ASTRONOMY 309R – FALL 2009
GALAXIES, QUASARS, AND THE UNIVERSE

Unique No. 49510

Course Web Page

Course information including important announcements, reading and homework assignments, homework solutions, lecture notes, and study guides will be made available within the University's Blackboard Learning System: https://courses.utexas.edu

Instructor

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Exam Review Sessions: Tuesdays 6 – 7 p.m.
Review Session Location: RLM 15.216b

COURSE OBJECTIVES

This course provides an introduction into our basic understanding of the formation, structure, and evolution of the universe. Where do the light and the matter permeating space come from? What do we really mean when we say that "the universe is expanding"? How do we know that it was hot and dense at the beginning? What was the Big Bang, and what are the residual traces of this event? How did the intricate cosmic structure, evident in vast astronomical surveys, come into existence? Why are there billions upon billions of stars in every galaxy, and billions of galaxies in the observable universe? What are black holes and what is their unique role in the transformation of galaxies? Where are the boundaries of the present understanding? What are the missing pieces, and what are the scientists doing to complete the picture? Along with a review of modern cosmology, we will briefly discuss the historical emergence of the discipline from its pre-scientific precursors. While tracing the evolution of the universe to its beginnings, we will review recent and future experiments and missions, conducted on Earth and in space, to explore and measure the universe. We will use these examples to illustrate the mechanisms of scientific discovery that set science apart from other endeavors.

PREREQUISITES, LECTURES, HELP SESSIONS, OFFICE HOURS, AND STUDENTS WITH DISABILITIES

Prerequisites

To take Astronomy 309R, you should have taken a descriptive introduction to astronomy, such as Astronomy 301, 302, or 303, or have obtained consent of the instructor.

Hours and Venue

The class meets in Robert A. Welch Hall (WEL) 3.502 on Tuesdays and Thursdays at 9:30 – 10:45 a.m.

Help Sessions

Review help sessions will be scheduled prior to exams or homework assignment due dates in Robert Lee Moore Hall (RLM) 15.216b on Tuesdays at 6 – 7 p.m.

Study Guides

Study guides outlining the material to be covered on each exam will be made available about one week prior to the exam.

Office Hours

Instructor office hours: Tuesdays 2 – 3 p.m., Wednesdays 2:30 – 3:30 p.m., Thursdays 3:30 – 4:30 p.m., or by appointment, in RLM 17.214

Teaching assistant office hours: Mondays 2 – 3 p.m. in one of the TA offices. Additional TA office hours will be scheduled. Please coordinate with your classmates and submit a request for additional office hours with the TAs or the instructor.

Students with Disabilities

Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, 471-6259.

TEXTBOOKS AND REQUIRED READING

Required Textbooks

Foundations of Modern Cosmology, *2nd Edition,* by John F. Hawley and Katherine A. Holcomb (Oxford University Press)

Black Holes and Time Warps: Einstein's Outrageous Legacy, by Kip S. Thorne (W. W. Norton)

Required Course Packet

An excerpt from the book Lakatos: An Introduction by Brendan Larvor, available for purchase at the University Co-op (about $1).

Additional required reading accessible electronically through the University of Texas Libraries Research Tools will be assigned on the course web page in the Blackboard.

Great Books to Read for this Course

Cosmology, The Science of the Universe, 2nd Edition, by Edward Harrison (Cambridge University Press)

The First Three Minutes: A Modern View of the Origin of the Universe, 2nd Updated Edition, by Steven Weinberg (Basic Books)

The Big Bang: 3rd Edition, by Joseph Silk (Times Books)

In Search of Dark Matter, by Ken Freeman and Geoff McNamara (Springer Praxis Books)

Space-Time, Relativity, and Cosmology, by Jose Wudka (Cambridge University Press)

The Edge of Infinity: Supermassive Black Holes in the Universe, by Fulvio Melia (Cambridge University Press)

Dark Cosmos: In Search of Our Universe's Missing Mass and Energy, by Dan Hooper (Collins)

The Extravagant Universe: Exploding Stars, Dark Energy, and the Accelerating Cosmos, by Robert P. Kirshner (Princeton University Press)

Dark Side of the Universe: Dark Matter, Dark Energy, and the Fate of the Cosmos, by Iain Nicolson (Johns Hopkins University Press)

Calibrating the Cosmos: How Cosmology Explains Our Big Bang Universe, by Frank Levin (Springer)

EXAMS AND GRADING

Exams

There will be 5 multiple-choice, 20-question in-class exams, and no final exam. Please see the course schedule at the end of the syllabus for the dates of exams. The lowest exam score will be dropped, and the remaining 4 scores will be added toward the grade. Since each exam will contribute 20 points toward the final grade, the 4 exams will contribute a total of 80 points toward the final grade. ***Please bring a No. 2 pencil to the exam!***

There will be make-up exams for students with valid excuses. The reasons for absence must be presented and acknowledged in advance of examination. No make-up exams can be arranged for those who did not notify the instructor about their absence in advance.

