CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

ACADEMIC SENATE

GENERAL EDUCATION COMMITTEE

REPORT TO

THE ACADEMIC SENATE

GE-069-156

AST 1010- Stars, Galaxies and the Universe (GE B1)

General Education Committee	**Date: 2/4/2016**
Executive Committee Received and Forwarded	**Date: 5/17/16**
Academic Senate	**Date: 5/25/16 First Reading 06/01/2016 Second Reading**

BACKGROUND:

The Department of Physics and Astronomy introduced a new semester course for GE Area B1.

RESOURCES CONSULTED:
Faculty
Department Chairs
Associate Deans
Deans
Office of Academic Programs

DISCUSSION:

The GE Committee reviewed the ECO for this course and found it to satisfy the GE SLO's and other requirements of GE Area B1

RECOMMENDATION:

The GE Committee recommends approval of GE-069-156 (AST 1010-Stars, Galaxies and the Universe for GE Area B1).

AST - 1010 - Stars, Galaxies, and the Universe

C. Course - New General Education* Updated

General Catalog Information

- ****READ BEFORE YOU BEGIN****
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1. **Import curriculum data from the Catalog by clicking on the following icon . It is a BEST PRACTICE to always import data on existing courses. This will limit the opportunity for data errors.**
2. **Turn the help text on by clicking on the following icon .**
3. **All fields with an asterisk (*) are required fields. If left blank, the request will not be launched and cannot be acted upon.**
4. **Run and attach an impact report by clicking to show all courses and programs impacted by this proposal.**
5. **Attach additional documentation by clicking .**

- **College/Department**

  Physics and Astronomy

- **Semester Subject Area**

  AST

  Semester Catalog Number

  1010

- **Quarter Subject Area**

  None Selected

  Quarter Catalog Number

  NA

- **Course Title**

  Stars, Galaxies, and the Universe

- **Units***

  (3)

- **C/S Classification***

  C-01 (Large Lecture)

- **To view C/S Classification Long Description click: http://www.cpp.edu/~academic-programs/scheduling/Documents/Curriculum%20Guide/Appendix_C_CS_Classification.pdf**
- **Component***

  Lecture

- **Instruction Mode***

  Face-to-Face
  Hybrid w/Asynchronous Component
  Web-Assisted

- **Grading Basis***

  Graded Only

- **Repeat Basis***

May be taken only once

- **If it may be taken multiple times, limit on number of enrollments**

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- **Cross Listed Course Subject Area and Catalog Nbr (if offered with another department)**
- **Dual Listed Course Subject Area and Catalog number (If offered as lower/upper division or ugrd/grad)**
- **Choose appropriate type(s) of course(s)***
  - ☐ **Major Course**
  - ☐ **Service Course**
  - ☑ **GE Course**
  - ☐ **None of the above**
- **General Education Area / Subarea***

B1

- **To view the General Education SubArea definitions, click http://www.cpp.edu/~academic-programs/scheduling/Documents/Ch.3-GeneralEducationProposals.pdf.**
- **I. Catalog Description**
- **Catalog Description**

Survey of the universe including lifecycles of stars, supernovae and creation of the chemical elements, collapsed objects (white dwarfs, pulsars and black holes), the Milky Way and other galaxies, distances to stars and galaxies, expansion of the universe, and Big Bang cosmology. Emphasis on the basic principles of physics needed to interpret astronomical observations.

- **II. Required Coursework and Background**
- **Prerequisite(s)**

Prerequisite: None.

Corequisite: None.

- **Corequisite(s)**
- **Pre or Corequisite(s)**
- **Concurrent**
- **III. Expected Outcomes**
- **List the knowledge, skills, or abilities which students should possess upon completing the course.***

Upon completion of the course:

1. The student will be able to explain the nature of scientific investigation and observation, including the critical role that telescope observations combined with fundamental physical laws play in our acquisition of knowledge of diverse and bizarre objects in the Universe.

2. The student will, after guided practice in the dissection and explanation of complex astronomical phenomena, be able to solve problems that involve scaling laws and simple calculations.

