

## **Astronomy 5682: Introduction to Cosmology Spring 2023**

*Meetings:* MW 4:10-5:30, University Hall 014

*Instructor:* David Weinberg, 4055A McPherson Lab, 292-2022, [weinberg.21@osu.edu](mailto:weinberg.21@osu.edu)

Mailbox is in 4055 McPherson outside my office

*TA:* Joy Bhattacharyya, Astronomy PhD student, 4029 McPherson, [bhattacharyya.37@osu.edu](mailto:bhattacharyya.37@osu.edu)

*Office hours (in person):* Wednesday, 11:15-12:30, 4055A McPherson Lab

*Office hours (zoom):* Thursday, 9:15-10:15, Meeting ID 963 5497 6034, Password A5682

I should always be there for scheduled office hours unless I have notified the class otherwise, but it's useful to send me an email if you are planning to come to office hours just to remind me (even ~ 20 minutes ahead is useful).

*Course web page:* <http://www.astronomy.ohio-state.edu/~dhw/A5682>

*Midterm Exam:* Wednesday, Feb 22, in class

*Final Exam:* Monday, May 1, 4-5:45 pm, in the usual classroom

### **Course Objectives**

This course is an advanced undergraduate level introduction to astrophysical cosmology, with emphasis on the “standard” big bang theory of the universe and, in the latter part of the course, its extension to a more detailed theory ( $\Lambda$ CDM: the inflation + cold dark matter + cosmological constant model) that is presently the leading scenario for explaining the origin of structure in the universe. The course is intended to give you a solid understanding of the fundamentals of this exciting subject, with a degree of rigor that will prepare you for graduate study in the field if you choose to pursue it.

### **Course Outline**

The topics I plan to address during the course are:

Observational and theoretical basis of the standard model

Spacetime and the Friedmann-Robertson-Walker metric

Dynamics of the expanding universe

Evolution of homogeneous cosmological models

The cosmic microwave background

Big Bang nucleosynthesis

Dark matter and dark energy

Inflationary cosmology

Cosmic microwave background anisotropy

Formation of galaxies and large scale structure

By the end of the course, you should be able to explain the basic ideas behind all of these topics, to other astrophysicists or to non-scientists. You should be able to explain how they fit together to define our current understanding of the universe; in particular, you should be able to explain what the key empirical evidence is for the big bang theory and the  $\Lambda$ CDM scenario. You should be able to explain what the major open questions in contemporary cosmology are and what methods

astronomers and physicists are using to try to answer them. You should be able to carry out calculations that illustrate these concepts and these methods.

## Readings

We are fortunate to have an excellent textbook for this course, *Introduction to Cosmology*, by Barbara Ryden. Dr. Ryden is a Professor of Astronomy at Ohio State, and she developed this textbook out of her own notes for this course in years past. *Introduction to Cosmology* won the American Astronomical Society's Chambliss Writing Award for an outstanding advanced undergraduate textbook; it was the first recipient of this award. We will use the second edition, published by Cambridge University Press. I will list reading assignments from the textbook in class and via Carmen.

## Assignments and Grading

The most important requirement is to attend class and take good notes. Even though we have a good textbook, it is a supplement to the lectures, not a replacement, and you will not be able to learn the material from the textbook alone. I will make my lecture notes for each section of the course available after we complete that section, and you may find them a useful supplement to your own notes.

The course grade will be based 15% on class participation and in-class questions, 40% on problem sets, 15% on the midterm exam, and 30% on the final exam. There will be in-class questions at irregular intervals, and these will contribute to the class participation grade. *Please check now for any conflicts with the midterm exam or final exam (dates and times listed above) and let me know of any conflicts immediately.*

The problem sets are a central component of the course. While they partly serve the function of testing your knowledge and abilities, their most important functions are to help you learn the course material and to teach you new things.

Problem sets should typically take 6-10 hours to complete, and there will be roughly eight problem sets during the semester. They will usually be handed out on Wednesday and due the following Thursday, but specifics will be listed on the individual problem set when it is handed out.

The principal function of the exams is to test your understanding of the course material, but often in the form of applying what you have learned in somewhat new ways. I try to design exams that teach you something, so that you know more coming out than you did going in (even though it may *feel* like you know less than you thought you did!).

## Academic Integrity and Academic Misconduct

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. All OSU instructors are required to report suspected cases of academic misconduct to the Committee on Academic Misconduct. If you are not already familiar with it, I recommend reading the University's Code of Student Conduct, which is available from <http://oaa.osu.edu/academic-integrity-and-misconduct/student-misconduct>.

*In this course, you may consult with your classmates when working on problem sets; this is often a good way to learn. However, you must write up your solutions independently. No consultation is allowed on exams.*

## **Students with Disabilities**

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on a disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; [slds.osu.edu](http://slds.osu.edu); 098 Baker Hall, 113 W. 12th Avenue.

## **Flexibility**

More generally, I try make reasonable accommodations for student needs within the constraints imposed by a 50-person class. If there are dates you know you will miss because of religious observances, athletic competitions, research travel, or other reasons, let me know as far ahead as possible. If illness affects your ability to attend class or complete an assignment on time, let me know as early as you can.

Should in-person classes be canceled because of weather, I will let you know of alternative plans via Carmen/e-mail.