



# El Camino College

## COURSE OUTLINE OF RECORD - Official

### I. GENERAL COURSE INFORMATION

**Subject and Number:** Astronomy 25  
**Descriptive Title:** Stars and Galaxies

**Course Disciplines:** Physics/Astronomy

**Division:** Natural Sciences

**Catalog Description:** This course is an introduction to the universe and its history. The main focus is on our view of the heavens and how astronomers learn about stars and galaxies. The formation, life histories, and fates of different kinds of stars, including the sun, are examined. Exotic stars as well as black holes are explored. The structure and distribution of galaxies are discussed, with a focus on our own Milky Way Galaxy. The possibility of simple and intelligent life in the Milky Way Galaxy will be examined. The history of the universe, starting with the Big Bang is also investigated.

**Conditions of Enrollment: Recommended Preparation**

English 84

**Course Length:**  Full Term  Other (Specify number of weeks):  
**Hours Lecture:** 3.00 hours per week  TBA  
**Hours Laboratory:** 0 hours per week  TBA  
**Course Units:** 3.00

**Grading Method:** Letter  
**Credit Status:** Associate Degree Credit

**Transfer CSU:**  Effective Date: Prior to July 1992  
**Transfer UC:**  Effective Date: Prior to July 1992

**General Education:**

**El Camino College:** 1 – Natural Sciences  
Term: \_\_\_\_\_ Other: Approved

**CSU GE:** B1 - Physical Science  
Term: \_\_\_\_\_ Other: Approved

**IGETC:** 5A - Physical Science without Lab  
Term: \_\_\_\_\_ Other: Approved

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## II. OUTCOMES AND OBJECTIVES

### **A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)**

1. Students will be able to explain the causes of seasonal variations in the length of the day, direction of sunrise and sunset, and the amount of solar heating on the Earth.
2. Students will explain how electromagnetic radiation and astronomical instruments are used to reveal the properties of stars and planets.
3. Students will be able to describe the structure and contents of the Universe and major events in the history of the Universe that led to the formation of the earth.

The above SLOs were the most recent available SLOs at the time of course review. For the most current SLO statements, visit the El Camino College SLO webpage at <http://www.elcamino.edu/academics/slo/>.

### **B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)**

1. Compare and contrast the scientific method to pseudo science.  
Essay exams
2. Illustrate and describe why it is hot in summer and cold in winter.  
Essay exams
3. Explain how electromagnetic radiation and astronomical instruments are used to reveal the properties of stars and galaxies.  
Essay exams
4. Describe the solar cycle and how it affects the Sun and the Earth.  
Essay exams
5. Compare different methods used to measure astronomical distances  
Multiple Choice
6. Contrast the life history of a low-mass star with the life history of a high-mass star.  
Essay exams
7. Explain what black holes are, how they are formed and their effect on local spacetime.  
Multiple Choice
8. Illustrate and describe the structure and contents of the Milky Way Galaxy.  
Essay exams
9. Compare and contrast the different types of galaxies.  
Matching Items
10. Illustrate how galaxies are distributed through space in superclusters, walls, and voids.  
Essay exams
11. Discuss the conditions for nuclear fusion and how elements are created.  
Multiple Choice