3. The student will be able to explain basic principles of Newtonian mechanics, optics, thermodynamics, and nuclear phenomena, and apply them to the solution of problems in astronomy and the description of astronomical phenomena.

- **If this is a course for the major, describe how these outcomes relate to the mission, goals and objectives of the major program.**
- **Explain how the course meets the description of the GE SubArea(s). Please select appropriate outcomes according to the GE Area/SLO mapping.**

Astronomy is, by many reckonings, the oldest of the physical sciences, and was pivotal in the development of physics in its current form (through the work of Kepler, Galileo, and Newton on celestial mechanics and its implications for the general laws that govern the mechanical motion of all objects). A modern course on astronomy is not merely a description of what is seen in the sky, but is in fact a highly quantitative exploration of the physical principles that underlie

The course satisfies all of the expected Student Learning Outcomes for GE subarea B1:

Ia. Write effectively for various audiences.

Students will produce written explanations of their reasoning in calculations, and will provide short essay answers to conceptual questions about physical situations. Questions requiring written explanations of reasoning, or written interpretation of physical situations, will be included on graded homework assignments as well as tests. (See Course SLOs 1 and 3)

Id. Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.

Students will produce problem solutions that not only give a correct numerical result, but also correct reasoning leading to the result. Students will explain why they used a particular principle for a calculation, or why they translated a verbal description of a physical or astronomical situation into a particular geometrical model or equation. (See Course SLOs 2 and 3)

Ie. Apply and communicate quantitative arguments using equations and graphical representations of data.

Students will solve conceptual problems (e.g. ranking tasks, applications of scaling relations) using equations for scaling relations, and also do simple numerical problems. Students will explain in their solutions how the principles underlying the relevant equation(s) apply to the physical situation in the problem. Additionally, students will answer questions that require them to produce graphs or diagrams that represents physical quantities such as the orbit of a binary stars around their center of mass and the time variation of their velocities. (See Course SLOs 1, 2, and 3).

IIa. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.

Students will work on conceptual problems in which they apply principles from many areas of physics, ranging from Newtonian mechanics to thermodynamics to even quantum mechanics (e.g. relation between the energy/frequency of photons emitted from a star and the temperature of the star). Students will also perform simple calculations. The solutions to these calculations and conceptual problems will yield qualitative and quantitative predictions about astronomical phenomena, which can and will be compared with real observational data. (See course SLOs 1, 2, and 3)

- **Describe how these outcomes relate to the associated GE Learning Outcomes listed below.***

Ia. Write effectively for various audiences.

Students will produce written explanations of their reasoning in calculations, and will provide short essay answers to conceptual questions about physical situations. Questions requiring written explanations of reasoning, or written interpretation of physical situations, will be included on graded homework assignments as well as tests. (See Course SLOs 1 and 3)

Id. Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.

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Ie. Apply and communicate quantitative arguments using equations and graphical representations of data.

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IIa. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.

Students will work on conceptual problems in which they apply principles from many areas of physics, ranging from Newtonian mechanics to thermodynamics to even quantum mechanics (e.g. relation between the energy/frequency of photons emitted from a star and the temperature of the star). Students will also perform simple calculations. The solutions to these calculations and conceptual problems will yield qualitative and quantitative predictions about astronomical phenomena, which can and will be compared with real observational data. (See course SLOs 1, 2, and 3)

- **General Education Outcomes***

Ia. Write effectively for various audiences
Id. Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.
Ie. Apply and communicate quantitative arguments using equations and graphical representations of data.
IIa. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.

- **To view the mapping, click https://www.cpp.edu/~academic-programs/Documents/GE%20SLO%20Mapping.pdf**
- **IV. Instructional Materials**
- **Provide bibliography that includes texts that may be used as the primary source for instruction, and other appropriate reference materials to be used in instruction. The reference list should be current, arranged alphabetically by author and the materials should be listed in accepted bibliographic form.**
- **Instructional Materials***

Texts may vary with instructor and over time. Examples of possible texts include:

- Jeffrey Bennett, Megan Donahue, Nicholas Schneider, and Mark Voit. 2008. *The Cosmic Perspective: Stars, Galaxies, and Cosmology*, 5th edition. San Francisco: Pearson/Addison Wesley.
- Edward E. Prather, Timothy F. Slater, Jeffrey P. Adams, Gina Brissenden. 2008. Lecture Tutorials for Introductory Astronomy, 2nd edition. San Francisco: Pearson/Addison Wesley.

