

## **COURSE OUTLINE**

### **Descriptive Astronomy**

#### **Course Description**

PH 103. Descriptive Astronomy. 4 hours credit. This course will enable the student to study the characteristics of the solar system, stars, and galaxies. Also discussed will be the tools and methods used by astronomers. Other topics will include the effect of the space program on the understanding of astronomical phenomena, several of the current theories on the origin of the universe, and the current projects involved in the search of extraterrestrial intelligence. In the laboratory portion of the course, familiarity with the objects on the nighttime sky (constellations, the feature of the moon, identification of planets) will be developed. Techniques of small telescopes and binoculars will be developed, indoor exercises will include the use of star and constellation charts, planetary models, and a variety of computer activities. This course will meet for three hours of lecture and 2 hours of laboratory per week.

#### **Course Relevance**

The impact of astronomy in everyday life is phenomenal. The ability to see and do astronomy in action is necessary to develop a fuller knowledge and understanding of the world around us. Astronomy will enrich the student's appreciation of the world and help him/her better understand the studies of science and the scientific methods.

#### **Required Materials**

Chaissen & McMillan. (2006) *Astronomy: a beginner's guide to the universe*. (5<sup>th</sup> ed.) Addison-Wesley

Laboratory Experiments: The instructor will facilitate at least 15 experiments that support the objectives of the course. Some copies of previously used experiments may be obtained upon request from the lead instructor.

Telecourse:

Astronomy: Observations and Theories. Twenty 30-minute lessons on DVD

#### **Other departmental materials**

The Physics Department has available to instructors a set of Astronomy laboratory activities entitled *Virtual Astronomy Laboratory* produced by Physics Curriculum and Instruction. The activities consist of experiments that allow the students to collect astronomical data from a computer. The data is analyzed by the student. Contact the Lead Instructor for more information about the laboratory activities.

Also available is *Discovering Astronomy* laboratory packets by Shawl. A supply of the *Discovering Astronomy* is available at each learning site. The activities consists of hands-on learning, where the students get to actually construct and gather data

using the instrument they designed. Contact the Lead Instructor for more information about this set of laboratory activities.

### **Learning Outcomes**

The intention is for the student to be able to:

1. Analyze scientific materials in various forms
2. Use scientific method
3. Read, discuss, and understand scientific materials
4. Demonstrate a knowledge of basic math skills
5. Apply scientific reasoning to real world problems

### **Learning PACT Skills that will be DEVELOPED and/or documented in this course**

Through involvement in this course, the student will develop in the following PACT skill area(s):

#### **Personal Development Skills**

1. Personal management
  - Through the production of either an essay or questionnaire the student will reflect on his/her personal management skills.

#### **Analytical Thinking Skills**

1. Critical thinking
  - Through the production of various mathematical, graphical, experimental and written assignments, the student will demonstrate scientific reasoning.

#### **Communication Skills**

1. Creation and delivery of messages
  - Through a variety of methods using either the internet and/or computer the student will produce a lab report to express his/her findings laboratory reports.

#### **Technology Skills**

1. General Computer use
  - Through the production of electronic-facilitated research, preparing the graphs, and manipulation of data, the student will develop basic computer skills.

### **Major Summative Assessment Task(s)**

These learning outcome(s) and the Learning PACT skill(s) will be demonstrated by

1. Writing a research paper or preparing a project upon a topic of astronomy as assigned by the instructor.
2. Demonstrating the use of technology by performing searches, online lab activities, and graphing.
3. Completing the departmental final.

### **Course Content**

- I. Skills/Competencies - Actions that are essential to achieve the course outcomes:
  - A. Mathematics
  - B. Writing
  - C. Reading
  - D. Speaking
  - E. Computer literacy

- F. Computer spreadsheet/graphing
- G. Internet use
- H. Teamwork
- II. Themes - Key recurring concepts that run throughout the course:
  - A. Scientific method
  - B. Scientific reasoning
- III. Issues - Key areas of conflict that must be understood in order to achieve the intended outcome:
  - A. The balance between the conceptual and mathematical models
  - B. The cumulative nature of science and the world
  - C. The cumulative influence of scientific discoveries and the subsequent application of the discoveries
  - D. The balance between lab and computer interfacing, collection and analysis of data
- IV. Concepts – Key concepts that must be understood to address the issues:
  - A. Mathematics
  - B. Visual/conceptual
  - C. Scientific methods
  - D. Scientific reasoning
  - E. Modeling
  - F. Scientific writing
  - G. Scientific principles
  - H. MLA writing format
  - I. Word processing
  - J. Excel spreadsheet
  - K. Graphing
  - L. Characteristics and impact of science in the world around them