Homework

There will be several homework assignments. The cumulative homework assignment grade will count 72 points toward the final grade. Each assignment will be a set of essay questions, based on the material covered in class and/or available in resources that will be specified in the assignment. Yours answers of the essay questions should be submitted in typewritten form, about two to three pages in length (to be specified in the assignment), double-spaced, in 12-point font. ***Please staple the pages and write your name on your assignment!***

University of Texas policy stipulates that in answering homework essay questions, you can paraphrase but not cite or copy material from any source. Distinction between paraphrasing and citing or copying is clearly explained in:
http://projects.uwc.utexas.edu/handouts/files/Paraphrasing.pdf

You are encouraged to discuss and work on the homework assignments in groups, **but you must write the final answers on your own**. Essays containing identical or nearly identical text fragments will be returned ungraded, and may be referred to the Office of the Dean of Students for adjudication.

Friends and apartment mates taking Astronomy 309R together should be especially careful to write the homework individually. Please never, ever copy-and-paste anyone else's writing into your assignment, because would be a violation of the University's policy. If your classmate asks you to email him or her your homework assignment essay, please ascertain that the classmate will not copy your writing, because if he or she does, credit cannot be assigned to either person; the situation resulting could be an instance of plagiarism and could lead to an administrative nightmare.

Calculation of the grade

Component	Maximum Score
4 best-scoring out of 5 exams (missed exams count as 0 score)	$4 \times 20 = 80$
6 homework assignments 12 points each	$6 \times 12 = 72$
Total	**152**

Score Range	Grade
130 – 152	A
110 – 129	B
90 – 109	C
70 – 89	D
0 – 69	F

Attendance

Since many concepts covered in the course are not covered in the textbook, please do attend the lecture. WEL 3.502 has noisy doors and thus please do arrive on time and do not leave the lecture room until lecture ends, to avoid distracting other students.

Please sit in the front rows – do not sit in the rear of the room! Also, please do let me know if you cannot read the information on the blackboard or on the projector display.

You are strongly encouraged to raise your hand to ask questions during lecture. If I do not notice that you have raised your hand, please call my name, and ask your question.

Please do not read newspapers, magazines or books that are unrelated to the course. You may use your laptops to take notes, but do not use the laptop for chat, computer games, etc., during lecture, since this is highly distracting to anyone sitting next to you or behind you. For the same reasons, please do not converse during lecture.

SCHEDULE

Lecture	Date	Day	
1	August 27	Thursday	Introduction to the Course
2	September 1	Tuesday	Premodern Cosmology
3	September 3	Thursday	Philosophy of Science
4	September 8	Tuesday	Momentum, Energy, Gravity
5	September 10	Thursday	The Virial Relation and its Applications
6	September 15	Tuesday	Stars
7	September 17	Thursday	**First Exam** + lecture
8	September 22	Tuesday	Formation of the Elements
9	September 24	Thursday	Galaxies
10	September 29	Tuesday	Dark Matter
11	October 1	Thursday	Formation of Stars and Galaxies
12	October 6	Tuesday	Special Relativity
13	October 8	Thursday	**Second Exam** + lecture
14	October 13	Tuesday	Curved Space
15	October 15	Thursday	General Relativity
16	October 20	Tuesday	Black Holes
17	October 22	Thursday	**Third Exam** + lecture
18	October 27	Tuesday	Expansion of the Universe
19	October 29	Thursday	Expansion of the Universe
20	November 3	Tuesday	The Cosmic Microwave Background
21	November 5	Thursday	The Cosmic Microwave Background
22	November 10	Tuesday	Dark Energy
23	November 12	Thursday	**Fourth Exam** + lecture
24	November 17	Tuesday	Formation of the Elements Revisited
25	November 19	Thursday	Fluctuations and Inflation
26	November 24	Tuesday	Formation of Stars and Galaxies Revisited
			~ Thanksgiving ~
27	December 1	Tuesday	The Early Universe
28	December 3	Thursday	**Fifth Exam**