Additional notes and current papers on the diverse topics may also be made available on BlackBoard by the instructor.

- **Faculty are encouraged to make all materials accessible. Indicate with an asterisk those items that have had accessibility (ATI/Section 508) reviewed. For more information,http://www.cpp.edu/~accessibility**
- **V. Minimum Student Material**

- **List any materials, supplies, equipment, etc., which students must provide, such as notebooks, computers, internet access, special clothing or uniforms, safety equipment, lockers, sports equipment, etc. Note that materials that require the assessment of a fee may not be included unless the fee has been approved according to University procedures.**
- **Minimum Student Material***

Students will use Classroom Response Systems (CRSs) or clickers (purchased at the bookstore) to respond to Think-Pair-Share (TPS) questions in class.

- **VI. Minimum College Facilities**
- **List the university facilities/equipment that will be required in order to offer this class, such as gymnastic equipment, special classroom, technological equipment, laboratories, etc.**
- **Minimum College Facilities***

A smart classroom with Internet connection and computer projector and seating for at least 50 students.

- **VII. Course Outline**
- **Describe specifically what will be included in the course content. This should not be a repetition of the course description but an expansion that provides information on specific material to be included in the class, e.g. lecture topics, skills to be taught, etc. This should not be a week-by-week guide unless all instructors are expected to follow that schedule.**
- **Course Outline***

Topics will be clustered into approximately 8 units

1. Introductory fundamentals

- Our Place in the Universe
- The Science of Astronomy: Kepler's Laws

2. Key physics principles for astronomy

- Making Sense of the Universe: Motion, Energy, and Gravity
- The Nature and Interaction of Light and Matter
- Special relativity: Space and Time

3. Observational tools

- Imaging with telescopes: Ground-based, space-based, reflectors, antennas, and beyond
- Spectral measurements
- Detection of particles other than photons

4. Types of stars

- Our Star: The Sun

- Surveying the Stars: Stellar Properties

5. The life and death of stars

- Stellar birth
- Stellar Evolution
- The Bizarre Stellar Graveyard: White Dwarfs and Neutron Stars

6. Extremes of space and time

- Black Holes
- Spacetime and Gravity

7. Galaxies

- Our galaxy
- Types of galaxies
- Galactic evolution

8. The universe on the large scale

- The distribution and motion of galaxies and the Foundation of Modern Cosmology
- Dark Matter, Dark Energy, and the Fate of the Universe
- The Beginning of Time

VIII. Instructional Methods

Describe the type(s) of method(s) that are required or recommended for the instruction of this course (lectures, demonstrations, etc.). Include any method that is essential to the course, such as the use of particular tools or software.

Instructional Methods*

- Short, targeted lectures, designed to prepare students to participate in Interactive Learning activities, such as those described below
- Demonstrations designed to illustrate basic physical principles, e.g., the use of a discharge tube to demonstrate the formation of emission line spectra by excited atoms, and the uniqueness of each element's spectrum
- Extensive use of computer animated figures (provided with textbook and from the internet) to show dynamical processes (e.g,. orbits of binary stars), or to illustrate basic principles (e.g., Kepler's 2nd Law)
- Interactive learning activities including:

- Think-Pair-Share (TPS) questions, during which students first answer a challenging multiple choice question individually (their answers recorded by a classroom response system, or clickers), then discuss with their near neighbors (peer instruction), then answer again.
- Lecture Tutorials (LTs): Socratic-dialogue driven worksheets, completed in groups, that make use of students' ordinary language to promote small cognitive steps, ultimately guiding student thinking towards between able to provide a scientifically accurate description of the topic.
- Ranking Tasks (RTs), which present the student with a series of four to eight pictures or diagrams that describe several slightly different variations of a basic physical situation, from which he or she is asked to make a comparative judgment and to identify the order or ranking of the various situations based on some physical outcome or result.

