Course Syllabus

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Astrophysics & Stellar Astronomy – Syllabus, Fall 2019

AST 5010 / PHY 5010

Instructor: Prof. Ed Cackett

Lecture: Tuesday and Thursday, 2:30pm – 3:45pm

Location: 1172 Old Main

Office: 337 Physics

E-mail: ecackett@wayne.edu (mailto:ecackett@wayne.edu)

Phone: (313) 577 9355

Office Hours

Tuesday and Thursday 10:30am – 11:30pm. If you can't make it during regular office hours, please feel free to email me to schedule an appointment at some other day/time. As a general rule, if my office door is open, you're free to come in and ask questions.

Course Synopsis

This is a 3-credit course, which covers an introduction to the physics of stars, discussing the structure of stars and how they evolve.

Learning Outcomes

By the end of the course students should be able to do the following:

1. Know and use the stellar structure equations
2. Know, and be able to apply, the virial theorem
3. Know how to get the total energy of a star
4. Understand what an equation of state is
5. Know the basic nuclear fusion processes in stars
6. Know and be able to use the Lane-Embden equation and how it relates to the density and pressure profiles in a star
7. Know what the Chandrasekhar mass is and where it comes from

8. Understand what the Eddington luminosity is and where it comes from
9. Understand the conditions under which a star is stable/unstable
10. Explain the evolution of stars of different masses, and relate it to the logT-logρ diagram
11. Explain the end-points of stellar evolution

Text

An Introduction to the Theory of Stellar Structure & Evolution (2nd Edition) by Dina Prialnik (Cambridge University Press, 2010). This textbook is required for the course.

An additional textbook that is also very useful is An Introduction to Modern Astrophysics by Carroll & Ostlie (2nd Edition, Cambridge University Press). This book is often affectionately referred to as BOB ("Big Orange Book") by astronomy undergrads around the country. It covers all of astrophysics and will be used as the main textbook in AST 5100 (Galaxies and the Universe). If you plan on taking AST 5100, I highly recommend getting the book now, since it's section on Stellar Astrophysics is also very good. The University Library has 2 copies of this book.

Canvas

Many course announcements, grades, etc will be made using the Canvas system - please check regularly.

Exams

- There will be 2 mid-term exams and 1 final exam.
- As per the university's exam schedule, the final exam will be held on **Thursday, December 12 from 2:45pm – 4:45pm** (note the different time).
- Material covered on each exam will be announced in class.
- The final is a cumulative exam, i.e. covers all the material seen through the semester.
- There will be **no make-up exams**.
- **If you do not take the final exam, your course final grade will be automatically 'F' – no exception.**
- **If you miss more than one mid-term, your course final grade will automatically be 'F' – no exception.**

Homework

There are 8 homework problem sets. The due dates and chapters covered by each homework set are given in the class schedule at the end of the syllabus.

Group presentations

There will be two approximately 10-minute presentations made in groups of 2-3 during the class. Graduate students will be expected to work separately from undergraduates and will be expected to give a more detailed presentation, lasting 15 minutes.

Honors Option

If you are interested in taking this class for Honors, please speak to me.

Performance Evaluation

Your final grade in this course will be based on the following items:

Mid-terms	40%	(each mid-term counts for 20%)
Final Exam	25%	
Homework	30%	
Group presentations	5%	(each presentation counts for 2.5%)

Final Grades

Final grades will be given using the grading scale in the table below, however, it is almost impossible to set 'perfect' exams, and so grades may be curved, if necessary.

A	**A-**	**B+**	**B**	**B-**	**C+**	**C**	**C-**	**D+**	**D**	**D-**	**F**
85 – 100%	80 – 84	75 – 79	70 – 74	65 – 69	60 – 64	55 – 59	50 – 54	45 – 49	40 – 44	35 – 39	< 35

Advice:

1. **Get the text**, read it before class, go to class, take notes and participate in the discussion.
2. **Come to class!** Research has shown that students who come to class do better, on average, than those that don't.
3. **Ask questions in class**. If things aren't clear, or even if you just want me to leave something up for longer to write it down, **don't be afraid to ask**. You will likely not be the only one with the same question/request.

4. You cannot skip the final exam because you feel you are getting a good enough grade without it. If you miss the final exam you will receive a grade of ‘F’. No exceptions.

In-class policies

Out of consideration for the other students in the lecture please abide by the following rules of conduct:
(1) Turn off all cell phones while in lecture,
(2) Please arrive on time for lecture and do not leave early,
(3) Please be mindful of your classmates.

Academic Dishonesty

All of the graded assignments are designed to measure your individual understanding of the material. No forms of cheating on these graded assignments will be tolerated (working together on the homework assignments is not considered cheating but copying of someone else’s homework is). Anyone found cheating on any graded activity will receive a grade of zero for that part of their grade and may receive a failing grade for the course.

Student Disability Services

If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TTY: telecommunication device for the deaf; phone for hearing impaired students only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services’ mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.

Class Schedule

This is the expected schedule for the course, though it is subject to change, as needed.

Day	Date	Lecture Topics	Chapter	HW due
Th	8/29	Introduction, Stellar Basics, H-R Diagram	1	
Tu	9/3	Equilibrium, dynamics	2.1 - 2.4	

Day	Date	Lecture Topics	Chapter	HW due
Th	9/5	Evolution, timescales	2.5 - 2.8	
Tu	9/10	Equation of State, Pressure	3.1 - 3.4	Chap 1 – 2
Th	9/12	Radiation, Radiative Transfer	3.5 - 3.7	
Tu	9/17	Group presentation prep (choose a topic from Chp 1 - 4)		
Th	9/19	Group presentations		Chap 3
Tu	9/24	Nuclear reactions, H burning	4.1 - 4.4	
Th	9/26	He, C, O, Si Burning, Heavy elements	4.5 – 4.10	
Tu	10/1	Problem solving review, Chap 1 – 4	1 – 4	Chap 4
Th	10/3	**Exam 1** (Chapters 1 – 4)	1 – 4	
Tu	10/8	Simple stellar models I	5.1 – 5.4	
Th	10/10	Simple stellar models II	5.5 – 5.7	
Tu	10/15	Thermal stability, Dynamic stability	6.1 - 6.4	Chap 5
Th	10/17	Convection	6.5– 6.7	
Tu	10/22	T-ρ evolution, The Main Sequence	7.1 - 7.4	Chap 6
Th	10/24	Group presentation prep (choose a topic from Chp 9 - 12)		
Tu	10/29	Late evolution	7.5 – 7.6	

Day	Date	Lecture Topics	Chapter	HW due
Th	10/31	Group presentations & Review	5 – 7	Chap 7
Tu	11/5	**Exam 2** (Chapter 5 – 7)	5 – 7	
Th	11/7	Pre-main sequence, Main-sequence phase	9.1 – 9.3	
Tu	11/12	Red Giant phase	9.4 – 9.6	
Th	11/14	Star death & Massive stars	9.7 – 9.10	
Tu	11/19	Supernovae	10.1 – 10.3	Chap 9
Th	11/21	Neutron stars & Black Holes	10.4 – 10.6	
Tu	11/26	Binary Stars	11	
Th	11/28	**Thanksgiving – No Class**		
Tu	12/3	Stellar life cycle	12	Chap 10 – 11
Th	12/5	Review	1 - 12	
Tu	12/10	**Study day – No Class**		
Th	12/12	**Final Exam (2:45 – 4:45pm)**	1 - 12	

Course Summary:

Date	Details