I. GENERAL COURSE INFORMATION

Subject and Number: **Astronomy 15**
Descriptive Title: **Astrobiology**
Course Disciplines: **Physics/Astronomy**
Division: **Natural Sciences**

Catalog Description:
In this course students will learn the current ideas and theories concerning the origin and evolution of life on Earth and discuss how these ideas are influencing our search for life on other planets and moons in our solar system and elsewhere in the Galaxy. Topics covered include the chemical and biological basis of life, the search for life on other worlds, and the search for extraterrestrial intelligence (SETI).

Conditions of Enrollment:
Recommended Preparation: English 1A or qualification by appropriate assessment

Course Length:	**X 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: **X Effective Date: 01/19/2021**
Transfer UC: **Effective Date: Proposed**

General Education:
El Camino College:
1 – Natural Sciences
Term: Other:

CSU GE:
Term: Other:

IGETC:
Term: Other:

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. **Scientific Method**
   Students will be able to recognize the elements of the Scientific Method in the discussion of a scientific problem.
2. **Possibility of Life**
   Students will be able to evaluate the possibility of life in a given environment based on the key components of habitability.
3. **Modern Theory**
   Students will be able to describe the modern theory of the evolution of life on other worlds.

B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below.)

1. Elucidate the origins of the Earth in the context of structure formation in the universe, star formation in our Galaxy, and planetary system formation.
2. Explain the emergence of life on our planet, to the extent that it is currently understood.
3. Discuss the co-evolution of the Earth and its biosphere up to the present time.
4. Characterize the cosmic habitats that might allow for the emergence of life elsewhere in the universe.
5. Examine the factors that might make life either a rarity or a commonplace occurrence in the universe.
6. Investigate how we might undertake the search for signs of, or signals from, life elsewhere in the universe.

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	3	I	**The Science of Astrobiology & its Historical Origins** A. The Scientific Method B. The Science of Astrobiology, & its Historical Origins C. The Cosmic Arena: some perspective on the present-day universe 1. constituents 2. homogeneity of the observable universe 3. distance scales and time scales
Lecture	3	II	**Evolution of the Universe From the Big Bang to the Earth** A. Gravity and structure formation B. Galaxies and galaxy clusters C. Stars and star clusters D. The birth and death of stars E. Nucleosynthesis: the formation of the elements F. Formation of planetary systems – the Nebular Hypothesis G. Terrestrial planets versus gas giants
Lecture	4	III	**Sky Phenomena** A. Seasons B. Moon phases and eclipses C. Planetary motions D. Heliocentric vs. Geocentric views
Lecture	4	IV	**The Dynamic Earth: life's one known platform** A. reconstructing Earth's past in the geological and fossil record B. sequencing and dating C. Hadean Earth D. The Late Heavy Bombardment E. Formation of the oceans and atmosphere F. The Earth's interior G. Plate tectonics H. The Earth's magnetic field I. Climate and climate change
Lecture	6	V	**Life As We Know It** A. Definition of life B. The theory of evolution C. Cells and their biochemical basis D. Nucleic acids: DNA and RNA E. Genes and genomes: the genetic code F. The production and role of proteins G. Branches on the tree of life H. Evolution at the molecular level I. Evolution in real time J. Metabolism – the use and flow of energy K. Extremophiles – what can life endure?

Lecture	3	VI	**The Emergence of Life on Earth** A. Challenges to self-replication B. The RNA world? C. Isotopic evidence for the earliest life forms D. Microfossils, blue-green algae, and stromatolites E. Where did life begin? F .Panspermia?
Lecture	4	VII	**Major Episodes of Niche Expansion, Species Radiation, and Evolutionary Innovation** A. The appearance of eukarya B. Oxygen – the transformation of the atmosphere C. The Cambrian explosion D. the advent and radiation of plants E. the colonization of land F. chordates to fish to amphibians to reptiles to mammals to primates G. hominid evolution -- the lineage of homo sapiens
Lecture	3	VIII	**Setbacks and Detours** A. Major extinction events B. Impacts and other catastrophes C. Snowball earth D. The P-T boundary: the mother of all extinctions E. The K-Pg boundary and the demise of the dinosaurs F. The current blight: humans! – climate change, habitat G. Destruction, and the role of overpopulation
Lecture	4	IX	**Life in Other Habitats of the Solar System** A. Is water a necessity? B. Mars as the (potential) abode of life C. Martian meteorites and the interplanetary migration of life D. The Jovian atmosphere E. The oceans of Europa and other large planetary satellites F. Titan and other satellites of the gas giant planets
Lecture	4	X	**Moving Beyond the Solar System: What Constitutes Habitability** A. Niches: liquid, solid, and gaseous media. Surfaces B. Habitable zones around the Sun and other stars C. The role of planetary size: holding an atmosphere D. The greenhouse effect and runaway planetary warming E. Evolution of the Sun, and the migration of the habitable zone F. The last days of the Earth G. The role of the central star: lifetime, mass, and stellar temperature H. Brown dwarf stars? I. The problems with multiple star systems