- **IX. Evaluation of Outcomes**
- **Describe the methods to be used to evaluate students' learning, i.e. written exams, term papers, projects, participation, quizzes, attendance, etc.***

A number of tools will be used to evaluate the extent to which the students meet the educational outcomes specified for the course:

0. **On-line reading quizzes:** Students will complete an on-line reading quiz for each reading assignment, ensuring that they come to class prepared for the interactive activities.
1. **In-class Think-Pair-Share (TPS) questions and Lecture Tutorials/Ranking Tasks:** The answers to TPS questions will be collected and scored automatically by the Classroom Response System, and Lecture Tutorials and Ranking Tasks will be collected and evaluated. All three activities, TPS questions, LTs and RTs, will probe students' critical reasoning skills (GE SLOs Id and Ie), as the questions they ask require higher order reasoning to complete correctly. Also, all three activities emphasize group problem-solving skills. Moreover, Ranking Tasks and any questions involving scaling relations or simple calculations (whether in TPS form or Lecture Tutorials) will require students to use quantitative skills (GE SLO IIa).
2. **Homework Assignments (including Ranking Tasks, and additional conceptual questions and short calculations):** These assignments will have problems and questions that are similar to the in-class TPS questions and Lecture Tutorials, but will be more in-depth, requiring students to select the proper principles and models to apply to different physical situations (GE SLOs Id, Ie, and IId) and produce written explanations of their reasoning (graded for both scientific correctness and writing quality).
3. **Exams:** The exams will also test students critical reasoning skills, and will provide a measure of how well each individual student can explain and apply the fundamental physical concepts governing the Universe and how these fundamental laws of nature, together with careful observation, can reveal the nature of distant objects in the Universe, as well as the structure of the Universe as a whole.

- **Describe the meaningful writing assignments to be included.***

Students will provide justification for their reasoning and calculation steps in weekly written homework assignments, which will be graded and critiqued both for clarity and correctness. Short calculations will typically require just short explanations (a sentence or two) to clarify steps, while conceptual questions will require longer explanations (short paragraphs). Graded work will be returned with comments. On exams, given after students have completed several written assignments and received comments, students will be expected to provide more detailed justifications for answers, and the expectations for the depth and clarity of written justifications will increase on each subsequent exam, after students have received feedback on the previous exam.

- **Discuss how these methods may be used to address the course and program outcomes, as appropriate. Include or attach a matrix to align the evaluation methods to the outcomes.***

Student Learning Outcomes	**Reading quizzes**	**In-class activities**	**Homework**	**Exams**
Course SLO 1: The student will be able to explain the nature of scientific investigation and observation, including the critical role that telescope observations combined with fundamental physical laws play in our acquisition of knowledge of diverse and bizarre objects in the Universe.	X	X	X	X
Course SLO 2: The student will, after guided practice in the dissection and explanation of complex astronomical phenomena, be able to solve problems that involve scaling laws and simple calculations.		X	X	X
Course SLO 3: The student will be able to explain basic principles of Newtonian mechanics, optics, thermodynamics, and nuclear phenomena, and apply them to the solution of problems in astronomy and the description of astronomical phenomena.	X	X	X	X

- **If this is a general education course, discuss how these methods may be used to address the associated GE Learning Outcomes listed below. Include or attach a matrix to align the evaluation methods to the outcomes.***

Student Learning Outcomes	**Reading quizzes**	**In-class activities**	**Homework**	**Exams**
GE SLO Ia: Write effectively for various audiences.			X	X
GE SLO Id: Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.	X	X	X	X
GE SLO Ie: Apply and communicate quantitative arguments using equations and graphical representations of data.		X	X	X
GE SLO IIa: Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.		X	X	X

- **X. This OPTIONAL Section is for describing Course/Department/College specific requirements.**
- **Department/ College Required ECO Information (Optional)**