ASTR A200: INTRODUCTION TO ASTROPHYSICS

Item	Value
Curriculum Committee Approval Date	10/16/2024
Top Code	191100 - Astronomy
Units	4 Total Units
Hours	72 Total Hours (Lecture Hours 72)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S), • Pass/No Pass (B)
Associate Arts Local General Education (GE)	• Area 5 Physical and Biological Sciences, Scientific Inquiry, Life Science (OB)
Associate Science Local General Education (GE)	• Area 5 Physical and Biological Sciences, Scientific Inquiry, Life (OSB)
California General Education Transfer Curriculum (Cal-GETC)	• Cal-GETC 5A Physical Science (5A)
Intersegmental General Education Transfer Curriculum (IGETC)	• IGETC 5A Physical Science (5A)
California State University General Education Breadth (CSU GE-Breadth)	• CSU B1 Physical Science (B1)

Course Description

An introduction to astrophysics for science students. Emphasis on applying physical principles to gain a quantitative understanding of astrophysical phenomena. Topics covered include celestial mechanics; electromagnetic radiation; spectroscopy; stellar structure, evolution, and remnants; galaxies; and cosmology. Enrollment Limitation: ASTR A200H; students who complete ASTR A200 may not enroll in or receive credit for ASTR A200H. PREREQUISITE: PHYS A185 or PHYS A185H. ADVISORY: PHYS A285. Transfer Credit: CSU; UC.

Course Level Student Learning Outcome(s)

1. Apply physical principles and mathematical techniques to quantitatively analyze a wide range of astrophysical phenomena.
2. Analyze and interpret observational data in light of theoretical models in various areas of astrophysics.
3. Strengthen scientific literacy and numeracy skills by investigating and discussing key results in astrophysics.

Course Objectives

- 1. Calculate the orbital motion of planets, moons, and stars by applying Newton's laws and Kepler's laws.
- 2. Describe how atoms produce the three types of spectra (continuous, emission, absorption).
- 3. Compare and contrast the different methods of exoplanet detection.
- 4. Distinguish between flux and luminosity to calculate the distances to celestial objects.
- 5. Compare and contrast stars of different masses and ages according to the different nuclear fusion processes occurring within them.
- 6. Construct an H-R diagram and use it to describe the various stages of a star's life.
- 7. Classify galaxies according to their morphologies and star-formation histories.
- 8. Explain why most of the matter in the Universe is dark using physical arguments.
- 9. Describe the observational evidence for the Big Bang.
- 10. Outline the sequence of events occurring during the earliest moments of the Universe.

Lecture Content

Classical Astronomy Celestial coordinates (horizon, equatorial, galactic coordinates) The night sky (positional astronomy) Observational Astronomy Telescopes and optics Detectors Celestial Mechanics Newton's laws of motion Newton's law of universal gravity Kepler's laws of planetary motion Orbital motion of planets, stars, and galaxies Atoms and electromagnetic radiation Atomic and nuclear structure Bohr model Thermal radiation Spectroscopy Doppler effect Special and general relativity Time dilation, length contraction, simultaneity Lorentz transformation E=mc2 and its implications Gravity as curvature of spacetime Solar system and exoplanets Planetary atmospheres and temperatures Comparative planetology Methods of exoplanet detection Formation of planetary systems Measuring properties of stars Flux, luminosity, and magnitudes Methods of determining distance Temperature and color of stars Stellar Structure Nuclear fusion and the relation with E=mc2 Stellar interiors and energy transport Stellar atmospheres and spectral types The Sun as a star (solar dynamo model, solar neutrinos) Stellar Evolution H-R diagram and evolutionary tracks Stellar remnants (white dwarfs, neutron stars, black holes) Binary and variable stars Galaxies The Milky Way Galaxy classification (spiral, elliptical, irregular) Galaxy evolution and star formation Supermassive black holes and active galactic nuc lei Cosmology The early universe Observational evidence of the Big Bang Dark matter and dark energy as major constituents of the Universe Models of the universe

Lab Content

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Method(s) of Instruction

- Lecture (02)

Instructional Techniques

Lectures focusing on key concepts and problem-solving techniques Use of images, videos, animations to augment explanations of astrophysical concepts Group problem-solving activities in class Incorporation of computer-assisted learning (sky simulator software, computer-based activities)

Reading Assignments

Readings from the textbook, magazine/journal articles about relevant topics (2 hours per week)

Writing Assignments

Written responses to magazine/journal articles and short answer questions on homework assignments (2 hours per week)

Out-of-class Assignments

Homework assignments containing both problems and short written responses (2 hours per week)

Demonstration of Critical Thinking

Homework assignments and exams include multi-step problems that probe both conceptual reasoning and the use of mathematics to model astrophysical systems Assignments include the use of actual astronomical data that students must analyze and interpret based on concepts presented in class

Required Writing, Problem Solving, Skills Demonstration

Homework and exams include short-answer questions focusing on students' ability to reason conceptually and articulate their thoughts in writing. Problem-solving is a central component of the course--students apply physics knowledge to various astronomical concepts.

Eligible Disciplines

Physics/Astronomy: Master's degree in physics, astronomy, or astrophysics OR bachelor's degree in physics or astronomy AND master's degree in engineering, mathematics, meteorology, or geophysics OR the equivalent. Master's degree required.

Textbooks Resources

1. Required Ryden, B., Peterson, B.. Foundations of Astrophysics, ed. Cambridge University Press, 2020 Rationale: This is one of the few textbooks covering astrophysics at the appropriate level. 2. Required Carroll, B., Ostlie, D.. An Introduction to Modern Astrophysics, 2 ed. Cambridge University Press, 2017 3. Required Owocki, S.. Fundamentals of Astrophysics, ed. Cambridge University Press, 2021