

ASTRONOMY (ASTR)

ASTR 100 - EXPLORING THE COSMOS

Short Title: EXPLORING THE COSMOS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Seminar

Credit Hour: 1

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Description: Introduction to concepts, methods and discoveries of astronomy and astrophysics, with a theme to be chosen from the frontier topics of modern astrophysics. Will emphasize student presentations. Designed for first year students interested in science or engineering, but other majors are welcome.

ASTR 101 - STARS, GALAXIES, AND THE UNIVERSE

Short Title: STARS, GALAXIES & THE UNIVERSE

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Distribution Group: Distribution Group III

Credit Hours: 3

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Description: An introductory course for students in academic programs. The formation, evolution, and death of stars; the composition and evolution of galaxies; the structure and evolution of the universe. Mutually Exclusive: Cannot register for ASTR 101 if student has credit for ASTR 201.

ASTR 102 - EXPLORATION OF THE SOLAR SYSTEM

Short Title: EXPLORATION OF THE SOLAR SYSTEM

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Distribution Group: Distribution Group III

Credit Hours: 3

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Description: The physical processes governing the nature and behavior of the various Solar System bodies are discussed with a focus on the origins, evolution and fate of the Solar System and its parts. This broader context leads to a deeper understanding of the Earth as a life-supporting planet. Mutually Exclusive: Cannot register for ASTR 102 if student has credit for ASTR 202.

ASTR 230 - ASTRONOMY LAB

Short Title: ASTRONOMY LAB

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Laboratory

Credit Hours: 3

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Description: A hands-on introduction to modern techniques of observational astronomy. Students use telescopes, CCDs, and computers to obtain and analyze their own images and spectra of solar system, galactic, and extragalactic objects. The course employs the campus observatory, dark sky observing sites, and state of the art data analysis software. Instructor Permission Required.

ASTR 238 - SPECIAL TOPICS

Short Title: SPECIAL TOPICS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Internship/Practicum, Laboratory, Lecture, Seminar, Independent Study

Credit Hours: 1-4

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Description: Topics and credit hours vary each semester. Contact department for current semester's topic(s). Repeatable for Credit.

ASTR 243 - LIVING WITH A STAR: THE PHYSICS OF THE SUN-EARTH CONNECTION

Short Title: LIVING WITH A STAR

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Credit Hours: 3

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Lower-Level

Prerequisite(s): (MATH 102 or MATH 106) and (PHYS 102 or PHYS 126)

Description: Introduction to astrophysical processes, particularly the effect of the Sun on the Earth. Possible effects of solar variability will be considered, especially global warming. The observational and theoretical basis of our current understanding will be presented.

ASTR 350 - INTRODUCTION TO ASTROPHYSICS-STARS

Short Title: INTRO ASTROPHYSICS-STARS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Credit Hours: 3

Restrictions: Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.

Course Level: Undergraduate Upper-Level

Prerequisite(s): MATH 211 and PHYS 202

Description: Introduction to celestial mechanics, radiative transfer, stellar structure, and stellar remnants (including black holes and neutron stars). Aspects of stellar atmospheres may also be explored. Together, ASTR 350 and ASTR 360 provide a comprehensive survey of modern astrophysics needed for senior research and graduate study in astronomy. Either ASTR 350 or 360 may be taken first. Recommended Prerequisite(s): MATH 212

