PHYS/ASTR 4080
Spring 2014

Professor: Kyle Dawson
Office: INSCC 328
Email: kdawson@astro.utah.edu
Office Hours: Thursdays 2:30PM-3:30PM and by appointment
Course Website: www.physics.utah.edu/~kdawson/phys4080

Teaching Assistant/Grader: Christopher Ahn
Email: chris.ahn43@gmail.com
Office Hours: 1:00-2:00 PM Friday

Class hours: Monday/Wednesday/Friday, 2:00 PM – 2:50 PM.
Classroom: JFB 102
Textbook: ***Introduction to Cosmology***, Barbara Ryden, 2003.
HW: Due on Fridays at 5PM in mailbox of Kyle Dawson – Main Physics office

Introduction

Cosmology is the study of the universe – past, present and future. Not only is cosmology the study of the time evolution of the universe, but also the study of the laws of physics and materials that determine the formation of stars, galaxies, and clusters of galaxies.

In this course, we will first discuss the earliest observations and theoretical framework that started the field of cosmology. In the second part of the course, we will discuss the cosmological evolution of the universe and the recent experiments that have led to this understanding.

There are no enforced pre-requisites for this course. However, the student is expected to have at least three semesters of physics and to have a keen interest in thermodynamics, statistical mechanics, and of course - the history and fate of our universe! A physics or astronomy major in the third year of study will have the appropriate background.

Course Structure

We will meet three times per week. In a typical week, two lectures will be dedicated to the physics behind a cosmological topic as outlined in the textbook. In the other lecture we will also discuss some experiments that are most important to our understanding of this topic. The small class size provides an excellent opportunity for active participation. Daily questions from all members of the class are encouraged and expected.

Student Projects

In the beginning of the semester, the class instructor will bring additional materials to class appropriate to the topic of the week. These materials will come in the form of

scientific publications, dedicated web pages, and small powerpoint presentations that describe an experiment that was essential to developing our understanding of the physical concept being discussed that week.

In the 13th and 14th weeks of the semester, students will make similar presentations on selected topics. Each student will be required to organize and present a 25 minute talk to the class. The talk will provide an introduction to the topic, it will relate to the material covered in class, and will describe at least one experiment that changed the way we understand cosmological physics. Suggested topics can be found below. Students will begin preparing for this talk early in the semester by making appointments for individual consultation in my office on several occasions. Those meetings will proceed as follows:

1. Week of Jan 20-24 – Before meeting, select a topic. Meet to discuss material that can be used for presentation.
2. Week of Feb 17-21 – Before meeting, prepare a rough outline of the slides that will be used and figures and text that will be included. Meet to discuss outline.
3. Week of Mar 17-21 – Before meeting, prepare a draft of talk. Meet to discuss first draft of talk with slides and figures.
4. Week of Mar 31-Apr 4 – Before meeting, practice talk in front of mirror. Meet to discuss talk and make a presentation of talk to the course instructor.

Students will make their presentations to the course according to the schedule below. Projects will be graded on the effort as demonstrated in the individual meetings and on the class presentation.

SUGGESTED TOPICS

1. Measurements of cosmic expansion, measurements of the cosmic distance scale, discovery of dark energy, supernovae and baryonic acoustic oscillations
2. Indirect observations of dark matter, search for direct detection of dark matter, gravitational lensing
3. Discovery of the cosmic microwave background (CMB), study of fluctuations of CMB and consequences for cosmology
4. Model for nucleosynthesis, observations of primordial abundances, model and observations for nucleosynthesis in current universe
5. Structure formation, observations of galaxy clusters, simulations of galaxy formation, large scale structure formation
6. Others

Course Outline

All classes will be held in the usual classroom. The schedule for the class will be as follows:

Week	Date	Topic	Relevant Experiments	Reading	HW
1	Jan 6-10	Fundamental Observations	Homogeneous universe	Ch 1-2	1: due 1/17
2	Jan 13-17	Theories of Gravity	First Gravitational Lensing	Ch 3	2: due 1/24
3	Jan 22-24	Cosmic Dynamics	Hubble Constant - Cepheids	Ch 4	3: due 1/31
4	Jan 27-31	Single-Component Universe		Ch 5	4: due 2/7
5	Feb 3-7	Multiple-Component Universe	Age of Universe	Ch 6	5: due 2/14
6	Feb 10-14	Measuring Cosmic Distances	Supernovae	Ch 7	6: due 2/28
7	Feb 19-21	Midterm	Midterm		
8	Feb 24-28	Dark Matter	Galaxy Rotation, Detection	Ch 8	7: due 3/7
9	Mar 3-7	Cosmic Microwave Background	COBE and WMAP	Ch 9	8: due 3/21
	Mar 10-14	SPRING BREAK			
10	Mar 17-21	Structure Formation	Numerical Simulations	Ch 12	9: due 3/28
11	Mar 24-28	Nucleosynthesis	QSO Spectra	Ch 10	10: due 4/4
12	Mar 31 - Apr 4	Inflation		Ch 11	11: due 4/11
13	Apr 7-11	Student Projects	Student Projects		
14	Apr 14-18	Student Projects	Student Projects		
15	Apr 21-23	Second Midterm	Second Midterm		

Homework

There will be 11 homework assignments over the course of the semester. These assignments will be due the following Friday before 5PM. Please deposit completed assignments in my mailbox in the main Physics office.

Homework will be graded on a scale of 0-10. Late assignments will be accepted but will have 0.5 points deducted if received on Monday, and 0.5 points deducted for each additional day that the assignment is late. Because the student projects will require a fair amount of effort, the homework load will be lighter than would be for a course with no student projects. The worst homework score of the semester for each student will be dropped before computing the final average.

Exams

There will be two exams for this course. Because sessions are 50 minutes, exams will be administered over two meeting times, with half of the material presented on the first day and half of the material on the second day. The first exam will be in class on February 19 and 21 and will cover the theoretical framework described in class and in chapters 1-6 of the textbook. The second exam be on the last days of class, April 21 and 23. This exam will cover chapters 7-12 of the textbook and material from the student projects.

Exams will be open-note and open-book. They will include material covered in the textbook (theory, physics) and covered in class (experimental results, student talks).

Grades

Grades will be determined from homework, student projects, and exams. All will have equal weight – in other words, HW, student talk, midterm, and final will each account for 25% of the grade. The final grades will be determined on a curve. The median grade will be determined at the discretion of the instructor.