

## ASTR 222 — Galaxies and Cosmology

**Time:** Mondays & Wednesdays, 12:45 pm - 2:00 pm

**Place:** Sears Library 552 (the “Astronomy Classroom”) or Zoom (as necessary)

**Instructor:** Bill Janesh                      **TA:** Ray Garner  
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**Course Webpage:** <http://astroweb.case.edu/bjanesh/astr222/> & Canvas for announcements and grades

**Recommended Texts:** *Foundations of Astrophysics*, by Ryden and Peterson (ISBN 978-1-108-83195-6)

(note: **not** required!) *Introduction to Modern Astrophysics, 2e*, by Carroll and Ostlie

<b>Grades:</b>	Homework:	<b>50%</b>	<i>We will use the CWRU Standard Grading Scheme</i>
	Midterm:	<b>25%</b>	<i>(A ≥ 90%   B ≥ 80%   C ≥ 70%   D ≥ 60%   etc.)</i>
	Final Exam:	<b>25%</b>	

**Course Description:** The Milky Way Galaxy. Structure, dynamics, and evolution of galaxies. Galaxy clusters and large scale structure of the Universe. Physical cosmology and the Big Bang. Evolution of the Universe.

**Disability Accommodations:** In accordance with federal law, if you have a documented disability, you may be eligible to request accommodations from Disability Resources. In order to be considered for accommodations you must first register with the Disability Resources office. Please contact their office at 216.368.5230 to register or get more information on how to begin the process. Keep in mind that accommodations are not retroactive.

**Homework:** There will be a total of 4 homework assignments. Collaborative discussion is permitted and encouraged, but **each person must turn in their own solutions with unique writeup/analysis**. Collaborative means talking with each other about approaches, techniques, etc., and *not* swapping final solutions to copy! **Submissions will be accepted on paper or in PDF format via Canvas**. Write-ups should be typed or *neatly* handwritten. For PDF submissions, scan your handwritten work properly (see homework tips page for suggestions) and please make an effort to merge all parts into a single file for submission. **Homework will generally be due in class** but see each assignment for specifics.

**Quizzes/Exams:** There will be one midterm and one final exam. **You are allowed one sheet (two for the final) of letter/A4-sized paper with notes on both sides**, but exam questions will ask you to synthesize information from what you know, not just work a problem. You **may not** work collaboratively with your classmates, and I’ll only answer clarifying or format questions. The final exam is scheduled for 5/4 from 8-11am; please register any time conflicts with Undergraduate Studies. *Academic integrity violations during an exam will result in, at minimum, the failure of the exam.*

**\*Attendance/Late Policy:** *Attendance:* you are **highly encouraged, but not required, to attend lectures**. I will be recording class audio (or Zoom lectures as necessary), which will be posted on the course webpage along with slides and notes. *Late work:* **You get one free no excuse late homework (up to one week). All other late work loses 20% per day (0.83% per hour)**. If you have an emergency or otherwise legitimate reason out of your control for missing a homework due date (illness, technology issues, etc.), please document this with your Navigator and me ASAP. We’ll then work out an alternate due date without penalty.

**Computing:** Most (not all) HW assignments will **require you to write and run code in Python** to solve astronomical problems. You do not need to show your code in the homework submission unless specifically noted. We’ll spend scattered class time on Python, but **ask for help if you need it**. There will be occasional Python homework support sessions scheduled outside of normal class time by the Python Mentors. Typed reports can easily be created using a Jupyter notebook, showing formatted text alongside code and math. *If you would like access to departmental computing resources, or have questions or concerns about this aspect of the course, please let me know as soon as possible.*

**Office Hours:** **Mondays and Wednesdays the hour after class ends, and a 90 minute block on Thursday decided by class popular vote**, or just drop in! Some questions can probably be answered via email; I will do my best to respond as soon as possible during normal business hours. If you have a question in person, please come prepared — for homework questions, you must attempt the problem on your own first! I will ask you to show me what you’ve tried before I answer questions. If you’re not sure where to start, see the homework tips page on the website.

	Date	General Topic	R&P Readings	Due
WEEK 1	Jan 10	Introduction to the Milky Way; Star Counts	19.1, 19.2	
	Jan 12	Size of the Milky Way; Distances	13.1	
WEEK 2	Jan 17	<b>MLK Jr. Day — no class</b>		
	Jan 19	Metallicity and Stellar Populations	14.2, 14.3, 14.4	
WEEK 3	Jan 24	Structure of the Milky Way: Disk, ISM	19.1, 19.2	
	Jan 26	Structure of the Milky Way: Bulge, Halo	19.1, 19.2	
WEEK 4	Jan 31	Velocities of Stars; Solar Motion	19.3, 19.4	
	Feb 2	Galactic Rotation; Galactic Center	19.5, 19.6, 19.7	<b>HW1</b>
WEEK 5	Feb 7	The Local Group		
	Feb 9	Galaxy Morphology and General Properties	20.1	
WEEK 6	Feb 14	Integrated Stellar Pops & Mass-to-Light Ratios	20.2	
	Feb 16	Disk Galaxies	20.1	
WEEK 7	Feb 21	Disk Galaxies; Spiral Arms	20.1	
	Feb 23	Elliptical Galaxies	20.1	<b>HW2</b>
WEEK 8	Feb 28	Lenticular & Dwarf Galaxies	20.1	
	Mar 2	<b>Midterm Exam</b>		
WEEK 9	Mar 7	<b>Spring Break — no class</b>		
	Mar 9	<b>Spring Break — no class</b>		
WEEK 10	Mar 14	Extragalactic Distances & Hubble's Law	20.4, 20.5	
	Mar 16	Peculiar & Interacting Galaxies	22.2	
WEEK 11	Mar 21	Active Galaxies & Quasars	21.1, 21.2, 21.3, 21.4	
	Mar 23	Galaxy Clusters	22.1	
WEEK 12	Mar 28	Galaxy Clusters & Galaxy Evolution	22.1, 22.2, 22.3	
	Mar 30	Large Scale Structure	22.3	<b>HW3</b>
WEEK 13	Apr 4	The Expanding Universe	23.1, 23.2, 23.3	
	Apr 6	Age of the Universe; Microwave Background	23.1	
WEEK 14	Apr 11	Observational Cosmology; Cosmological Constant	23.4, 23.5	
	Apr 13	Cosmological Models; Observational Constraints	23.4, 23.5, 24.1	
WEEK 15	Apr 18	The Early Universe; Inflation	24.2, 24.3	
	Apr 20	Recombination; BBN	24.3, 24.4	<b>HW4</b>
WEEK 15	Apr 25	Galaxy Formation		
	May 4	<b>Final Exam 8-11 am</b>		