University of South Carolina
Carolina Core

ASTRONOMY 201
INTRODUCTION TO ASTRONOMY II: THE DARK UNIVERSE

BULLETIN INFORMATION

ASTR 201 – Introduction to Astronomy II: The Dark Universe (3 credit hrs)

Course Description:

Astronomical topics including stellar death, black holes, dark matter, dark energy and cosmology. Astronomical techniques and application of the scientific method in astronomy. Pre-requisites: ASTR 101 or SCHC 115, or consent of the instructor

SAMPLE COURSE OVERVIEW

Astronomy 201 will be an interactive lecture course for students without any scientific background. The lectures will build on the material covered in ASTR 101 (astronomical observations, the solar system, stars, our galaxy and the big bang). In ASTR 201 we will explore selected topics in greater depth and extend to new areas of modern astronomy with an emphasis on the "dark" components of the universe. Subjects will include: stellar death, black holes, dark matter in galaxies and galaxy clusters, dark energy and the very early universe. The goal of the course is to develop an understanding of how astronomers study a universe that is mostly unknown and largely invisible.

ITEMIZED LEARNING OUTCOMES

Upon successful completion of ASTR 201, students will be able to:

1. Explain how the scientific process is applied in advancing astronomical understanding, from exploration to data collection and confrontation with theory.
2. Formulate productive questions when presented with new astronomical information or observations.
3. Name different types of astronomical observations, and explain how they are executed and what information they can provide.
4. Demonstrate an understanding of the role of uncertainty and probability in scientific reasoning, including differentiation and joint application of related concepts such as precision and accuracy, and statistical and systematic uncertainty.
5. Identify ways in which societal pressures and human bias can incentivize and influence scientific investigation.

SAMPLE REQUIRED TEXTS/SUGGESTED READINGS/MATERIALS

1. *Astronomy, A Beginners Guide to the Universe*, Seventh Edition, Chaisson and McMillan, 2013, Pearson Education Inc. (Glenview, Il). ISBN 978-0-321-81535-4. NOTE: This is the same book used in the ASTR 101 course.
2. Along with the physical textbook purchase, students will have on-line access to the Mastering Astronomy web site – www.masteringastronomy.com - that has an electronic version of the textbook and video tutorials.

3. **"**i>clicker2's" are required for this class and will be employed throughout each lecture. They can be purchased new from the bookstore or used from students.

SAMPLE ASSIGNMENTS AND/OR EXAMS

1. **Lectures, Class Participation, and iClickers**: Throughout the lectures, students will be asked questions on the astronomy topics presented and covered in the reading material as outlined in the lecture timetable. The students will work in small groups to answer the questions using iClickers. These groups will engage in discussions and problem solving that require critical thinking. These in-class questions then provide real-time feedback and allow the students to demonstrate their understanding of the concepts and methods of astronomy. Based on the answers to the questions, the lecture will be tailored to address in more detail areas of difficulty for the students.
2. **Homework**: Weekly homework assignments will consist of conceptual and numerical problems that accompany each chapter under discussion. Completion of these problem sets will require the students to demonstrate a deeper understanding of the topics in both qualitative and quantitative fashion.
   Problem sets are to be completed each week as designated on the course timetable and announced in class. Answers will be made available the next day.
   The LON-CAPA homework system will be used.
3. **Tests:** The exams for the class will include both conceptual and numerical problems in multiple choice questions. These exams will be closed-book, without notes. Successful completion of the exams will demonstrate mastery of the learning outcomes outlined above.
4. **Final Exam**: The final exam is comprehensive and will cover all concepts introduced in this course. All students must take the final exam.

SAMPLE COURSE OUTLINE WITH TIMELINE OF TOPICS, READINGS/ ASSIGNMENTS, EXAMS/PROJECTS

Week 1

Day 1: Introduction and overview
Day 2: White Dwarfs, Neutron Stars and Pulsars

Week 2

Day 3: Supernovae
Day 4: Gamma Ray Bursts

Part 1: The Stellar Graveyard

Week 3

Day 5: Black Holes I: Introduction
Day 6: Black Holes II: Relativity

Week 4

Day 7: Black Holes III: Supermassive Black Holes
Day 8: Gravitational Waves

Week 5
Day 9: TEST 1

Part 2: Dark Matter
Day 10: Dark Matter in Galaxies

Week 6
Day 11: Galaxy Clusters
Day 12: Gravitational Lensing

Week 7
Day 13: Collisions and Mergers
Day 14: Large Scale Structure

Week 8
Day 15: Direct Detection Experiments
Day 16: TEST 2

Week 9
Day 17: SPRING BREAK. NO CLASSES
Day 18: SPRING BREAK. NO CLASSES

PART 3: Cosmology and Dark Energy
Week 10
Day 19: Geometry of the Universe
Day 20: Observable Cosmological Parameters

Week 11
Day 21: Cosmic Acceleration and Dark Energy
Day 22: Cosmic Microwave Background

Week 12
Day 23: Nucleosynthesis
Day 24: Inflation

Week 13
Day 25: The Fate of the Universe
Day 26: TEST 3

PART 4: Life in a Dark Universe
Week 14
Day 27: Life in our solar system
Day 28: Habitability in our galaxy and beyond

Week 15

Day 29: Intelligent Life in the universe

Day 30: The next decade in astronomy

Final Exam according to University schedule.