This one-semester undergraduate course covers the physics governing the structure and evolution of stars and star-like objects.

Course goals
Stars are macroscopic objects, and describing their behavior requires weaving many separate topics in physics into a coherent narrative, often via numerical simulation. In this course, you will also learn astronomical nomenclature and practical skills in numerical calculation and working collaboratively. These skills apply not only to modeling astronomical phenomena, but also to many “real-world” phenomena, such as weather and climate.

Instructors
Professor Edward Brown
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Undergraduate Learning Assistant Claire Kopenhafer
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Office hours: M 2:00–3:00

Lecture times and location
TTh 12:40–2:00 in 1420 BPS

Click on links in gold-colored text to go to online material.
TEXTBOOK AND COURSE MATERIALS

REQUIRED


2. An up-to-date version of Anaconda Python.

3. An up-to-date installation of git. Mac and Linux users have this already as part of their OS. Windows users should download and install git for windows.

4. An account with the online CATME assessment tool for group projects. Instructions on how to access this will be sent to your MSU email account during the second week of the course.

SUPPLEMENTAL


2. Notes on stellar physics (at a graduate level) are available at this link or from the Open Astrophysics Bookshelf.


4. I will make use of the open-source stellar evolution code MESA; if you want to explore MESA for yourself, you will find installation instructions and tutorials on its homepage and user-contributed materials at the MESA user forum.

Additional material, as well as homework assignments and projects, will be posted on D2L.

HOMEWORK AND IN-CLASS WORKSHEETS

Homework sets are assigned weekly and are due Thursdays at the start of lecture. We will assign one of 4 grades: ☓ (not done), ☑ (below expectations), ✔ (meets expectations), + (exceeds expectations). Note that a grade of ✔ or + does not guarantee that the set is done correctly; it just means that the
set appears to be on the right track. I will always work through the correct solutions in class, so you will have a chance to evaluate how you did. In addition, we will often assign worksheets that you will complete during a class. These will be collected and graded in a similar fashion to the homework.

You are responsible for making sure that you understand the solutions—making mistakes, and learning from them, is much less expensive on the homework sets than on the exams!

**WORKING COLLABORATIVELY**

I have no objection to your working on homework problems collaboratively; the set you turn in must, however, be your own. If you do work on homework solutions in a group, you must list your collaborators and describe their contributions. Please refer to the "Spartan Code of Honor Academic Pledge" recently adopted by the Associated Students of Michigan State University (ASMSU)\(^1\).

**GROUP COMPUTATIONAL PROJECT**

In addition to learning about stars, this course has two other ancillary goals:

1. learning to solve complex problems numerically; and

2. learning to work collaboratively on larger projects.

Computation has become an indispensable component of modern science. While many sophisticated libraries of computational software, such as MatLab, are readily available, a scientist must understand how the algorithms work. Collaborative work is now the norm in many fields of science. A scientist must know how to work effectively as part of a team; indeed, this skill is essential for any technical career.

To develop your competence in these areas, you will work in teams of four to complete progressively more sophisticated computational projects over the semester. For each project, your team will submit your code (Python) and a brief report. You will be asked to review, using CATME, the performance of your team and teammates; these reviews will form part of your grade for each project.

We envision assigning three group projects during the semester. Projects are due at the end of the day on the dates indicated in the table.

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\(^1\)The text of the pledge is available on the login screen for D2L.
Project Title Due
1 Ordinary differential equations: Kepler’s problem 4 Oct
2 The mass-radius relation for white dwarfs 15 Nov
3 The low-mass main sequence 6 Dec

These dates are subject to revision.

ASSESSMENTS

Midterm There will be one midterm, tentatively scheduled for Thursday, 13 October. I’ll confirm that date towards the end of September.

Final The final exam is scheduled for Tuesday, 13 Dec, from 12:45–2:45 in 1420 BPS. The final will be cumulative, but weighted toward the latter half of the course.

WEIGHTS FOR THE OVERALL COURSE GRADE

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GRADING STANDARDS

4.0 Mastery of subject, based on homework, exams, and in-class performance. Able to consistently apply concepts to solve problems. Ready for graduate-level coursework.

3.5 Demonstrates qualities described immediately above and below.

3.0 Generally understands concepts, but has some difficulties in applying them.

2.5 Demonstrates qualities described immediately above and below.

2.0 Incomplete or incorrect understanding of basic concepts.

DISABILITY ACCOMMODATIONS

Students who require disability accommodations should bring their VISA forms to Prof. Brown during the first week of classes. If you require accommodations but have not yet registered as a student with a disability, please register with the MSU Resource Center for Persons with Disabilities at https://www.rcpd.msu.edu/services/accommodations.
WHEN THERE IS A CONFLICT

Disagreements and conflicts occur from time to time and are a fact of life; what is important is that they are swiftly and satisfactorily resolved. If you are unhappy about any aspect of the course, I propose that we follow a “24–48” rule: please bring your complaint to my attention promptly, within 24 hours of the issue arising; in turn, I shall evaluate your complaint and respond within 48 hours.

REFERENCES—UNDERGRADUATE-LEVEL STELLAR PHYSICS


REFERENCES—GRADUATE-LEVEL STELLAR PHYSICS


**REFERENCES—CODING (ALL FREE)**


**REFERENCES—MANAGEMENT & WRITING**


