ASTR A102: STELLAR ASTRONOMY

Item	Value
Curriculum Committee Approval Date	10/06/2021
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
Grading Policy	Standard Letter (S), • Pass/No Pass (B)
Associate Arts Local General Education (GE)	• OC Physical/Biological Sci - AA (OB)
Associate Science Local General Education (GE)	• OCC Physical/Biological Sci-AS (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

A detailed study of the formation, structure, and evolution of the sun and stars, including an overview of binary systems, variable stars, supernovae, white dwarfs, neutron stars, black holes, and other stellar phenomena. A survey of particle physics and special and general relativity will also be included. Transfer Credit: CSU; UC.

Course Level Student Learning Outcome(s)

1. Apply physical principles to explain how astronomers determine the properties of stellar atmospheres and interiors.
2. Explain the model of stellar evolution for high and low mass stars, highlighting observations that support the model.
3. Strengthen scientific literacy and numeracy skills by interpreting data and key results in stellar astrophysics.

Course Objectives

- 1. Demonstrate knowledge of terminology, basic facts, and concepts pertaining to the origin, structure, and evolution of stars.
- 2. Differentiate pre-main sequence, main sequence, and final evolutionary stages on a Hertzsprung-Russell Diagram.
- 3. Describe fundamental conditions for nuclear processes necessary for element synthesis and the modes of energy transport in a low, intermediate, and high mass star.
- 4. Explain basic processes of supernovae, white dwarfs, neutron stars and black holes.
- 5. Apply particle physics, special relativity, and general relativity as needed to stars.
- 6. Differentiate between types of binary stars.
- 7. List conditions for intrinsic and extrinsic variable stars.

Lecture Content

I. Four forces in nature A. Atoms and matter (weak and strong forces) B. Light/spectroscopy/ electromagnetic force (absorption/ emission/continuous) C. Galilean mechanics/ Newtonian mechanics/gravitational force D. Telescopes (optical and radio/spaced based astronomy) II. Sun A. Interior (temperature, pressure, density) B. Solar luminosity, surface temperature, black body radiation, chemical composition. C. Energy sources, nuclear cycles, fusion reactions. D. Atmosphere (photosphere, chromosphere, corona) E. Sunspots, magnetic fields, flares, prominence III. Messages from starlight A. Apparent and absolute magnitudes B. Distances (parallax, colors, temperatures, diameters Doppler shift) IV. Spectral Classification A. Spectral lines B. Hertzsprung-Russell diagram (temperature and luminosity) C. Binaries/types of binaries/variables stars V. Starbirth and interstellar medium A. Gas and dust B. Protostellar models VI. Star lives A. Stellar taxonomy B. Energy transport C. Star models ; D. Evolution of one, five, and ten solar mass objects VII. Star Demise A. White dwarfs, neutron stars, black holes B. Type I and II supernovae, pulsars, explosive nucleosynthesis C. Special and general relativity D. Particle Physics VIII. Galaxies A. Milky Way B. Evolution and structure C. Other types of galaxies

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 stellar astronomy. 3. Small group interactions will be applied for evaluation of the more complex materials with discussion amongst the groups. 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

All responses on homework, quizzes, and exams are in the form of short answers or written format. This allows students to practice and improve on their writing skills. (2 hours per week)

Out-of-class Assignments

Regular homework assignments (2 hours per week)

Demonstration of Critical Thinking

1. Weekly homework questions based on readings. 2. Written short answers for quizzes. 3. Written Exams covering the scope of the class. 4. Comprehensive final exam.

Required Writing, Problem Solving, Skills Demonstration

Quizzes and exams contain written responses as well as basic quantitative calculations.

Eligible Disciplines

Physics/Astronomy: Masters degree in physics, astronomy, or astrophysics OR bachelors degree in physics or astronomy AND masters degree in engineering, mathematics, meteorology, or geophysics OR the equivalent. Masters degree required.

Textbooks Resources

1. Required Thorne, Kip. Black Holes, and Time Warps, ed. New York: W. W. Norton and Company, 1994 Rationale: Thorne, Kip. Black Holes, and Time Warps, New York: W. W. Norton and Company, 1994 latest. 2. Required Cooper, C.. Our Sun: Biography of a Star, ed. Race Point Publishing, 2013 Rationale: Latest edition. 3. Required Bartusiak, M.. Black Hole: How an Idea Abandoned by Newtonians, Hated by Einstein, and Gambled on by Hawking Became Loved, ed. Yale University Press, 2016 Rationale: Latest Edition. 4. Required Frebel, A.. Searching for the Oldest Stars, 1 ed. Princeton: Princeton University Press, 2015 Rationale: First and latest edition. 5. Required Fraknoi, A., Morrison, D. Wolff, S.. Astronomy (OER), 18 ed. XanEdu Publishing Inc., 2021