12. Discuss the evidence for Dark Matter and Dark Energy.

Written homework

13. Evaluate the evidence in favor of the Big Bang theory.

Essay exams

14. Estimate the possibility of intelligent life elsewhere in the Milky Way.

Essay exams

15. Explain the evidence for the expansion of the Universe and discuss how the expansion will change in the future.

Essay exams

**III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)**

Lecture or Lab	Approximate Hours	Topic Number	Major Topic
Lecture	7.5	I	Overview of the Universe A. The Universe in Space: Structure, Size, and Contents B. The Universe in Time: Origin, Expansion, and Evolution C. Matter in the Universe: Atomic Structure D. The Scientific Method and the Heliocentric vs. Geocentric Models of the Universe E. Galileo's Discoveries and Kepler's Laws of Motion F. Newton's Law of Gravity G. Newton's Laws of Motion H. Gravity, Orbits, Weightlessness
Lecture	6	II	Sky Phenomena A. The Celestial Sphere and Constellations B. The Seasons
Lecture	6	III	Light and Telescopes A. Properties of Light 1. Wave Properties 2. Particle Properties B. The Electromagnetic Spectrum C. Thermal Radiation 1. Wien's Law 2. Stefan's Law D. Spectroscopy 1. Line Emission 2. Line Absorption 3. Doppler Effect E. Visible Light Telescopes 1. Resolution and Light Gathering F. Non-Visible Light Telescopes
Lecture	3	IV	The Sun A. Structure, Hydrostatic Equilibrium B. The Solar Activity Cycle and its Possible Effect on the Earth C. The Process of Fusion D. The Role of the Four Forces
Lecture	4.5	V	Stars A. Determination of Distances, Color, and Temperature

			<ul style="list-style-type: none"> <li>B. Properties of Stars <ul style="list-style-type: none"> <li>1. Luminosity</li> <li>2. Radius</li> <li>3. Mass</li> <li>4. Brightness</li> </ul> </li> <li>C. Binary Stars</li> <li>D. The Hertzsprung-Russell Diagram</li> <li>E. Star Clusters</li> </ul>
Lecture	6	VI	<ul style="list-style-type: none"> <li>Stellar Evolution <ul style="list-style-type: none"> <li>A. Star Formation</li> <li>B. Life History of Low-Mass Stars</li> <li>C. Life History of High-Mass Stars</li> <li>D. The Origin of the Elements</li> </ul> </li> </ul>
Lecture	3	VII	<ul style="list-style-type: none"> <li>Compact Objects <ul style="list-style-type: none"> <li>A. White Dwarfs</li> <li>B. Neutron Stars</li> <li>C. Black Holes</li> </ul> </li> </ul>
Lecture	3	VIII	<ul style="list-style-type: none"> <li>The Milky Way Galaxy <ul style="list-style-type: none"> <li>A. Shape and Size of the Galaxy</li> <li>B. Structure of the Galaxy</li> <li>C. Contents of the Galaxy <ul style="list-style-type: none"> <li>1. Open Star Clusters</li> <li>2. Globular Star Clusters</li> <li>3. Nebulae</li> </ul> </li> <li>D. The Galactic Center</li> <li>E. History and Age of the Galaxy</li> </ul> </li> </ul>
Lecture	4.5	IX	<ul style="list-style-type: none"> <li>Galaxies <ul style="list-style-type: none"> <li>A. Determination of Distances to Galaxies: the Cosmic Distance Ladder (Pyramid)</li> <li>B. Classification of Galaxies <ul style="list-style-type: none"> <li>1. Spiral</li> <li>2. Elliptical</li> <li>3. Dwarf</li> <li>4. Irregular Active Galaxies, Quasars</li> </ul> </li> <li>C. Galaxy Clusters</li> <li>D. Starburst Galaxies and Galaxy Evolution</li> </ul> </li> </ul>
Lecture	4.5	X	<ul style="list-style-type: none"> <li>Cosmology <ul style="list-style-type: none"> <li>A. Einstein's Theory of General Relativity</li> <li>B. Gravitational Lensing</li> <li>C. Hubble's Law and the Expansion of the Universe</li> <li>D. Distances in an Expanding Universe</li> <li>E. Curvature of Space and Matter Density</li> <li>F. Closed and Open Universes</li> <li>G. Dark Matter, Dark Energy and the Future of the Universe</li> </ul> </li> </ul>
Lecture	3	XI	<ul style="list-style-type: none"> <li>The Big Bang <ul style="list-style-type: none"> <li>A. Development of the Big Bang Theory</li> <li>B. The First Second: Grand Unified Theories</li> <li>C. The Creation of Helium</li> <li>D. The Creation of Atoms</li> <li>E. The Cosmic Microwave Background Radiation</li> </ul> </li> </ul>
Lecture	3	XII	<ul style="list-style-type: none"> <li>Life in the Universe <ul style="list-style-type: none"> <li>A. Possibility of Life in the Universe: the Drake Equation</li> <li>B. Intelligent Life</li> <li>C. Interstellar Travel and the Special Theory of Relativity</li> </ul> </li> </ul>
<b>Total Lecture Hours</b>		54	

