ASTR 228: Astrophysics I

Welcome!

Instructor: Dr. Katie Lester, klester@mtholyoke.edu, 213 Kendade Hall
Please feel free to call me Katie, but I also understand if you are more comfortable using a formal title such as Professor Lester, Professor Katie, Dr. Katie... During the week, I will try to answer any emails within 24 hours. Over the weekend, I may not get back to you as quickly. If you do not hear back from me in two days M-F, please email me again.

Office Hours: I will hold drop-in help hours each week (time TBD), so stop by any time you have questions or want to chat! You're also welcome to email me with questions or to arrange a different meeting time that fits both our schedules.

TA: Valentina Flores (flore24v@mtholyoke.edu) is the TA for this class. Vale is available to help you with the course material or homework questions during her own help hours (time TBD), so feel free to contact me or Vale if you need help!

Overview

Course Description: A calculus-based introduction to the properties, structure, formation, and evolution of stars and galaxies. The laws of gravity, thermal physics, and atomic physics provide a basis for understanding observed properties of stars, interstellar gas, and dust. We apply these concepts to develop an understanding of stellar atmospheres, interiors, and evolution, the interstellar medium, and the Milky Way and other galaxies. (This is an introductory astronomy class for science majors!)

Course Website: Moodle will contain lecture slides, homework assignments, announcements, grade book, and all other course materials.

Textbooks: *Astronomy: A Physical Perspective*, by Mark Kutner, 2nd ed., ISBN 9780511802195. A copy is on reserve at the library and available in the Physics & Astronomy lounge. This book is a good reference when you need to look something up quickly.

An Introduction to Modern Astrophysics, by Bradley Carroll & Dale Ostlie, 2nd ed., ISBN 0805304029. A copy is available in the Physics & Astronomy lounge. This book covers everything in great detail, so use as an additional resource for a deep dive into a topic.

Prereqs: PHYS-110 and MATH-102. PHYS-201 is recommended and can be taken concurrently.

Grading

Homework (40%)
There will be homework due every 10 days that will include qualitative and quantitative questions. You're encouraged to work on assignments with your classmates, but each of you must write your homework in your own words! Make sure to show all of your work for math problems – information that was given, values you're trying to find, equations you could use, steps you took to solve the problem, and checking

that your answer makes sense. Please hand write (or digitally write) your homework and turn in a physical copy at the start of class on the due date.

Each homework problem will be graded on a 10-point scale:

10	Perfect	You made no errors and wrote everything neatly & clearly!
9	Excellent	You've mastered the problem, but there are some minor mistakes or missing explanations.
8	Good	You've made a great attempt at solving the problem, but there is one major error or many small errors.
7	Poor	You've somehow missed the point of the problem or haven't addressed it adequately.
0		No attempt at solving the problem.

Every assignment has a due date and I expect you to strive to submit each assignment by this date (accounting for any accommodations you have). This ensures I have an opportunity to give you feedback before we review the homework in class. Missing one homework often leads to missing another one, and getting behind is overwhelming and can derail your ability to make progress towards our learning goals. I want you to succeed so if you anticipate a problem meeting a homework due date, email me to propose an extension and we will come to an agreement together. I am always willing to be flexible if you contact me in advance of a due date.

Homework turned in after the deadline (without an extension) will be deducted 10% per day with a maximum deduction of 50%.

Once each homework is graded and returned, you have the opportunity to submit a redo to move up one grade on the 10-point scale. These redo's have two required parts: (1) redone homework problem(s) that you got wrong, and (2) a short reflection on what went wrong the first time and how you could avoid this mistake in the future. These reflections will help you manage your time better and avoid making the same errors on future homework in addition to helping you think through which concepts you need to review in more detail. These redos+reflections are due anytime before the end of finals.

Activities (25%)
I hope you come to class and actively participate in this course so you can best engage in learning. Your participation will help you understand the material better, and it will contribute to the learning of your peers. As members of our learning community, each of us has a responsibility to create an environment in which we can all learn from each other. Class worksheets will be graded for completeness.

