Agenda Item #06-122
Effective Spring 2008

Eastern Illinois University
New Course Proposal
PHY 4100, Astrophysics

Please check one: ☒ New course ☐ Revised course

PART I: CATALOG DESCRIPTION

1. **Course prefix and number:** PHY 4100
2. **Title:** Astrophysics
3. **Long title:**
4. **Class hours per week, lab hours per week, and credit:** (3-0-3)
5. **Term(s) to be offered:** ☐ Fall ☒ Spring EVEN Years ☐ Summer ☐ On demand
6. **Initial term of offering:** ☐ Fall ☒ Spring ☐ Summer ☐ Year 2008
7. **Course description:** An introductory course in astrophysics, with an emphasis on applying the tools of mechanics, electromagnetism, thermodynamics, and quantum theory to understand the processes inherent in galaxies, cosmology and the structure and evolution of stars.
8. **Registration restrictions:**

   a. Identify any equivalent courses. There are no equivalent courses.

   b. Prerequisite(s): PHY 3080

   c. Who can waive the prerequisite(s)?

   ☐ No one ☒ Chair ☐ Instructor ☐ Advisor ☐ Other (Please specify)

   d. Co-requisites: None

   e. Repeat status: ☒ Course may not be repeated.

   ☐ Course may be repeated to a maximum of hours or times.

   f. Degree, college, major(s), level, or class to which registration in the course is restricted, if any:
   g. Degree, college, major(s), level, or class to be excluded from the course, if any:
9. **Special course attributes**: None
10. **Grading methods** (check all that apply): ☒ Standard letter ☐ C/NC ☐ Audit ☐ ABC/NC
11. **Instructional delivery method:** lecture

PART II: ASSURANCE OF STUDENT LEARNING

1. List the student learning objectives of this course:

Students will:

- Analyze the physical principles that are applicable in astrophysical systems.
- Evaluate observational data relevant to astronomical systems and judge its physical meaning.
- Perform calculations that model the observed astronomical data and guide new observational work.

a. This is not a general education course.
b. This is not a graduate level course.

2. Identify the assignments/activities the instructor will use to determine how well students attained the learning objectives:

	(30%) Homework	(50%) Exams	(20%) Final Exam
Analyze the physical principles that are applicable in astrophysical systems.	X	X	X
Evaluate observational data relevant to astronomical systems and judge its physical meaning.	X	X	X
Perform calculations that model the observed astronomical data and guide new observational work.	X	X	X

3. Explain how the instructor will determine students' grades for the course:
   - 3 Exams and final (70%)
   - Homework (30%)
4. This is not a technology delivered course.
5. The course number for this course is not between 4750 and 4999.
6. *There is no writing designation for this course.*

PART III: OUTLINE OF THE COURSE

a) Units of time: 3 fifty-minute lectures for 15 weeks.
Week 1: Celestial coordinates, distances, magnitude scales (absolute and apparent), color indices
Week 2: Spectral classes, gravity, celestial mechanics
Week 3: Masses of stars, mass measurement (exo planets and black holes)
Week 4: Telescopes and detectors
Week 5: Hydrostatic equilibrium, classical and quantum statistics, Saha equation
Week 6: Polytropic stars, equations of state, examples from the sun, white dwarfs
Week 7: Radiative transport, convection, opacities, scaling laws
Week 8 Energy generation, nuclear burning, Coulomb barrier penetration, evolution of low and high mass stars
Week 9: Stellar atmospheres, spectral lines
Week 10: Galaxy morphology, properties of galaxies, relaxation times
Week 11: Boltzmann and Jeans equation, clusters of galaxies
Week 12: Evidence for expansion of the universe, galaxy formation
Week 13: Friedmann-Robertson-Walker metric and general relativity
Week 14: Helium production, supernovae and cosmic acceleration
Week 15: Fluctuations in microwave background, inflation
Finals week: Final exam.

PART IV: PURPOSE AND NEED

1. Explain the department's rationale for developing and proposing the course.
   - Physics majors seek a broad understanding of the physical processes that govern the universe and modern problems of current interest to astronomers and physicists. Students need a course that unifies the application of the various branches of physics, such as mechanics, quantum theory, thermodynamics, and electromagnetism. The newly proposed course PHY 4100 aims at this. This

course focuses on the theoretical approach to the solution of the multifaceted physical systems inherent to astronomy. Topics that will be covered include the structure, evolution, stability and death of stars, galaxies and the universe. In the topics of stars, students will gain experience in dealing with complex systems where gravity, radiation, statistical mechanics, and nuclear physics play a vital role.

a. This course is not a general education course.
b. This course is not a technology delivered course.

2. Justify the level of the course and any course prerequisites, co-requisites, or registration restrictions.
This course is designed to be an upper-level course for physics majors and minors. Since this course deals with topics in mechanics, electrodynamics, and quantum theory, students are expected to have a working knowledge in these areas, and therefore students must have completed PHY 1351, PHY 1361, PHY 1371 and PHY 3080. This course is appropriately placed at the 4000 level.

3. If the course is similar to an existing course or courses, justify its development and offering.

a. This course does not substantially duplicate the contents of an existing course.
b. No course will be deleted if this course is approved. This course is required in the new option.

4. Impact on Program(s):

This course will be required for undergraduate Physics majors who have chosen the Astronomy option. It will be an elective for undergraduates in the Physics major and minor.

PART V: IMPLEMENTATION

1. Faculty member(s) to whom the course may be assigned:
   - This course will be initially taught by Dr. James Conwell but can be taught by other faculty members in the Physics Department who have background in astronomy or astrophysics.

2. Additional costs to students:
   - The physics department has the required software for this course. No additional course fees.

3. Text and supplementary materials to be used (Include publication dates):
   - "An Introduction to Modern Astrophysics" , 2nd edition, by Carroll and Ostlie, Addison Wesley, 2006.

PART VI: COMMUNITY COLLEGE TRANSFER

A community college course will not be judged equivalent to this course.

PART VII: APPROVALS

Date approved by the Physics Department October 5th, 2006

Date approved by the College of Sciences Curriculum Committee November 17th, 2006

Date approved by CAA December 7th, 2006