ASTR 352: Astrophysics III

Spring 2024

Lectures: Monday & Wednesday 3:15 – 4:30 pm

Instructor: Dr. Katie Lester, klester@mtholyoke.edu, 213 Kendade Hall

Office Hours: Thursday 10:00 am – 12:00 pm or by appointment.

Course Website: Moodle contains lecture slides, homework, announcements, and other material.

Textbook: There is no required textbook for this course, and there will be no assigned readings. Here are some textbooks to use as an additional resource:

- *Extragalactic Astronomy & Cosmology*, P. Schneider, 2nd edition (see PDF copy on Moodle)
- *Galaxies in the Universe*, L. S. Sparke & J. S. Gallagher, 2nd edition
- *Astronomy: A Physical Perspective*, M. Kutner, 2nd edition

Prerequisites: Astrophysics II (ASTR 335) or two physics courses at the 200 or 300 level.

Course Description: Advanced course covering physical processes in the gaseous interstellar medium, including photoionization in HII regions and planetary nebulae, shocks in supernova remnants and stellar jets, and energy balance in molecular clouds. Dynamics of stellar systems, star clusters, and the viral theorem will also be discussed, along with galaxy rotation and the presence of dark matter in the universe, as well as spiral density waves. The course concludes with quasars and active galactic nuclei, synchrotron radiation, accretion disks, and supermassive black holes.

Grading: Homework (60%), Activities (20%), Project (20%).

Letter grades:	A > 94	B+ = 87-89	C+ = 77-79	D+ = 67-69
	A- = 90-93	B = 83-86	C = 73-76	D = 63-66
		B- = 80-82	C- = 70-72	F < 60

Homework: We have homework sets due roughly every 2 weeks that will contain quantitative problems or short answer questions. These will typically have longer math problems so should be hand written (when possible) and turned in at the start of class. Make sure to show all of your work, especially if you get stuck on a problem, so you can get partial credit. The focus is on problem-solving skills, not getting the right numerical answer – the clearer your work is, the easier it is to assign partial credit! You are welcome to turn in homework after the deadline with a 10% penalty for each day late, unless an extension was previously granted. You can also redo any homework questions you got wrong to make up 50% of the points you lost, as long as you explain what went wrong the first time and write up the correct solution.

Participation: We will spend some time in class working on hands-on activities (like group problem solving or python coding labs). Participating in these activities will be a critical part of your classroom experience so they will be graded, but can be finished at home if needed. I will let you know ahead of time when you need to bring your laptops to class.

Semester Project: The final project for this class will be a 5-page literature review on a galaxy-related topic of your choice (with instructor approval). You will review your topic in detail by citing original references from the astronomical literature, as well as textbooks and other resources. There will be various checkpoints due throughout the semester (outline, first draft, presentation...) that will all add up to 20% of your final grade. We will have a peer review session in class where you'll read and give feedback on other students' paper drafts. Then you'll present your paper to the class in a 10-minute presentation and submit the final version of your paper during finals week. This project enables you to practice reading scientific papers, presenting research, and building science communication skills.

MHC Learning Goals:

1. Think analytically and critically by questioning assumptions, evaluating evidence, and articulating well-reasoned arguments.
2. Acquire depth, methodological expertise, and historical understanding in a discipline.
3. Develop intellectual breadth through study across disciplines and different modes of inquiry.
4. Develop the ability to write and speak confidently and effectively.
5. Engage in artistic forms of expression.
6. Acquire quantitative and technological capabilities.
7. Develop skills in more than one language and engage with cultural communities other than their own.
8. Conduct independent or collaborative research incorporating diverse perspectives and skill sets.
9. Apply the liberal arts through experiential learning in work and community environments.
10. Learn practices of self-assessment and reflection for academic, personal, and career growth.

ASTR 352 Learning Goals:

- Demonstrate proficiency in fundamental concepts in each of the major areas of astronomy: galaxies and the universe. (MHC goal #2).
- Show a working knowledge of a broad array of physical phenomena that are based upon fundamental concepts (MHC goal #3).
- Gain familiarity with observational, computational, and database methods utilized by professional astronomers (MHC goal #6).
- Exhibit a proficiency in the methods of scientific inquiry in research projects (MHC goal #1, #2, #6).
- Demonstrate use of critical thinking skills in well-organized, logical and scientifically sound oral and written scientific reports (MHC goals #1, #4, #8).

Accommodations: Please let me know if you need any accommodations from the Disability Services office (Mary Lyon Hall 3rd Floor or by email). I would like to meet with you and discuss your approved accommodations and how we can apply them to this class. (For more information on who might be eligible for accommodations and the application process please see the Disability Services website.)

Academic Integrity: I encourage you to work together on homework & activities, since science is often very collaborative, but you are still expected to follow MHC's academic integrity policy. Any work that does not will be given a zero and reported to the Academic Honor Board. Each student is required to

write up and submit their own work. Using artificial intelligence on assignments is prohibited; students should not have another person/entity do the writing of any portion of an assignment for them, which includes AI tools like ChatGPT.

Mount Holyoke College is a community of students, faculty, staff, and administrators committed to free inquiry and the pursuit of knowledge in the tradition of the liberal arts. The decision to join this academic community requires acceptance of special rights and responsibilities that are essential for its effective functioning and the realization of its mission. All members of the community share the responsibility to uphold the highest standards of academic integrity. I expect all your work to abide by the MHC Honor Code: “I will honor myself, my fellow students, and Mount Holyoke College by acting responsibly, honestly, and respectfully in both my words and deeds." Any work that does not will be reported to the Academic Honor Board.

Finally, I expect everyone to treat each other with respect & compassion both inside and outside the classroom.

Tentative Course Schedule:

Week	Date	Topic	Deadline
1	Jan 24	Introduction / review	
2	Jan 29, 31	Milky Way	
3	Feb 5, 7	Distance Ladder	HW1 due
4	Feb 12, 14	Milky Way	
5	Feb 19, 21	Galaxy Classification	HW2 due
6	Feb 26, 28	Spiral Galaxies	
7	Mar 4, 6	Elliptical & Irregular Galaxies	HW 3 due
8	Mar 11, 13	Dark Matter	Project outlines due
9	Mar 18, 20	Spring break	
10	Mar 25, 27	Galaxy Formation	HW4 due
11	Apr 1, 3	Large Scale Structure	
12	Apr 8, 10	AGN & SMBHs	Paper draft due
13	Apr 15, 17	Project peer review	
14	Apr 22, 24	TBD	HW5 due
15	Apr 29	Project presentations	Final paper due May 3

Schedule is subject to change. If class is cancelled, then any homework due that day will be pushed to the next class period.