

**Astronomy 404
Stellar Astrophysics
Fall Semester 2021**

MWF 10:00–10:50 pm 144 Loomis Laboratory & Online

Course webpage URL

<http://go.illinois.edu/ASTR404>

Professor

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Course Goals

Stars play an essential role in all of astrophysics and cosmology. We know a great deal about the physics that drives the lives and deaths of stars, thanks to more than a century of intense research celebrated in nine Nobel Prize awards to date.

In this course we will build an observational and theoretical understanding of the astrophysics of stars and stellar evolution; we will then apply this to understand the impact of stars on the larger cosmos.

Course alumni will:

- Be familiar with the observed properties of individual stars and stellar populations.
- Develop the underlying physics needed to understand the structure, stability, and evolution of single stars, and have an appreciation for the effects of binarity.
- Understand the final stages stellar evolution and the violent events events that mark the deaths of the most massive stars: supernova explosions. Appreciate the connection among gamma ray bursts, compact object mergers, and gravitational radiation observations.
- Understand stellar remains in the form of compact objects: white dwarfs, neutron stars, and black holes.
- Place stellar evolution the larger context of astrophysics and cosmology, including element production, the observed properties of star clusters and observed galaxies, and stellar-based standard candles.

Course Requirements

Requirement	Percentage of Grade	Points
Problem Sets (best 11 of 12)	$11 \times 6\%$ each	660
Hour Exam	12%	120
Final Exam	18%	180
Participation	4%	40
Total	100%	1000

Grading

The following table shows the approximate grading scale in this course. Final course grades will follow these guidelines. Plusses and minuses will be used.

The ranges are approximate in that I may have to adjust them if, for example, I give an exam that is a little too hard. In any case, I will not increase the minimum cutoffs for each letter grade.

Grade	Approximate Range
A	92–100%
B	82–91%
C	72–81%
D	60–71%
F	< 60%

All scores and the final course grades will be posted on the course Canvas page.

Texts

- Dina Prialnik, *An Introduction to the Theory of Stellar Structure and Evolution*, 2nd Edition, 2010, Cambridge University Press.
[**Required**] This text is written at about the right level, and covers much of the material we will discuss in the course.
- A. C. Phillips, *The Physics of Stars*, 2nd Edition, 1999, Wiley.
[**Recommended**] A nice complement to the approach in Prialnik.

Some additional readings may be taken from handouts, and from the Web.

Problem Sets

There will be 12 problem sets given throughout the course, posted on the course Canvas page. These assignments represent the bulk of the work you will do for the course. The problem sets are meant to sharpen your thinking on the material covered in lecture, to develop physical intuition and quantitative skills, and to help prepare you for the exams. Problem sets are due online, almost every Friday.

Problem sets count for the bulk of your grade, at 66% of the total points. Your best 11 homework grades will be counted. However, you are responsible for all of the material covered on all 12 homework assignments. Thus, it is to your advantage to do all 12 of the assignments, and hand them in on time.

Late homework will be penalized 10 points off (out of 60 total) per calendar day late.

Exams

There will be one Midterm exam and a comprehensive final exam. Dates are as follows.

- Midterm Exam: Friday, Oct. 15
- Final Exam: **1:30-4:30 pm, Monday, Dec. 13**

Further information about each exam will be forthcoming as the exam approaches.

Participation

It is important to attend lectures. I will cover material in class that will not always be in the text, and the lecture material will be included on the exam. To encourage your engagement, the lectures will often be punctuated by opportunities for your feedback, in the form of asking questions, voting on the possible outcomes of observations or demonstrations, or brainstorming answers to open-ended questions. To reward your participation in these activities, you will often be asked to respond. For online class meetings, this will be via a Zoom poll, for in-person meeting this will be via iClicker.

These participation surveys are not “quizzes” in the usual sense, in that you are not required to get all answers right. Rather, you will always get some credit simply by offering a scientifically reasonable response even if it is wrong (and in some cases the questions have no single correct answer, in which case all responses receive full credit). The point of this is that the survey is always an opportunity to gain points as long as you are actively engaged, even if you are still a little confused. Indeed, the most difficult and potentially confusing subjects are precisely those that most require your participation!