Lecture	4	XI	**Extrasolar Planets** A. The recent explosive discovery of "exoplanets" techniques used to discover planets, and their biases B. Hot Jupiters and planetary migration C. The importance of heavy elements – metallicity D. The technical challenge of finding terrestrial planets are terrestrial planets rare? E. The greater challenge of finding evidence for life on terrestrial planets
Lecture	3	XII	**Cosmic Threats and Cosmic Assists to the Progression of Life** A. Bombardments – asteroids, comets, and other rogue bodies the protective role of Jovian planets B. Is the Moon a factor? C. Supernovae and gamma-ray bursts D. Radiation background from the Galaxy E. Thermal, orbital, and climatological instability
Lecture	3	XIII	**Intelligent Life in the Cosmos** A. definition of "intelligence" – an inevitable consequence of evolution B. How commonplace is it? – the Drake Equation The endurance & stability of intelligent species and their civilizations C. Energy use, and the long-term impact of intelligent species on their environments; Dyson Spheres D. he impact of population; sustainability and the stewardship of resources
Lecture	3	**XIV**	**SETI: the Search for Extra Terrestrial Intelligence** A. Search strategies for intentional signals – beacons B. Leakage radiation C. Likely time scales – the technological status of potential D. communication partners E. UFOs
Lecture	3	XV	**Interstellar Travel and Colonization of the Galaxy** A. Physical limitations to travel between the stars B. Energy considerations C. Science fiction shortcuts D. Motivations for colonization E. The Fermi Paradox – where are they? F. Facing one of two stunning conclusions: We Are Alone, or We Are Not Alone. G. Implications
Total Lecture Hours		**54**	
Total Laboratory Hours		**0**	
Total Hours		**54**	

IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

A. PRIMARY METHOD OF EVALUATION:

Substantial Writing Assignments.

B. TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:

In a well-reasoned paragraph or more, explain how habitable zones differ among stars of different mass. The answer should reflect your understanding of the material and also include a quantitative solution for a thorough explanation. No page limit is required. The correctness is what will be evaluated.

C. COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:

1. In a few paragraphs, identify and describe four crucial events in evolutionary history without which our current existence would have been highly unlikely. Explain your reasoning clearly.

2. Mathematically, make your own estimate of a value for each of the four terms in the modified Drake equation. Explain how you arrived at each estimate, and then use your estimates to calculate N. Show all your steps.

D. OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:

Essay exams
Other exams
Quizzes
Homework Problems
Term or other papers
Multiple Choice
Completion
Matching Items
True/False
Other (specify):
Short answers, drawing diagrams

V. INSTRUCTIONAL METHODS

Demonstration
Discussion
Group Activities
Internet Presentation/Resources
Lecture
Multimedia presentations

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
Skill practice
Required reading
Problem solving activities
Written work

Estimated Independent Study Hours per Week: 6

VII. TEXTS AND MATERIALS

A. UP-TO-DATE REPRESENTATIVE TEXTBOOKS

Jeffrey Bennett & Seth Shostak. Life in the Universe. 4 ed. Pearson/Addison Wesley, 2017.

B. ALTERNATIVE TEXTBOOKS

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

B. Requisite Skills

Requisite Skills

C. Recommended Preparations (Course and Non-Course)

Recommended Preparation	Category and Justification
English 1	**Category**: Course. **Justification:** Students are required to read and comprehend a college-level textbook and to write well-composed paragraphs and essays; therefore, the reading skills developed in English 1 will greatly enhance their chance for successfully completing this course.
Eligibility for English 1A or qualification by appropriate assessment	**Category**: Non-Course. **Justification:** Students are required to read and comprehend a college-level textbook; therefore, having these reading skills will greatly enhance their chance for successfully completing this course.

D. Recommended Skills

Recommended Skills
A student needs to have well-developed reading skills to understand and interpret information provided in their textbooks. ENGL 1 -Summarize, analyze, evaluate and synthesize college-level texts. Students needs to be able to write a paragraph, essay, or paper about a technical subject. ENGL 1 –Write a well-reasoned, well-supported expository essay that demonstrates application of the academic writing process.

