

PHYSICS 310/610 – Extragalactic Astronomy and Cosmology

Monday, Wednesday, and Friday 1:00-1:50, Olin 103

Instructor: Eric Carlson

Office: 306 Olin Physical Laboratory

My Web: <http://users.wfu.edu/ecarlson>

Class Web: <http://users.wfu.edu/ecarlson/cosmo2>

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Texts: Two are required

Office Hours

11:30 – 12:45 Monday – Friday

or any time by appointment

1. “Galaxies in the Universe, An Introduction” by Linda Sparke and John Gallagher, 2nd edition; available free online at link
<https://ebookcentral.proquest.com/lib/wfu/reader.action?docID=307061>
2. “An Introduction to Cosmology” by Barbara Ryden, Second Edition.

Who are you: There is a class survey I expect everyone to complete, preferably before the start of the semester, but at the latest by the end of August 25. Please complete ASAP.

<https://forms.gle/ozpuEpgHCrX39ovR7>

Description: This course covers two topics: The nature and organization of galaxies, and the nature, history, and future of the Universe as a whole. A wide variety of physics skills will be brought to bear. The course assumes a level of understanding of physics at the level of Modern Physics (Physics 215), though this material will be reviewed as needed. Often, more advanced concepts will come in as well (general relativity, particle physics, quantum mechanics, statistical mechanics), which will be discussed as needed throughout the course.

Materials: A scientific calculator is a necessity. At times a metric ruler may come in handy. A symbolic manipulation program like Maple is a good idea too.

Covid and Attendance: You are expected to follow all university regulations regarding precautions for Covid-19. To help minimize the spread of germs, if you have any symptoms of a communicable disease, **do not come to class**. Instead, email me and your absence will be considered excused (you don’t need a doctor’s note, unless it is a test date).

Class Participation: Class participation is encouraged, and counts 10% towards your grade. If you don’t understand something, ask me. If you don’t ask me, I’ll ask you, which can be embarrassing.

Pandemic Plans: If there is a catastrophic closure of the school, for any reason, we will attempt to continue class electronically. Check the website, your email, or try my cell phone. We will probably continue via a [Zoom link](#), but this will not be enabled until the appropriate time.

Exams: There will be a midterm and a final. Both tests will include both quantitative and essay questions. You should bring a calculator on exam days. The midterm will be around **October 10**, and the final will be as scheduled on **Wednesday December 10** at 2:00. If possible, I would like to schedule the midterm for two hours one evening in the middle of October.

For undergraduates, there will often be a selection of questions for which one may be skipped; graduates will be required to do all questions and skip none of them

Homework: Homework will occur regularly, generally due on Wednesdays and Fridays. It is to be done and turned in at the start of each class period. Homework will normally be posted on the

web at least one week before it is due. Twice during the semester, you may use a homework pass (distributed by me) to give you a one-class extension on the homework (it is still due). Homework turned in late (without a homework pass) will receive a 20% penalty per class day it is overdue.

Graduate students will typically have a single extra question on each homework which only graduate students are expected to do.

You should attempt to do the homework by yourself, but if you get stuck, you should feel free to talk to your friends in the class, or myself. In particular, you should feel free to check your final answers with your friends. You must ultimately understand and have performed all the calculations in your homework yourself, but I do not mind if others have helped you with it.

Grading: The two tables at right are a not necessarily accurate guess as to what my grading scheme will be. In particular, I reserve the right to grade on a sliding scale.

For graduate students, because there are no D grades, anything below 70% is an F.

<u>Grading Breakdown</u>	
Homework:	40%
Midterm:	20%
Class Part:	10%
Final:	30%
TOTAL:	100%

<u>Grading Scale</u>				
94% A	80% B-	67% D+		
90% A-	77% C+	63% D		
87% B+	73% C	60% D-		
83% B	70% C-	<60% F		

World-Wide-Web: Materials for this course can be found on our home page at

<http://users.wfu.edu/ecarlson/cosmo2>

This includes handouts, slides, homework and solutions, old tests, and links to recorded lectures.

Tentative Schedule:

August	25	27	29	Introduction, star basics, stellar evolution
September	1	3	5	Giant stars and later stages, stellar clusters, geometric distance
September	8	10	12	Standard candle distances, Milky Way basics, the Disk
September	15	17	19	The bulge, nucleus, and halo, gravity and orbits, rotation, dark matter
September	22	24	26	Spiral arms, clusters, shapes of galaxies, galaxy classification
Sept/Oct	29	1	3	Galaxy collisions, active galaxies, galaxy clusters and superclusters
October	6	8	10	Hubble's law, Friedmann equations, review, Midterm
October		13	15	{Fall break} scale factor, expansion
October	20	22	24	General relativity, dark energy, the big bang, the CMBR
October	27	29	31	Matter and radiation eras, recombination, primordial nucleosynthesis
November	3	5	7	Particle physics, particles in the early universe
November	10	12	14	The early universe, inflation, origin of everything, structure formation
November	17	19	21	What is dark matter? Baryogenesis, the fine-tuned universe,
November	24			multiple universes, {Thanksgiving break}
December	1	3	5	Cosmic eschatology, review
December		10		Final 2:00 PM