### **Learning Units - Lecture**

- I. The night sky
  - A. Describe the patterns formed by the fixed stars in the nighttime sky
  - B. Discuss the changes in the night sky caused by movements of the Earth
  - C. Discuss eclipses and their relation to relative motions of the Earth and moon
- II. Gravity and basic science
  - A. Discuss the development and foundations of modern science and be able to utilize them in explaining various astronomical phenomena
  - B. Describe how past civilizations have attempted to explain the behavior of the Earth and sky (i.e. Babylonians and Greeks)
  - C. Discuss the contributions of renaissance scientists such as Copernicus, Galileo, Tycho, and Kepler (as examples)
  - D. Discuss the different theories of gravitation as developed by Newton and Einstein
- III. Light and telescopes
  - A. Discuss the nature and properties of light (wave-particle theory and photons)
  - B. Discuss the electromagnetic spectrum and how astronomers use those properties

- to investigate the heavens
- C. Discuss the optics of a telescope and the different telescopes

#### IV. The origin of light

- A. Define and discuss blackbody radiation
- B. Identify and discuss spectra, atoms and elements

#### V. The Solar System

- A. Provide a general description of the organization of the solar system
- B. Discuss the Earth-moon system
- C. Identify and describe the inner (terrestrial) planets
- D. Identify and describe the outer (Jovian) planets
- E. Describe asteroids, comets, and meteoroids
- F. Discuss the various phenomena of the sun

#### VI. Stars

- A. Discuss the nature and functioning of stars
- B. Describe the different types of stars
- C. Discuss the relationships between temperatures and different properties of stars
- D. Identify and energy production and structure of stars
- E. Explain the methods astronomers use to determine distance to the stars (stellar and galactic)
- F. Describe the evolution of stars and H-R diagram

#### VII. Galaxies

- A. Describe the nature and structure of our galaxy
- B. Describe other types of galaxies
- C. Discuss the distribution of galaxies
- D. Explain quasars

#### VIII. Cosmology

- A. Discuss ancient models
- B. Discuss the Big Bang model

#### IX. Life in the universe

- A. Discuss several of the current theories about the origin of life on Earth
- B. Explore the Drake equation – factors affecting the possibility of finding extra-terrestrial life

### **Learning Units - Laboratory**

#### I. Utilize hands on activities

- A. Identify with the naked eye prominent constellations and stars
- B. Gain experience with the use of elementary astronomical instruments
  - 1. Cross-staffs, quadrants, etc
  - 2. Binoculars

3. Small telescopes
  - C. Make observations, record data and interpret in various ways from the elementary astronomical instruments
- II. Working in the laboratory in accordance with good laboratory practices
    - A. Dress in an appropriate manner as to promote safety in the laboratory
    - B. Follow written directions accurately
    - C. Work safely and effectively, using equipment correctly
    - D. Demonstrate use of required safety and common laboratory techniques
  - III. Gather and record qualitative and quantitative data accurately
    - A. Acquire data using balances and various equipment
    - B. Make and record visual observations
    - C. Use computers, when appropriate, as data acquisition tools
    - D. List or describe experimental assumptions made and any deviations from the written experimental procedures
  - IV. Handle and evaluate data in logical, productive, and meaningful ways
    - A. Create notebooks and laboratory reports that are clear, understandable, and that accurately represent the data collected
    - B. Display computer data in a spreadsheet or graphically, as appropriate
    - C. Correlate observations with astronomical processes
    - D. Carry out suitable calculations with quantitative data, recognizing when data and calculations are within a reasonable range
    - E. Use observations of experimental data to present relevant conclusions pertaining to the experimental procedure
  - V. Correlate laboratory work with principal topics in Descriptive Astronomy lecture/readings

### **Learning Activities**

Independent and collaborative learning activities will be assigned within and outside the classroom and laboratory to achieve the intended course outcomes. Classroom discussion, lecture, and textbook reading assignments will also contribute to the learning process.

### **Grade Determination**

Grade determination may include tests, projects, quizzes, homework, written assignments and laboratory experiments. Other methods may be used at the discretion of the instructor.