ASTR A103: COSMOLOGY

Item	Value
Curriculum Committee Approval Date	10/16/2024
Top Code	191100 - Astronomy
Units	3 Total Units
Hours	54 Total Hours (Lecture Hours 54)
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 the origin and evolution of the cosmos. Application of modern physics concepts, including quantum mechanics and the theory of relativity, to describe the history and ultimate fate of the Universe. Observational evidence for the expanding Universe, dark matter, dark energy, and the Big Bang. Transfer Credit: CSU; UC.

Course Level Student Learning Outcome(s)

1. Apply physical principles to describe the evolution of the Universe from the Big Bang to the present day.
2. Demonstrate how the current cosmological model of the Universe is supported by observational data.
3. Strengthen scientific literacy and numeracy skills by interpreting data and key results in cosmology.

Course Objectives

- 1. Correctly apply terminology, basic facts and concepts pertaining to the origin, structure, and evolution of the Universe.
- 2. Describe the methods used to measure distances and motion of objects in the Universe.
- 3. Explain the postulates and basic conclusions of special relativity.
- 4. Apply basic concepts of general relativity to describe the curvature and expansion of the Universe.
- 5. Compare different expansion histories of the Universe and identify the currently accepted model.
- 6. Describe the observational evidence for dark matter and dark energy.
- 7. Explain how the Big Bang model of the origin of the Universe is supported by observations.
- 8. Explain how conditions in the very early Universe gave rise to the fundamental forces and the creation of matter.

Lecture Content

Nature of science Size and scale of the Universe Scientific method Scientific literacy Newtonian cosmology Historical conceptions of the Universe Newton s laws of motion and gravity Olbers paradox Special relativity Einstein s postulates Relativity of simultaneity Mass-energy and E=mc2 General relativity Geometry of spacetime Equivalence principle Tests of general relativity Observational cosmology Light and spectroscopy Redshifts and velocities Distance ladder Hubble s discovery Models of the expanding universe Scale factor Critical density Behavior of critical, closed, and open universes Age of the Universe Dark matter and dark energy Observational evidence for dark matter Evidence for an accelerating universe The cosmological constant and dark energy The Big Bang Conditions in the early Universe Evidence for the Big Bang Expansion of the Universe Cosmic microwave background Abundance of helium The very early Universe Basics of particle physics Origin of the fundamental forces Origin of matter Cosmic inflation Issues with the Big Bang model Predictions of inflation Implications of inflation

Method(s) of Instruction

- Lecture (02)

Instructional Techniques

1. Lecture and demonstrations will be used to present the basic concepts. 2. Slide and video materials will be used to illustrate and animate some of the physical processes in cosmology. 3. Small group interactions during class will allow students to discuss and practice important concepts. 4. All students are provided with an environment that encourages interactive participation with the instructor.

Reading Assignments

Readings from the textbook, magazine articles, handouts (2 hours per week)

Writing Assignments

Quizzes and exams containing written responses and quantitative problems. (2 hours per week)

Out-of-class Assignments

Regular homework assignments and projects (2 hours per week)

Demonstration of Critical Thinking

1. Regular homework assignments and projects requiring written responses. 2. Exams that require synthesis of multiple concepts. 3. Class activities and discussions to address misconceptions and clarify difficult concepts.

Required Writing, Problem Solving, Skills Demonstration

Homework assignments, projects, and exams will include written components.

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 Perlov, D., Vilenkin, A.. Cosmology for the Curious, ed. Springer, 2017 2. Required Fraknoi, A., Morrison, D., Wolff, S.. Openstax Astronomy, ed. Rice University, 2018