Astronomy 363: Galactic Astrophysics and Cosmology Autumn 2017

Overview:

Instructor:	Daniel Reisenfeld
Office:	CH Clapp Bldg. CHCB 121
Phone:	243-6423
Text:	*An Introduction to Modern Astrophysics (Second Edition)* by Bradley Carroll & Dale Ostlie (Pearson/Addison Wesley, 2007)
Lectures:	MWF, 10:00 – 10:50. CHCB Room 230
Office Hours:	M: 3-4, W: 2-3; Th: 2-3, and by appointment or right after class for quick questions
Course web site:	Moodle. `https://moodle.umt.edu` The course Moodle site contains course information, selected lecture presentations, syllabus, assignments, and solutions.

Description:

The star is the fundamental unit of astronomy. In this course, we will establish a basis for studying the Universe with a physical understanding of the nature of individual stars. We will begin with the observables: stellar properties we can ascertain through direct measurement. From there we will apply physical principles from mechanics, thermodynamics, statistical mechanics, electromagnetism and quantum, atomic and nuclear physics to develop a physical understanding of the nature of stellar interiors. The unifying theme of the course will be to understand the Hertzsprung-Russell diagram via basic principles of physics. The first semester, ASTR 363, will focus on the internal structure of an individual main sequence star. In the second semester, ASTR 365, we will investigate the time evolution of stars (their birth, death, and remnants).

Prerequisites:

I will assume that you are familiar with all areas of physics at the level of PHSX 215/217, and it will be helpful to have taken modern physics (PHSX 343), but not required. Calculus through the level of M 273 (Multivariable Calculus) (or equivalent) is a pre- or co-requisite.

Grading:

Midterm exams:	36% (12% each)
Final exam:	24%
Homework:	40%

Class Meetings:

I will spend most of each class period lecturing, but class participation will also be an important part of the course. We will sometimes go over homework problems during class. I will frequently ask you questions, and I expect you to ask me questions too.

Homework:

Homework will be assigned weekly. The assigned problems will be collected, graded, and returned. Homework will be due by **5:00 PM** on the due date, typically Mondays. There will be a late penalty of 10% off per day late (weekends and holidays excluded). If you have a conflict with the due date, it is recommended that you turn in the assignment early or talk to me ahead of time to see if other arrangements can be made. **I am much more agreeable if you talk to me ahead of time rather than after the fact.** You are encouraged to work together on the homework problems and to see me if you need hints; however, the work you turn in must be your own.

Exams:

There will be three mid-term exams and a final exam. The final, which will be on **Friday, December 15th** from 8:00-10:00, will be comprehensive. Exams will be closed book except for a calculator and one sheet (8½" x 11") of paper with anything written on *one* side that you want. (Two sheets with both sides with writing are allowed for the final.) Make-up exams may be given in exceptional circumstances, but only if arranged in advance.

Student Conduct Code:

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/vpsa/policies/student_conduct.php

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Targeted Course Syllabus

Week	Week of	Topics		Chapter
		STELLAR OBSERVATIONS		
0	(9/01)	Course Introduction, Positions & motions of stars		1.3
1	9/04	(*No Class Monday*) Distances, magnitudes, luminosity		3.1, 3.2
2	9/11	Continuous spectra of stars; Line emission		3.4, 3.5, 5.1
3	9/18	Spectral types; Hertzsprung-Russell diagram		8.1, 8.2
4	9/25	Binary stars; Radioactive dating	**Exam 1 (9/29**)	Ch. 7, Pp 756-759
		PHYSICS OF STELLAR STRUCTURE		
5	10/02	Radiation field of a star; Radiative transfer, LTE		9.1, 9.2
6	10/09	Stellar opacity; Spectral Line Profiles		9.3, 9.4, 9.5
7	10/16	Hydrostatic Equilib, Pressure equation of state		10.1, 10.2
8	10/23	Ener. Transport, Eqs of stellar structure	**Exam 2 (10/27)**	10.4,10.5
		STELLAR NUCLEOSYNTHESIS		
9	10/30	Nuclear reactions & binding energy; tunneling		10.3, 5.4
10	11/06	(*No Class Friday*) Reaction rates; Fusion		10.3
		STELLAR MODELING		
11	11/13	Boundary conditions & integration		10.5
12	11/20	MESA Stellar Code	(*Thanksgiving Break W-F*)	Handouts
13	11/27	Modeling solar interior structure	**Exam 3 (12/01**)	11.1
		THE SUN AS A STAR		
14	12/04	Solar Interior, Atmosphere		Ch. 11
15	12/11	Review (Last day of class: Monday, 12/11)		
		Final Exam: Friday, 12/15, 8:00 am – 10:00 pm		

Drop/Add/Auditing: Drop/Add can be performed online until **September 21st**, and with the instructor's and advisor's signatures until **November 2nd**. Last day to drop with petition to the Dean is **December 12th**. Students interested in **auditing** the course must choose so on or before **September 21st**.

Disability Modification:
Students with disabilities will receive reasonable modifications in this course. Your responsibilities are to request them from me with sufficient advance notice, and to be prepared to provide verification of disability and its impact from Disability Services for Students. Please speak with me after class or during my office hours to discuss the details. For more information, visit the Disability Services for Students website at http://www.umt.edu/disability

LEARNING OUTCOMES:

By the end of this course, it is expected that the student will be able to:

- Have a working knowledge of the observable properties of stars (luminosity, temperature, mass, spectral class) and how to interpret them.
- Understand the classification of stars into different types as delineated on the Hertzprung-Russell diagram.
- Display an understanding of concepts related to the theory of stellar atmospheres including: opacity, optical depth, emissivity, statistical equilibrium, etc.
- Demonstrate an understanding of how spectral lines form in stellar atmospheres and the knowledge that can be obtained from their study.
- Analytically calculate and solve problems related to the structure of stars including the use of stellar structure equations and the Saha equation.
- Display a qualitative understanding of the physics of stellar models.