ASTR 360 - INTRODUCTION TO ASTROPHYSICS-GALAXY AND COSMO**Short Title:** INTRO ASTROPHYSIC-GALAXY&COSMO**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** MATH 211 and PHYS 202 (may be taken concurrently)**Description:** Morphology, kinematics, and dynamics of the Milky Way and external galaxies, including interstellar matter and evidence for dark matter. Peculiar and active galaxies, including interacting systems and evidence for super massive black holes in active galactic nuclei such as quasars. Large-scale structure and expansion of the universe, including various cosmologies ranging from the inflationary big bang theory to steady state and anthropic concepts. Either ASTR 350 or 360 may be taken first. PHYS 202 may be taken as a prereq or concurrently with ASTR 360.**ASTR 400 - UNDERGRADUATE RESEARCH SEMINAR****Short Title:** UNDERGRADUATE RESEARCH SEMINAR**Department:** Physics and Astronomy**Grade Mode:** Satisfactory/Unsatisfactory**Course Type:** Seminar**Credit Hour:** 1**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** Seminar on current research topics in astronomy, astrophysics, and space physics for juniors and seniors. Students will be expected to give one oral presentation each semester. Graduate/ Undergraduate Equivalency: ASTR 500. Repeatable for Credit.**ASTR 408 - STATISTICAL METHODS IN PHYSICS AND ASTRONOMY****Short Title:** STATISTICS IN PHYS AND ASTR**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** (PHYS 101 or PHYS 111 or PHYS 125) and (PHYS 102 or PHYS 112 or PHYS 126)**Description:** Statistical methods commonly used in the analysis of astronomical, laboratory, and survey data. Topics include curve fitting, parametric and non-parametric hypothesis testing, cluster analysis, principal component analysis, time-series data, and truncated data. Fundamentals of statistics, including probability distributions, means, variances, the Central Limit Theorem, hypothesis testing, error propagation, Bayesian analysis, jackknife, and bootstrap are covered. The class introduces students to the R programming language. Graduate/ Undergraduate Equivalency: ASTR 508. Mutually Exclusive: Cannot register for ASTR 408 if student has credit for ASTR 508.**ASTR 451 - ASTROPHYSICS I: SUN AND STARS****Short Title:** ASTROPHYSICS I: SUN AND STARS**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** (ASTR 350 or ASTR 360) and (PHYS 301 and PHYS 302)**Description:** Physics of stellar atmospheres, interiors and evolution. Polytropes, nucleosynthesis, radiative transfer, convection, oscillations, opacities, curves of growth, spectral line theory and observation.**ASTR 452 - ASTROPHYSICS II: GALAXIES AND COSMOLOGY****Short Title:** ASTROPHYS II:GALAXY&COSMOLOGY**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** (ASTR 350 or ASTR 360) and (PHYS 301 and PHYS 302)**Description:** Study of physical cosmology models. Description of the evolution of the universe, including nucleosynthesis, cosmic background radiation, large-scale structure, galaxy formation and evolution, and high redshift phenomena.**ASTR 461 - INDEPENDENT RESEARCH IN ASTRONOMY****Short Title:** INDEPENDENT RESEARCH**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Independent Study**Credit Hours:** 1-6**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** Mentored research under the supervision of a Physics and Astronomy faculty member. The topic of the research must relate to astrophysics or space science. The analogous course for physics topics is PHYS 461. To register, students must provide a research plan approved by the faculty mentor. Repeatable for Credit. Instructor Permission Required. Repeatable for Credit.**ASTR 470 - SOLAR SYSTEM PHYSICS****Short Title:** SOLAR SYSTEM PHYSICS**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Prerequisite(s):** PHYS 301 and PHYS 302**Description:** The Sun, solar-terrestrial relationships, solar wind; planetary atmospheres, ionospheres and magnetospheres. Graduate/ Undergraduate Equivalency: ASTR 570. Mutually Exclusive: Cannot register for ASTR 470 if student has credit for ASTR 570.

ASTR 477 - SPECIAL TOPICS**Short Title:** SPECIAL TOPICS**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Internship/Practicum, Lecture, Seminar, Laboratory**Credit Hours:** 1-4**Restrictions:** Enrollment is limited to Undergraduate, Undergraduate Professional or Visiting Undergraduate level students.**Course Level:** Undergraduate Upper-Level**Description:** Topics and credit hours may vary each semester. Contact department for current semester's topic(s). Repeatable for Credit.**ASTR 500 - GRADUATE RESEARCH SEMINAR****Short Title:** GRADUATE RESEARCH SEMINAR**Department:** Physics and Astronomy**Grade Mode:** Satisfactory/Unsatisfactory**Course Type:** Seminar**Credit Hour:** 1**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** A presentation of current research programs in the department. Graduate/Undergraduate Equivalency: ASTR 400. Repeatable for Credit.**ASTR 502 - TEACHING EARTH AND SPACE SCIENCE****Short Title:** TEACHNG EARTH & SPACE SCIENCE**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Overview of the Earth and the solar system: structure, evolution, and dynamics. Includes non-calculus mathematics: algebra, logarithms and simple trigonometry, including Kepler's laws. Observing sessions at campus observatory and George Observatory TBD. Designed for inservice and preservice science teachers (grades 4-12), but open to undergraduates considering a teaching career. Mutually Exclusive: Cannot register for ASTR 502 if student has credit for ASTR 402.**ASTR 503 - ASTRONOMY FOR TEACHERS****Short Title:** ASTRONOMY FOR TEACHERS**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Overview of the Sun, stars, galaxies, and the Universe at a non-calculus level. Methods to help students master content, including lab activities suitable for K-12. Observing sessions at Rice campus observatory and George Observatory TBD. Designed for inservice and preservice teachers (grades 5-12), but open to undergraduates considering a teaching career.**ASTR 505 - PROCESSES IN COSMIC PLASMAS****Short Title:** PROCESSES IN COSMIC PLASMAS**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Prerequisite(s):** ASTR 470 and PHYS 480**Description:** Study of plasma phenomena that occur widely in nature. May include quasi-static equilibrium, magnetic equilibrium, magnetic reconnection, particle acceleration, plasma winds and jets, and interchange instabilities.**ASTR 508 - STATISTICAL METHODS IN PHYSICS AND ASTRONOMY****Short Title:** STATISTICS IN PHYS AND ASTR**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Lecture**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Description:** Statistical methods commonly used in the analysis of astronomical, laboratory, and survey data. Topics include curve fitting, parametric and non-parametric hypothesis testing, cluster analysis, principal component analysis, time-series data, and truncated data. Fundamentals of statistics, including probability distributions, means, variances, the Central Limit Theorem, hypothesis testing, error propagation, Bayesian analysis, jackknife, and bootstrap are covered. The class introduces students to the R programming language. Graduate/Undergraduate Equivalency: ASTR 408. Mutually Exclusive: Cannot register for ASTR 508 if student has credit for ASTR 408.**ASTR 530 - TEACHING ASTRONOMY LABORATORY****Short Title:** TEACHING ASTRONOMY LABORATORY**Department:** Physics and Astronomy**Grade Mode:** Standard Letter**Course Type:** Laboratory**Credit Hours:** 3**Restrictions:** Enrollment is limited to Graduate level students.**Course Level:** Graduate**Prerequisite(s):** ASTR 230 or ASTR 350 or ASTR 360 or ASTR 402 or ASTR 403 or ASTR 502 or ASTR 503**Description:** Methods of observational astronomy for public education: telescopes, astronomical binoculars, portable planetariums, digital cameras, and photography (still, 3D, and time lapse). Students will train beginners in the use of telescopes and carry out a modest observational program. The course requires one public presentation. Topics vary with each offering. Mutually Exclusive: Cannot register for ASTR 530 if student has credit for ASTR 430.

