ASTRONOMY 400A – Theoretical Astrophysics
Spring 2024

Class meets: T/Th 11:00-12:15
Classroom: Steward Observatory Room 204

Instructor: Dr. Josh Eisner
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Office Hrs: by appointment

Course Description
This course is a continuation of the ASTR300AB series. The main topic of the course is stellar structure, a field of astronomy that brings many different branches of physics to bear on the fundamental objects of astronomical study—stars. Toward the end of the semester, we may discuss several other (related) topics as well, including planet formation and hydrodynamics.

Expected Learning Outcomes:
By the end of the course, students will:

- Develop an understanding of fundamental theoretical astrophysics, that can be applied to a broad range of specific problems.
- Apply a theoretical framework to stellar structure and derive from first principles stellar properties that match observations.
- Use mathematical and computational skills to solve astrophysical problems.

Textbook
The main textbook for the course is "An Introduction to the Theory of Stellar Structure and Evolution" by Dina Prialnik. Presumably you have already acquired this book, but if not, copies should be available in the campus bookstore. Several topics covered in the course are beyond the scope of this book, and I recommend "Accretion Processes in Star Formation" by Lee Hartmann as another reference.

Lectures
Lectures will generally follow the content of the main textbook. Typically, lectures will consist of blackboard lessons, with participation from the class expected. However some class time will be devoted to problem-solving sessions, review, or other topics. There may also be occasional class meetings held online via zoom.

Homework and Classwork

There will be approximately six homework assignments during the semester, which will consist of problems that should be done individually (i.e., not in collaboration with fellow students) and group problems where collaboration is allowed. These assignments will be due *at the beginning of class on* the due date. For collaborative assignments, each student must turn in his or her own copy but should include the names of those with whom he or she worked. Note also that some of the assignments include computational components.

ASTR 400A is a writing emphasis course, and we will have a short additional assignment devoted to a scientific writing exercise. This exercise is intended to help students critique a piece of professional science writing, and to provide an opportunity for feedback on student writing from peers and the instructor.

Exams

There will be two mid-term examinations as well as a final exam. These exams will cover material discussed in lecture as well as in the homework.

Grading

The grades for the course will be computed as follows:

Homework	40%
Midterm Exams	30% (15% each)
Final Exam	30%

Grades may be adjusted to reflect overall class performance.

Topic Schedule and Corresponding Reading

A rough schedule of topics and readings is provided here. However, we may not get to all topics, depending on progress throughout the semester and student interest in various topics.

- Observed Stellar Properties
- Thermal and Hydrostatic Equilibrium
- Virial Theorem
- Pressure Sources
- Energy Transport
- Nuclear Energy Generation
- Analytic and Computational Stellar Models
- Stellar Stability and Convection
- Stellar Evolution
- Supernovae
- Neutron Stars and Black Holes
- Accretion

- Star Formation
- Protoplanetary Disks
- Planet Formation

Academic Integrity

According to the Arizona Code of Academic Integrity, "Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own." Unless otherwise noted by the instructor, work for all assignments in this course must be conducted independently by each student. Co-authored work of any kind is unacceptable.

Misappropriation of exams before or after they are given will be considered academics misconduct. Misconduct of any kind will be prosecuted and may result in any or all of the following:

- Reduction of grade
- Failing grade
- Referral to the Dean of Students for consideration of additional penalty, i.e. notation on a student's transcript re. academic integrity violation, etc.

http://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity

Attendance Policy

It is important to attend all classes, as what is discussed in class is pertinent to adequate performance on assignments and exams. If you must be absent, it is your responsibility to obtain and review the information you missed.

"All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored."

Classroom Behavior

The Arizona Board of Regents' Student Code of Conduct, ABOR Policy 5-308, prohibits threats of physical harm to any member of the University community, including to one's self. See:
http://policy.web.arizona.edu/threatening-behavior-students

Students with Disabilities

If a student is registered with the Disability Resource Center, he/she must submit appropriate documentation to the instructor if he/she is requesting reasonable accommodations.
http://drc.arizona.edu/instructor/syllabus-statement.shtml

The information contained in this syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.