E. Enrollment Limitations

Enrollment Limitations and Category	Enrollment Limitations Impact

Course created by: Shimonee Kadakia on 02/06/2018

BOARD APPROVAL DATE: 01/19/2021

LAST BOARD APPROVAL DATE:

Last Reviewed and/or Revised by

Justification:
☒ Department faculty and the Division Curriculum Committee have determined that this course is appropriate for the distance education delivery method/s listed below.

☐Other: (Please explain.)

I. Course Delivery Method/s (Check all that apply.)

☒ **Online:** Complete Section A: Online refers to courses offered fully (100%) online. All approved instructional contact hours are delivered through online interactions with no mandatory on campus class meetings or assessments.

☒ **Hybrid:** Complete Section B: Hybrid refers to courses being partially offered online. Some of the approved instructional contact hours are delivered through online interactions. The remaining contact hours are conducted through scheduled on campus class meetings and are noted in the schedule of classes.

A. Online Delivery

1. Learning Management System (LMS)
☒ Instructors agree to use the current College-approved Learning Management System.

2. Methods of Regular Effective Contact Between Instructor and Students and Among Students
(Check all that apply.)

☒ One-on-One Faculty-Student Communication, including office hours if required (through LMS, email, chat rooms, Zoom, telephone, texts, social media, etc.)

☒ Electronic Announcements (through LMS, email, blogs, text, social media, etc.)

☒ Timely Feedback and Comments on Student Work (through LMS, ECC Connect, email, etc.)

☐ Facilitated Group Discussions (through LMS, Zoom, chat rooms, social media, etc.)

☐ Collaborative Group Work (through LMS, GoogleDocs, etc.)

☐ Other (Please specify.)

3. Methods of Evaluation
☒Methods of Evaluation do NOT differ from those in the Course Outline of Record
☐ Methods of Evaluation listed in the Course Outline of Record are modified or supplemented. (Please explain.)

4. Administration of Examinations
☒ Electronic (through the LMS, proctored and/or un-proctored)
☐ Not applicable (Please specify)
☐Other (Please specify)

5. Text/Supplemental Readings/Materials

☒Texts, Supplemental Readings, and Materials do NOT differ from those listed in the Course Outline of Record

☐ Texts, Supplemental Readings, and Materials differ from those listed in the Course Outline of Record and are modified or supplemented. (Please explain.)

6. Accommodations for Students with Disabilities and Instructional Delivery

In compliance with ECC Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973 – Sections 504 and 508, and the Americans with Disabilities Act, instructional delivery shall provide access, full inclusion, and effective communication for students with disabilities. Instructional delivery methods may include, but are not limited to, Braille/audiotape for print material, on-site interpreter/real-time transcription/live captioning for audio material, captioning for video material, alternative text for images, and captioning of audio information for electronic media materials (such as web and online).

☒ Instructors of the online version of this course will read and will comply with the Accommodations for Students with Disabilities and Instructional Delivery.

B. Hybrid Delivery

1. ☒ Instructors agree to use the current College-approved course management system.

2. Methods of Regular Effective Contact Between Instructor and Students and Among Students

(Check all that apply.)

☒ One-on-One Faculty-Student Communication, including office hours if required, (through email, chat rooms, Zoom, telephone, texts, social media, etc.)

☒ Electronic Announcements (through LMS, email, blogs, text, social media, etc.)

☐ Timely Feedback and Comments on Student Work (through LMS, ECC Connect, email, etc.)

☐ Facilitated Group Discussions (through LMS, Zoom, chat rooms, social media, etc.)

☐ Collaborative Group Work (through LMS, GoogleDocs, etc.)

☐ Other

3. Methods of Evaluation

☒Methods of Evaluation do NOT differ from those in the Course Outline of Record

☐ Methods of Evaluation listed in the Course Outline of Record are modified or supplemented. (Please explain.)

4. Administration of Examinations

☒ On Campus

☐ Electronic (through the LMS proctored and/or un-proctored)

☐ Not applicable (Please specify)

☐Other (Please specify)

5. Text/Supplemental Readings/Materials

☒Texts, Supplemental Readings, and Materials do NOT differ from those listed in the Course Outline of Record

☐ Texts, Supplemental Readings, and Materials differ from those listed in the Course Outline of Record and are modified or supplemented. (Please explain.)

6. Accommodations for Students with Disabilities and Instructional Delivery

In compliance with ECC Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973 – Sections 504 and 508, and the Americans with Disabilities Act, instructional delivery shall provide access, full inclusion, and effective communication for students with disabilities. Instructional delivery methods may include, but are not limited to, Braille/audiotape for print material, on-site interpreter/real-time transcription/live captioning for audio material, captioning for video material, alternative text for images, and captioning of audio information for electronic media materials (such as web and online).

☒ Instructors of the hybrid version of this course will read and will comply with the Accommodations for Students with Disabilities and Instructional Delivery.