315 Astronomy in Practice (4 Credits)
Appropriate for non-science majors. Study of stars-types, properties, evolution, and distribution in space; supernovae, pulsars, and black holes.
Prerequisite: Must have completed or be concurrently enrolled in ASTR120.

ASTR320 Theoretical Astrophysics (3 Credits)
Application of selected physics concepts in an astrophysical context. Topics would include gravity (Keplerian motion, Virial theorem, Roche limit, dynamical friction); gas dynamics (hydrostatic equilibrium, stellar models, spiral density waves), thermodynamics and statistical physics (Boltzmann distribution, Wien displacement, convective instability, degenerate gas); atomic physics (quantum principles, H atom, permitted and forbidden lines); radiation processes (line radiation, opacity).
Prerequisite: ASTR121; and (PHYS270 and PHYS271; or PHYS273). Or permission of CMNS-Astronomy department.

ASTR330 The History of Astronomy (3 Credits)
Study of the development of astronomical thought from the earliest record to the present day. Emphasis on major figures, events, and trends.
Restriction: Must be in Astronomy program.

ASTR340 Topics in Astronomy (3 Credits)
Topics vary. Possible topics include: stellar evolution; galactic structure and evolution; and black holes.
Restriction: Must be in Astronomy program.

ASTR350 Research Training in Astronomy (3 Credits)
Independent study, short research projects, tutorial reading, and assisting with faculty research and teaching under special supervision.
Prerequisite: Permission of CMNS-Astronomy department.
Repeatable to: 6 credits.

ASTR360 Celestial Mechanics (3 Credits)
Study of the dynamics of celestial objects, including the orbits of planets and satellites.
Prerequisite: ASTR120 and MATH140; or permission of CMNS-Astronomy department.

ASTR388 Special Projects in Astronomy (1-3 Credits)
Independent study, short research projects, and assisting with faculty research and teaching under special supervision.
Prerequisite: Permission of CMNS-Astronomy department.
Repeatable to: 6 credits.

ASTR490 Undergraduate thesis (2-3 Credits)
Research project in an area not covered in current courses.
Prerequisite: Permission of CMNS-Astronomy department.
Repeatable to: 6 credits.

ASTR394 Special Topics in Astronomy (1-3 Credits)
Topics vary. Possible topics include: stellar evolution; galactic structure and evolution; and black holes.
Restriction: Must be in Astronomy program.

ASTR398 Independent Study (1-3 Credits)
Independent study, short research projects, tutorial reading, and assisting with faculty research and teaching under special supervision.
Prerequisite: Permission of CMNS-Astronomy department.
Repeatable to: 6 credits.

ASTR490 Undergraduate thesis (2-3 Credits)
Research project in an area not covered in current courses.
Prerequisite: Permission of CMNS-Astronomy department.
Repeatable to: 6 credits.
ASTR330 Solar System Astronomy (3 Credits)
Designed primarily for non-science majors. The structure of planets and
of their atmospheres, the nature of comets, asteroids, and satellites.
Comparison of various theories for the origin of the solar system.
Emphasis on a description of recent data and interpretation.
Prerequisite: ASTR100 or ASTR101; and completion of the CORE
Distributive Studies requirement in Mathematics and Sciences or the
General Education Fundamental Studies requirement in Mathematics. Or
permission of CMNS-Astronomy department.
Credit Only Granted for: ASTR330 or GEOL212.

ASTR340 Origin of the Universe (3 Credits)
Designed primarily for non-science majors. A study of our progression
of knowledge about the universe. Topics include: early cosmological
models, geocentric vs. heliocentric theory, curvature of space, Hubble’s
Law, Big Bang Theory, microwave background radiation, evolution of stars
and galaxies, dark matter, active galaxies, quasars and the future of the
universe.
Prerequisite: ASTR100 or ASTR101; and completion of the CORE
Distributive Studies requirement in Mathematics and Sciences or
General Education Fundamental Studies requirement in Mathematics. Or
permission of CMNS-Astronomy department.

ASTR350 Black Holes (3 Credits)
Black holes are the most exotic prediction of Einstein’s Theory of General
Relativity and, amazingly, the Universe seems to manufacture these
bizarre objects in copious numbers. As well as being the ultimate
laboratory for studying the nature of space and time, they drive some of
the most energetic and extreme phenomena known to astronomers (with
quasars and gamma-ray bursts being just a couple of examples). In this
introduction to the physics and astrophysics of black holes, we start by
examining the basic physics of black holes, which fundamentally means
understanding gravity. We then look at the nature of stellar-mass black
holes and supermassive black holes. We will discuss the fairly recent
realization that black holes may be crucial agents for regulating the
growth of galaxies. Finally, we dive into the realm of theoretical physics
and probe how black holes may provide a route for uncovering new laws
of physics governing the structure of space and time.
Prerequisite: ASTR100 or ASTR101; and completion of the CORE
Distributive Studies requirement in Mathematics and Sciences or
General Education Fundamental Studies requirement in Mathematics. Or
permission of CMNS-Astronomy department.
Credit Only Granted for: ASTR 398B or ASTR 350.
Formerly: ASTR 398B.