Group work – I will frequently ask you to turn to your group to discuss a topic or to solve a problem as a team, which will help you learn the material and practice effective teamwork. I will assign you a group of 3 who you'll need to sit next to and work on problems with in class. Each class, you and your group members will choose group work roles for the day:

- Manager: directs the sequence of steps and leads the discussion. Makes sure everyone is participating and all voices are heard. Keeps track of time and keeps the group focused on the task.
- Notetaker: writes down ideas, equations, diagrams, and solutions for the group. Makes sure the rest of the group agrees with what they wrote at each step.
- Critic: makes sure all perspectives and options are explored. Checks that values and units make sense for answers along the way. Keeps track of differing ideas, and summarizes the group's discussions and conclusions.

Coding labs – We will also be doing python coding labs on Fridays, which will be graded for correctness. Please bring your laptop to class every Friday. These labs will teach your basic coding skills that are necessary for summer research, grad school, or careers in STEM. You have two options for how to run python code:

- Google Colab – If you are new to python or coding, then it would be easier to run the code for free in your web browser as a part of Google Drive. The code will be saved to your Drive. You do not need to do anything to set this up, just be able to log in to your MHC google account.
- Anaconda – If you are interested in programming or summer research, you might want to install Python on your own computer using Anaconda. (Note that this takes up a lot of disk space!). Then you would run the code in the included Jupyter Notebooks application. Your code would be saved to your computer locally.

Exams (20%)
We will have 2 in-class exams throughout the semester, each worth 10% of your grade. (See the schedule for details). Neither of the exams will be cumulative, although many topics will overlap between the exams. These will include both short answer qualitative and math problems, and you will be given a choice of which questions you want to answer. Exams will be closed book, but I will give you an equation / constants sheet for reference. Exam questions will be graded on the same 10-point scale as the homework.

Final Project & Paper (15%)
Instead of a final exam, you will complete a final project in the form of a review paper and creative project. Your goal will be to choose a topic related to those covered in the course, investigate this topic using scholarly articles, and write a 3-4 page report explaining your findings. You will also complete a creative project about your topic, which can come in many forms: powerpoint presentation, art project, poster, children's book, youtube video... More information will be provided later in the semester!

Final grades:

A $\geq$ 94	B+ = 87-89	C+ = 77-79	D+ = 67-69	F $\leq$ 59
A – = 90-93	B = 83-86	C = 73-76	D = 63-66	
	B – = 80-82	C – = 70-72	D – = 60-63	

Learning Goals:

With this course, we present the study of the universe at the largest scales as an investigative, evidence-based, and interdisciplinary science. We strive for students to learn to employ quantitative concepts and mathematical methods, analytical thinking, and demonstration of the sensibilities, understandings, and perspectives of a person educated in a liberal arts tradition (particularly as these sensibilities relate to the natural environment). We aspire to prepare students to make informed decisions as stewards of their environment in their roles as voters, consumers, and contributing members of society.

Each assignment you complete in this course will contribute to your growth towards meeting specific learning goals:

1. Demonstrate proficiency in fundamental concepts in each of the major areas of astronomy: cosmology, planetary science, galaxies, stellar structure, and the universe. Show a working knowledge of a broad array of physical phenomena that are based upon fundamental concepts.
2. Demonstrate skills for quantitative analyses, including the ability to form a hypothesis, graphically

represent and interpret data, estimate error and understand sampling bias.

3. Gain familiarity with instrumentation, computational methods and software resources utilized by professional astronomers.
4. Demonstrate use of critical thinking skills in well-organized, logical and scientifically sound oral and written scientific reports.
5. Understand the variety of career paths and opportunities that are open to students who have majored in astronomy.

What you can expect from me:

- I will provide you with a clear, organized course that is designed to ensure you meet our learning goals in a meaningful manner.
- I will provide a variety of activities & assignments to ensure your learning needs are met.
- I will provide a supportive and safe environment for you to share and discuss ideas with your peers.
- I will treat you with dignity and respect and be flexible to support your individual needs.
- I will reach out to you when I sense that you need support.