<b>Total Laboratory Hours</b>	0
<b>Total Hours</b>	54

#### **IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS**

##### **A. PRIMARY METHOD OF EVALUATION:**

Problem solving demonstrations (computational or non-computational)

##### **B. TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:**

Spectra are shown of hydrogen, helium, and sodium as they appear in a laboratory here on Earth. In addition, the spectra of three gas clouds as seen from Earth are shown. Assume that the left end of each spectrum corresponds to shorter wavelengths (blue light) and that the right end of each spectrum corresponds with longer wavelengths (red light).

Ranking Instructions: Rank the speed of the stars (A-C) from moving fastest toward the Earth to moving fastest away from the Earth.

Ranking order:

Moving fastest toward 1 \_\_\_ 2 \_\_\_ 3 \_\_\_ Moving fastest away Or, the stars all have the same speed. \_\_\_ (indicate with a check mark). Next, rank the clouds in terms of the relative abundance of sodium compared to hydrogen from most to least sodium. Finally rank the clouds from hottest to coldest.

##### **C. COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:**

1. The Hertzsprung-Russell diagram of star cluster M3 is shown in Figure 2. Determine the age of the cluster. What kind of cluster is it?
2. In a short essay explain where the hydrogen in your body came from, and how old it is. Repeat for the calcium in your bones and the iron in your blood.

##### **D. OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:**

Essay exams

Other exams

Quizzes

Written homework

Homework Problems

Multiple Choice

Completion

Matching Items

True/False

Other (specify):

short answers, drawing diagrams

## V. INSTRUCTIONAL METHODS

Demonstration

Lecture

Other (please specify)

Planetarium demonstrations or interactive computer demonstrations, activities with models

**Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.**

## VI. WORK OUTSIDE OF CLASS

Study

Answer questions

Required reading

Problem solving activities

Written work

Other (specify)

sky observations

**Estimated Independent Study Hours per Week: 6**

## VII. TEXTS AND MATERIALS

### A. UP-TO-DATE REPRESENTATIVE TEXTBOOKS

Bennett et al. The Cosmic Perspective. 7th ed. Pearson Addison Wesley, 2013.

### B. ALTERNATIVE TEXTBOOKS

Chaisson and McMillan. Astronomy Today. 8th ed. Pearson, 2014.

### C. REQUIRED SUPPLEMENTARY READINGS

### D. OTHER REQUIRED MATERIALS

## VIII. CONDITIONS OF ENROLLMENT

### A. Requisites (Course and Non-Course Prerequisites and Corequisites)

Requisites	Category and Justification
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### B. Requisite Skills

Requisite Skills
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**C. Recommended Preparations (Course and Non-Course)**

<b>Recommended Preparation</b>	<b>Category and Justification</b>
Course Recommended Preparation English-84	

**D. Recommended Skills**

<b>Recommended Skills</b>
There are sufficient reading requirements that the student be at a college level of reading ability. ENGL 84 - Identify an implied main idea (thesis), and support with major and minor details, from a longer text or novel. ENGL 84 - Interpret a book-length work through discussion, journal writing, or composition writing.

**E. Enrollment Limitations**

<b>Enrollment Limitations and Category</b>	<b>Enrollment Limitations Impact</b>
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**Course created by David Pierce on 11/01/1985.**

**BOARD APPROVAL DATE:**

**LAST BOARD APPROVAL DATE:**

**Last Reviewed and/or Revised by Perry Hacking on 03/09/2015**