Astronomy 6: Cosmology: The Origin, History, and Fate of the Universe

Winter 2025

Lectures: Tuesday, Thursday, 11:00 am - 12:15 pm, Kinsey Pavilion 1240B

Discussion Section 1A: Tuesday, 5:00-5:50 pm, Physics and Astronomy Building (PAB) 1434A
Discussion Section 1B: Wednesday, 1:00-1:50 pm, Kaufman Hall 101

Homepage: http://www.astro.ucla.edu/∼aes/AST6
BruinLearn Homepage: https://bruinlearn.ucla.edu/courses/198231

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Texts: Foundations of Modern Cosmology, second edition (2005),
by Hawley & Holcolmb. This textbook may be purchased new, used, or digitally.

Calculators: A simple one is **highly** recommended, though not required.

1 Introduction

Cosmology is the study of the large-scale properties of the universe. In this class, we will consider such important questions as: What is the origin of the universe? What is the fate of the universe? What is the universe made of? How large is the universe? What is its shape? What are the origin and evolution of all the structure we see around us in the universe today? We will discuss the ways in which astronomers and physicists try to address these questions, and develop an understanding of cosmology for ourselves.

2 Prerequisites

We will review all the basic physical concepts required for understanding the material in the course. However, we expect that students should feel comfortable performing *basic* calculations at the level of high-school algebra and, occasionally, geometry.

3 Learning Outcomes

Based on based on lectures, and weekly homework assignment, students will engage in the scientific process of inquiry, analysis, problem-solving, and quantitative reasoning. They will also acquire an informed appreciation of the study of cosmology, which concerns the origin, nature, and fate of the universe.

4 GE Credit Acknowledgement

Upon successful completion of this course, students will receive credit towards the General Education requirement in the area of Foundations of Scientific Inquiry: Physical Sciences.

5 Grading

Final grades will be based on homework assignments (a total of 8 given during the quarter), the midterm exam, and the final exam. These factors will be combined in the following percentages to determine your class grade:

- 40% homework
- 30% midterm exam
- 30% final exam

Homework will be assigned roughly every week and is to be turned in online by midnight on the designated day. A total of 8 assignments will be given during the quarter. Late homework may be turned in up to 1 week after the due date. After one week, we will return graded homework and no late assignments will be accepted after that.

The midterm exam is scheduled for Tuesday, February 11th, in class. It will test all material covered up to that point, **and will be given during the regular class lecture time.** It will contain a combination of multiple choice, matching, and True/False questions.

The final exam is scheduled for Tuesday, March 18th, from 8:00 am – 11:00 am. It will be cumulative, drawing on all material covered in the course, and contain a combination of multiple choice, short answer, and True/False questions.

6 Resources

- Midterm and final exams must be completed by the student without assistance and in a manner consistent with standard testing procedures and regulations. Any cheating will be dealt with through the University. We follow the UCLA policies on intellectual integrity, which can be found at: http://www.deanofstudents.ucla.edu/Student-Conduct.

- The UCLA Astronomy division and your professor and teaching assistants are committed to promoting and fostering an inclusive environment to serve our diverse community of learners. Please visit our website at https://www.astro.ucla.edu/diversity-resources.html to learn more about diversity resources and workshops. Our website also lists contact information for allies within the department who are actively working to address diversity issues. If you have questions, concerns, ideas, or feedback, we would love to hear from you.

- Title IX prohibits gender discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking. Students who have experienced sexual harassment or sexual violence can receive confidential support and advocacy at the CARE Advocacy Office for Sexual and Gender-Based Violence, which is found on the 1st Floor of the Wooden Center West, CAREadvocate@caps.ucla.edu, (310) 206-2465. You can also report sexual violence or sexual harassment directly to the University's Title IX Office (2241 Murphy Hall) at titleix@conet.ucla.edu, (310) 206-3417.

- CAPS (Counseling and Psychological Services) offers 24-hour crisis counseling via phone (310-825-0768) as well as in-person short-term counseling for all students. Students can walk in Mon-Thurs. 9am - 4pm, Fri. 9am - 3pm and be seen by a Brief Screen Counselor on the same day, who will address immediate needs and determine future care as needed. Please visit www.counseling.ucla.edu for more mental health resources available on campus.

- COVID Policies: Ensuring a safer campus depends on each of us following the latest UCLA health and safety guidelines. While campus policies must be modified to address changing local, state, and national orders and guidance, the current campus protocols are available at https://covid-19.ucla.edu/covid-protocols-at-a-glance/

Schedule of Lectures

No.	Date		Title	Chapter
1	Jan	7	Course Introduction. History of Cosmology.	1, 2
		9	CANCELLED	4
2		14	Light and Telescopes.	4
3		16	Properties of Light and Matter. Stellar Spectra.	4
4		21	Gravity and Energy.	3
5		23	Stars. **HW #1 due**	5
6		28	Distances.	10
7		30	The Expanding Universe. **HW #2 due**	10
8	Feb	4	Dark Matter, Dark Energy, and the Expansion History of the Universe I.	11, 13
9		6	Dark Matter, Dark Energy, and the Expansion History of the Universe II. **HW #3 due**	11, 13
10		11	**Midterm Exam, in class.**	
11		13	General Relativity. Spacetime. **HW #4 due**	8 (6 and 7 for background)
12		18	Black holes and Evidence for GR.	9
13		20	The Big Bang Theory. **HW #5 due**	12
14		25	Observations of the Big Bang.	14
15		27	BBN and Other Nucleosynthesis. **HW #6 due**	12
16	Mar	4	Inflation et al.	16, 17
17		6	Structure Formation. **HW #7 due**	15
18		11	Observations of Galaxy Formation and Evolution.	
19		13	Observations of the IGM and Reionization. **HW #8 due**	
		18	**Final Exam**	