AST 304, Fall 2020
Stars

# Syllabus

*This three credit undergraduate course introduces the physics governing the structure and evolution of stars and star-like objects.*

## Course goals

Stars are macroscopic objects: to describe their behavior requires weaving diverse physics concepts into a coherent narrative, often via numerical simulation. In this course, you will gain competency both in using simple physical arguments to estimate stellar properties and in constructing numerical models of stellar phenomena. In addition, you will learn how to work collaboratively on larger, longer-term projects.

## Course meetings

🕐 Tuesdays and Thursdays 10:20–11:40
🎥 https://msu.zoom.us/j/95874250939, passcode: *stellar*
🏠 https://d2l.msu.edu/d2l/home/1069806

## Instructors

### Professor Edward Brown

➤ 3266 BPS
📞 884–5620, voicemail checked daily
✉ browned@msu.edu
🏠 https://www.pa.msu.edu/~ebrown

### Office hours
🕐 Mondays and Wednesdays 11:00–12:00
🎥 https://msu.zoom.us/j/96359825279, passcode: *officehour*

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Click on links in gold-colored text to go to online material.

## Undergraduate Learning Assistant Aalayah Spencer

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✉ spenc333@msu.edu

**Office hours**
🕐 Tuesdays and Thursdays 4:00–5:00 (starting 8 September) or by appointment
🎥 https://msu.zoom.us/j/2632579457, passcode: *AST304*

## Course materials

### Texts

☐ 📖 Coursepack *To Build a Star*, available from the Spartan Bookstore.

### Software

All required software is freely available.

☐ 🐍 An up-to-date version of the Anaconda Python distribution.

☐ ❖ An up-to-date installation of the source control manager `git`. Linux and Mac[1] users have this already. Windows users should download and install git for windows.

### Supplemental

1. The open-source stellar evolution code `MESA`. Many user-contributed materials are available from the `MESA` Marketplace.

2. Consult the class reading list (posted on D2L) for additional texts on stellar physics, coding, writing, and project management.

### Course platform

This course is delivered online via the course management system and you will login to the D2L homepage using your MSU NetID. In D2L, you will access links to online lessons, course materials and additional resources.

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[1]This may require installation of the `Xcode` command-line tools.

## Contingency plans

If you become unable to attend class for more than one week, please inform me as soon as you are able. For absences of less than two weeks, once you have recovered we will develop a plan for finishing the semester. For longer-term absences, we shall consult with academic advising to find a solution that works best.

If I have an unexpected absence for less than two weeks, reading assignments and viewing of any online lectures will continue. I shall attempt to maintain a two week buffer on these items. Homework assignments and exams will be postponed. If I have an unexpected absence lasting longer than two weeks, the department will make arrangements for a substitute lecturer to finish the semester.

If you lose internet connectivity during a synchronous (lecture) section, please let me know as soon as possible so that we can make arrangements for any missed exercises.

## Grading

The final numerical course grade has the following qualitative meaning:

**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 on this topic.

**3.5** Demonstrates qualities described immediately above and below.

**3.0** Generally understands concepts, but has some difficulties in applying them to solve problems.

**2.5** Demonstrates qualities described immediately above and below.

**2.0** Incomplete or incorrect understanding of basic concepts.

The course evaluation is based on the following components.

### Homework and in-class worksheets (25%)

Homework sets are assigned weekly and are due Fridays at 5:00pm. You will upload your homework using *Gradescope* via a link in D2L. Late homework assignments will be given half-credit. Each problem will be scored as follows.

✚ complete analysis of the problem—10 pts

✔ correct concept but incomplete analysis—8 pts

━ faulty or incomplete application of concepts—4 pts

🚫 not turned in—0 pts

We will often assign in-class worksheets that you will complete as part of a group. These worksheets will be collected and graded in a similar fashion to the homework. If you miss a class, you may make up an in-class worksheet for half-credit.

We will work through the solutions to homework and worksheet exercises in class. You are responsible for making sure that you understand the solutions. Learning occurs when you are correcting mistakes, for in that moment misconceptions are exposed, examined, and discarded.

I HAVE NO OBJECTION TO YOU WORKING ON ASSIGNMENTS COLLABORATIVELY; the set you turn in must, however, be your own. If you do work in a group, you must list your collaborators and describe their contributions. Please refer to the "Spartan Code of Honor Academic Pledge" adopted by the Associated Students of Michigan State University (ASMSU)[2].

## GROUP COMPUTATIONAL PROJECT (30%)

In addition to learning about stars, this course has two other ancillary goals. The first is learning to solve complex problems numerically. Computation has become an indispensable component of modern science. Many sophisticated libraries of computational software, such as MatLab and Mathematica, are readily available. Before using them successfully, however, a scientist must understand *how* the algorithms work. The second goal is learning to work collaboratively on larger projects. Large collaborations are now the norm in many fields of science, and anyone working in a scientific or technical field must know how to work effectively as part of a team.

To develop your skills in these areas, you will work in teams to complete progressively more sophisticated computational projects. For each project, your team will submit your code (Python) and a short report. You will also self-evaluate, using CATME, the performance of your team and your teammates; these reviews will form part of your grade for each project.

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[2]The text of the pledge is available on the login screen for D2L.

There will be three group projects. The tentative due dates for each project are as follows.

| Project | Title | Due by 5:00pm on |
|---------|-------|------------------|
| 1 | Kepler's problem | 9 Oct |
| 2 | The white dwarf mass-radius relation | 13 Nov |
| 3 | The low-mass main sequence | 11 Dec |

### Quizzes (25%)

There will be a short quiz every two weeks, with the exception of the Thanksgiving holiday; dates for the quizzes are 17 September, 1 October, 15 October, 29 October, 12 November, and 3 December. Quiz problems will typically be more straightforward and less open-ended than homework problems. The topic of the quiz will be announced a week before. *Your lowest quiz grade will be dropped*.

### Final (20%)

The final will be a take-home exam given during finals week. Information on the timing and length of the exam will be provided two weeks before the end of classes.

## Disability accommodations

Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at rcpd.msu.edu. Once your eligibility for an accommodation has been determined, you will be issued a Verified Individual Services Accommodation (VISA) form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc.). Requests received after this date will be honored whenever possible.

## When there is a conflict

Disagreements and conflicts occur from time to time and are a fact of life; the first rule of managing conflict is to make sure that it is promptly addressed. I therefore propose a "24–48" rule if you are unhappy about any aspect of the course: 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.