For each poll, 1.0 participation points will be available: the full 1.0 points will be awarded to correct response(s), while 0.5 points will be given for any other scientifically reasonable responses.

You can also earn participation points by asking or answering a science question in class—that is, a question about course content, not logistics like due dates). And you can earn participation points by asking science questions one-on-one with the instructor, after class or outside class in office hours or by appointment. You can earn a maximum of 4 points total from in-class questions, and independently, a maximum of 4 points from office hours.

Activity	Points Each	Max Per Activity
In-Class Polls	0.5 per response + 0.5 if correct	up to 40 points
In-Class Question Responses	0.5 per response	up to 4 points
Talk to Instructor Outside Class	1.0 per discussion	up to 4 points

Your total participation points from all sources will accumulate until they reach a **maximum of 40 total participation points**; if you faithfully attend class and answer correctly most of the time, you can reach this maximum a few weeks before the end of the semester. There are thus ample opportunities to attain this maximum score, even if several classes are missed due to situations such as late class registration, family emergencies, job interviews, and malfunctioning iClickers; therefore no additional participation opportunities will be available beyond those in each class.

Course Schedule

The course schedule is posted online. The lecture material may vary, but the assignment dates are fixed. Check back to the course webpage for updates on the topics and readings.

Academic Integrity and Collaborative Work

Academic honesty is essential to this course and the University. Any instance of academic dishonesty (including but not limited to cheating, plagiarism, falsification of data, and alteration of grade) will be documented in the student's academic file. In addition, the particular exam, homework, or report will be given a zero.

Guidelines for collaborative work: Discussing course material with your classmates is in general a good idea. However, you are expected to do your own work. **You are responsible for understanding every part of your results and solutions, and for writing these in your own words.** Finally, on exams your work and your answers must of course be entirely your own.

Accessibility

To insure that disability-related concerns are properly addressed from the beginning, students with disabilities who require reasonable accommodations to participate in this class are asked to see the instructor as soon as possible.

Classroom Etiquette and Use of Electronic Devices

For the benefit of your fellow students and your instructor, you are expected to follow these basic rules of decorum.

- Show up for class on time. If you must be late on a regular basis, please inform the instructor.
- Be attentive in class. Do not leave early.
- Be respectful in your interactions with your fellow students and your teachers, whether in person or online.

For face-to-face class meetings, expectations are:

- Turn off or mute your cell phone before class begins.
- Do not use headphones, read newspapers, or prop your feet up on other chairs or desks.

For face-to-face meetings, electronic devices such as laptops, tablets, mobile phones, and the like, are tools that can enhance the classroom but also can be disruptive if misused. I will allow the use of such devices in class for the purpose of taking notes only. But you

are expected to pay attention in class, and these devices can be very distracting; you are expected to use them only for note-taking.

Students must respect the classroom environment. Unless specifically directed by the instructor, students shall refrain from sending email and instant messages, or from engaging in other activities (reading non-course materials, engaging in private conversations and so on) that disrespect the classroom environment and learning conditions for others.

Disruptive behavior and/or misuse of electronic devices can affect your participation grade for that day. If the behavior continues, there will be additional reduction in the overall course participation grade.

Late Course Registration

Students considering late registration, particularly after Sept. 3, are welcome but strongly encouraged to speak with the instructor prior to joining the course.

Out of fairness, the same grading standards will be used for all students in the course, and all students will be responsible for all assignments and all lecture material. Those students who register late are welcome, but join the course with the understanding that they are responsible for the material covered before they joined the course. The policy of dropping the lowest homework assignment allows late registering students to avoid penalty on any assignment missed before joining the course, as long as the remaining assignments are completed.

COVID-19 Policies

Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community. Students are also required to follow the campus COVID-19 protocols.

The first class meetings will be online via Zoom; link is provided over email and on the course Canvas page. Later meetings may be in person. In-person meetings are subject to campus policies, as follows.

Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.