ASTR380 Life in the Universe - Astrobiology (3 Credits)
Designed primarily for non-science majors. Study of the astronomical
perspective on the conditions for the origin and existence of life in the
universe.

ASTR386 Experiential Learning (1-3 Credits)
Restriction: Junior standing or higher; and permission of CMNS-
Astronomy department.

ASTR398 Special Topics in Astronomy (3 Credits)
This course is designed primarily for students not majoring in astronomy
and is suitable for nonscience students. It will concentrate study in some
limited field in astronomy which will vary from semester to semester.
Possible subjects for study are the solar system, extragalactic astronomy
and cosmology, the inconstant universe.
Restriction: Junior standing or higher; or permission of CMNS-Astronomy
department.
Repeatable to: 6 credits if content differs.

ASTR399 Honors Seminar (1-16 Credits)
Credit according to work done.
Restriction: Must be admitted to the departmental honors program in
astronomy.

ASTR406 Stellar Structure and Evolution (3 Credits)
Study of stellar internal structure, nuclear reactions, and energy
transport. Study of stellar evolution of both low-mass and high-mass
stars, including the stellar end states of white dwarfs, neutron stars, and
black holes.
Prerequisite: ASTR320; or permission of CMNS-Astronomy department.
Credit Only Granted for: ASTR 498N or ASTR 406.
Formerly: ASTR 498N.

ASTR410 Radio Astronomy (3 Credits)
Introduction to current observational techniques in radio astronomy.
The radio sky, radiophysics, coordinates and catalogs, antenna theory,
Fourier transforms, interferometry and arrays, aperture synthesis, and
radio detectors.
Prerequisite: ASTR121; and (PHYS271 and PHYS270; or PHYS273). Or
permission of CMNS-Astronomy department.

ASTR415 Computational Astrophysics (3 Credits)
Introduction to the most important computational techniques being used
in research in astrophysics. Topics include modern high performance
computer architectures, scientific visualization and data analysis, and
detailed descriptions of numerical algorithms for the solution to a wide
range of mathematical systems important in astrophysics.
Prerequisite: ASTR121; and (PHYS271 and PHYS270; or PHYS273). Or
permission of CMNS-Astronomy department. Jointly offered with
ASTR615.
Credit Only Granted for: ASTR415 or ASTR615.

ASTR421 Galaxies (3 Credits)
Introduction to structure, kinematics, and dynamics of normal and
peculiar galaxies. Quantitative descriptions of normal spiral galaxies
(like our Milky Way) and elliptical galaxies will be followed by more exotic
considerations such as interacting and merging galaxies, and active
galactic nuclei.
Prerequisite: ASTR121; and (PHYS271 and PHYS270; or PHYS273). Or
permission of CMNS-Astronomy department.

ASTR422 Cosmology (3 Credits)
Introduction to modern cosmology. Topics include large scale structure
of universe, the intergalactic medium, the nature of dark matter
cosmological models and galaxy formation.
Prerequisite: Must have completed or be concurrently enrolled in
ASTR320; or permission of CMNS-Astronomy department.

ASTR430 The Solar System (3 Credits)
Formation and evolution of the Solar System. Planetary surfaces,
interiors, atmospheres, and magnetospheres. Asteroids, comets,
planetary satellites, and ring systems. Emphasis on using basic physics
to understand observed properties of the Solar System. Intended for
students majoring in the physical sciences.
Prerequisite: ASTR121; and (PHYS271 and PHYS270; or PHYS273). Or
permission of CMNS-Astronomy department.
ASTR435 Astrophysics of Exoplanets (3 Credits)
Introduction to exoplanets. Topics include historical development, advantages, and limitations of detection methods, the statistics of exoplanet characteristics, the bulk properties of known exoplanets, and remote sensing for characterization of exoplanets.
**Prerequisite:** ASTR121; and (PHYS273; or (PHYS270 and PHYS271)). Or permission of CMNS-Astronomy department.
**Credit Only Granted for:** ASTR 498X or ASTR 435.
**Formerly:** ASTR 498X.

ASTR450 Orbital Dynamics (3 Credits)
Vectorial mechanics, motion in a central force field, gravitational and non-gravitational forces, the two-body and three-body problems, orbital elements and orbital perturbation theory, resonances in the solar system, chaos. Intended for students majoring in any of the physical sciences.
**Prerequisite:** Must have completed or be concurrently enrolled in ASTR320; or permission of CMNS-Astronomy department.

ASTR480 High Energy Astrophysics (3 Credits)
The structure, formation, and astrophysics of compact objects, such as white dwarfs, neutron stars, and black holes, are examined. Phenomena such as supernovae and high-energy particles are also covered.
**Prerequisite:** Must have completed or be concurrently enrolled in ASTR320; or permission of CMNS-Astronomy department.

ASTR498 Special Problems in Astronomy (1-6 Credits)
Research or special study. Credit according to work done.
**Restriction:** Must be in one of the following programs (Physics; Astronomy); and permission of CMNS-Astronomy department.