What I will expect from you:

- You will strive to be an active participant in this course by coming to class, taking notes, and participating in peer discussion or class activities.
- You will focus on understanding the concepts and performing the skills of this course, aiming for your own personal best.
- You will strive to meet due dates, but will contact me if you have a concern about completing an upcoming assignment.
- You will uphold academic integrity by submitting only work that you understand and completed for yourself.
- You will be thoughtful in your interactions with peers, while taking extra care to respect diverse perspectives. You will support your classmates as you share this learning space and treat them with dignity and respect.
- You will give yourself grace. You will challenge yourself to keep an open mind and recognize that mistakes are a vital part of the learning process.

Class Guidelines

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, since science is often very collaborative. You can help each other with questions and try to figure them out together, but each person must write up their work

individually. You are expected to follow MHC's academic integrity policy, and 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.

Tips for success

To help reduce that stress and improve your own likelihood of getting the best grades possible, allow yourself the time and space you need to do your best work. Do not procrastinate and if you get stuck on an assignment, please reach out to me or the TA. I welcome your questions and I am happy to help you think through your ideas so you can successfully complete an assignment. Sometimes just a quick conversation or email exchange is all you need resolve a problem. Struggle is a natural part of learning, but if you're feeling frustrated that means it is time to reach out for some assistance.

Some of the homework questions will ask you to give an answer *and* to explain your reasoning, which shows your understanding of the course material and critical thinking skills. You need both components to receive full credit for the question, so try to explain your reasoning in detail. Imagine you are explaining the answer to your classmates – walk through each step in your thought process and give evidence to support your ideas.

ASTR 228 Schedule - Spring 2025				
Week	Date		Topic	Assignment
1	W	Jan 29	Introduction	
	F	Jan 31	Lab 1 - python basics	
2	M	Feb 03	Light & energy	
	W	Feb 05	Blackbody radiation	
	F	Feb 07	Lab 2 - blackbody curves	
3	M	Feb 10	Telescopes	HW 1 due
	W	Feb 12	Fluxes & magnitudes	
	F	Feb 14	Lab 3 - imaging	
4	M	Feb 17	Spectroscopy	
	W	Feb 19	The Sun	HW 2 due
	F	Feb 21	Lab 4 - solar rotation	
5	M	Feb 24	Properties of stars	
	W	Feb 26	Properties of stars	
	F	Feb 28	Lab 5 - stellar spectra	HW 3 due
6	M	Mar 03	Star formation	
	W	Mar 05	Review	
	F	Mar 07	Exam 1	
7	M	Mar 10	Stellar evolution	
	W	Mar 12	Stellar evolution	
	F	Mar 14	Lab 6 - HR diagram	Project outlines due
8	M	Mar 17		
	W	Mar 19	No class - spring break	
	F	Mar 21		
9	M	Mar 24	Stellar remnants	
	W	Mar 26	Stellar remnants	HW 4 due
	F	Mar 28	Lab 7 - stellar evolution	
10	M	Mar 31	Gravity, Keplerian motion	
	W	Apr 02	Binary stars	Paper drafts due
	F	Apr 04	Lab 8 - binary stars	
11	M	Apr 07	Interstellar medium	
	W	Apr 09	Milky Way	HW 5 due
	F	Apr 11	Lab 9 - TBD	
12	M	Apr 14	Review	
	W	Apr 16	Exam 2	
	F	Apr 18	No class - Senior Symposium	
13	M	Apr 21	Milky Way	
	W	Apr 23	Other galaxies	
	F	Apr 25	Lab 10 - galaxies	
14	M	Apr 28	work day	HW 6 due
	W	Apr 30	presentations	Final project due
	F	May 02	No class - Pangy Day	
15	M	May 05	presentations	
16	T	May 13	Final paper due May 13 (last day of finals)	Final paper due