ASTR 542 - NEBULAR ASTROPHYSICS

Short Title: NEBULAR ASTROPHYSICS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Credit Hours: 3

Restrictions: Enrollment is limited to Graduate level students.

Course Level: Graduate

Prerequisite(s): ASTR 451

Description: The physics of emission nebulae, including radiative transfer, photo ionization and thermal equilibria, and internal gaseous dynamics. Physical processes in the interstellar medium. Recommended Prerequisite(s): PHYS 541.

ASTR 554 - ASTROPHYSICS OF THE SUN

Short Title: ASTROPHYSICS OF THE SUN

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Credit Hours: 3

Restrictions: Enrollment is limited to Graduate level students.

Course Level: Graduate

Description: Analysis of physical processes at work in the sun, such as helioseismology, solar variability, solar activity, magnetic reconnection, heliosphere interactions and modern observational techniques.

ASTR 555 - PROTOSTARS AND PLANETS

Short Title: PROTOSTARS AND PLANETS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Credit Hours: 3

Restrictions: Enrollment is limited to Graduate level students.

Course Level: Graduate

Prerequisite(s): ASTR 451

Description: Physics of star and planet information, including molecular cloud dynamics and chemistry, circumstellar accretion disks, jets, dust, debris disks, atmospheres rotation, and magnetic fields of young stars, binaries, brown dwarfs, comets, Kuiper belt objects, giant planet formation and discoveries of extra solar planets.

ASTR 565 - COMPACT OBJECTS

Short Title: COMPACT OBJECTS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Credit Hours: 3

Restrictions: Enrollment is limited to Graduate level students.

Course Level: Graduate

Description: The physics and astrophysics of the structure and environments of white dwarfs, neutron stars, black holes. Addressing pulsars, X-ray binaries, accretion, jets and gravitational radiation.

ASTR 570 - SOLAR SYSTEM PHYSICS

Short Title: SOLAR SYSTEM PHYSICS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Lecture

Credit Hours: 3

Restrictions: Enrollment is limited to Graduate level students.

Course Level: Graduate

Description: The Sun, solar-terrestrial relationships, solar wind; planetary atmospheres, ionospheres and magnetospheres. Includes a research paper and presentation on a physical process in the solar system. Graduate/Undergraduate Equivalency: ASTR 470. Mutually Exclusive: Cannot register for ASTR 570 if student has credit for ASTR 470.

ASTR 600 - ADVANCED TOPICS IN ASTROPHYSICS

Short Title: ADV TOPICS IN ASTROPHYSICS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Seminar

Credit Hours: 3

Restrictions: Enrollment is limited to Graduate level students.

Course Level: Graduate

Description: Lecture/seminars which treat topics of departmental interest. Not offered every year. Repeatable for Credit.

ASTR 677 - SPECIAL TOPICS

Short Title: SPECIAL TOPICS

Department: Physics and Astronomy

Grade Mode: Standard Letter

Course Type: Internship/Practicum, Laboratory, Lecture, Seminar, Independent Study

Credit Hours: 1-4

Restrictions: Enrollment is limited to Graduate or Visiting Graduate level students.

Course Level: Graduate

Description: Topics and credit hours vary each semester. Contact department for current semester's topic(s). Repeatable for Credit.