

# ASTR 5420 - STELLAR EVOLUTION AND INTERIORS

**University of Wyoming**

**Spring 2016**

*Last updated January 27, 2016*

**Instructor:** Prof. Hannah Jang-Condell

**Class Meeting Times:** Wednesdays & Fridays 10:00-11:15am, STEM 117

**Office Hours:** Mon 1-2pm, Thu 1-3pm, or by appt.

Contact Information: PS 329, x6-3680, [hjangcon@uwyo.edu](mailto:hjangcon@uwyo.edu)

## **Texts:**

Required:

- *Stellar Interiors - Physical Principles, Structure, and Evolution*, by Hansen, Kawaler, & Trimble, second edition. 2004, Springer.

Recommended resources:

- *Stellar Structure and Evolution*, by Kippenhahn, Weigert and Weiss, second edition, 2012, Springer.
- *An Introduction to Stellar Astrophysics*, by LeBlanc, 2010, Wiley.
- *Radiative Processes in Astrophysics* by Rybicki & Lightman
- *Introduction to Modern Astrophysics* by Carroll & Ostlie, Int'l. ed. of 2nd revised edition, 2013.
- W. Lyra's lecture notes from "Special Topics in Astrophysics."  
<http://wladimirlyra.com/SelectedTopics.html>
- MIT OpenCourseWare, 8.901 Astrophysics I.  
<http://ocw.mit.edu/courses/physics/8-901-astrophysics-i-spring-2006/>

**Course website:** <http://physics.uwyo.edu/~hannah/teaching/ASTR5420>

## **Course Description**

The life cycle of stars forms the basis for this course, including formation and early evolution, hydrostatic structure, and late stages of evolution. In addition, energy generation and transport are presented. Prerequisite: graduate standing in astrophysics or permission of the instructor.

## Topics

This class will consist of three units: radiative transfer, stellar structure, and stellar evolution. Topics include (subject to change):

### A. Radiative Transfer

- Principles radiative transfer
- Stellar atmospheres
- Spectral types

### B. Stellar Structure

- Dimensional analysis and homology relations
- Equations of state
- Energy transport
- Nucleosynthesis
- Stellar modeling
- Stellar pulsations

### C. Stellar Evolution

- Star formation
- Pre-main sequence evolution
- Main sequence stars
- Post-main sequence evolution
- Supernovae
- Stellar end states
- Binaries

## Grading

- 25% Problem Sets
- 25% Midterm Exam
- 25% Final Exam
- 25% Final Project

Grade ranges:

**A:** 87.5% – 100%

**B:** 75% – 87.5%

**C:** 62.5% – 75%

**D:** 50% – 62.5%

**F:** < 50%

Grades for this class may be subject to re-normalization, or “curving.”

## **Problem Sets**

Problem sets will be assigned approximately weekly. They are due in my mailbox no later than **4pm on Friday**.

I encourage you to collaborate and consult with your classmates on course material, but the work you turn in must be your own. **If you work together on assignments, write down your collaborators’ names on your work.** For coding assignments, you may consult your fellow students for ideas, but you may not simply copy their code and turn it in as your own work.

Complete solutions should show all work and should be neat and legible. If I can’t read it, I can’t grade it.

## **Exams**

The midterm exam will take place on **Friday, March 11**, and will cover radiative transfer and most of stellar structure. The final exam will take place during finals week, and is tentatively scheduled for **Monday, May 9, 10:15am-12:15pm** and will cover part of stellar structure and stellar evolution.

## **Final Project**

A detailed description of the expectations for the final project will be handed out later in the semester. There will be a number of suggested topics, but students are free to choose a topic in their own. Selection of the project topic is subject to instructor approval. Project topics closely related to the student’s research outside of class are not only permitted, but encouraged. You must have selected the topic of your final project by the due date of the last problem set. The final presentation will consist of two parts: a written paper and a poster presentation. Final presentations will take place during the last week of classes, and will include a 5 minute oral presentation of your poster.

## **Late Work**

Late assignments will be penalized 20% for each day late, compounded. For example, if a maximum of 50 points are possible for an on-time assignment, the maximum points possible will be 40 points for one day late, 32 points for two days late, etc. Extensions may be granted in certain circumstances (research travel, illness, etc.), but must be approved by the instructor in advance of the due date. Remember: in the real world, if you miss a proposal deadline by one minute, you get zero credit.

## **Class Policies**

### **General**

All policies described in the Student Code of Conduct apply.

### **Attendance**

As graduate students, travel to conferences or observing trips may conflict with class meeting times. If you know you will miss class, please inform the instructor as far in advance as possible. If you become ill, you are probably better off staying at home instead of infecting your fellow classmates. You are expected to obtain the notes from any class you miss either from your student peers or meeting with the instructor. If you must miss a research article discussion, you may make up your participation grade by writing a short synopsis of highlights of the article, due upon your return to class.

### **Student Conduct**

Students are expected to respect others opinions and abilities, and to help each other during group work activities. Those who repeatedly disrupt the class or interfere with other students opportunity to learn will be asked to leave the class. If you have a mobile phone or any other distracting equipment, leave it home, turn it off, or silence it and refrain from any non-class use during class.

### **Academic Integrity**

Any instance of academic dishonesty, including cheating and plagiarism, will be dealt with according to university regulations. It is your responsibility to avoid complaints or appearances of impropriety.

The University of Wyoming is built upon a strong foundation of integrity, respect and trust. All members of the university community have a responsibility to be honest and the right to expect honesty from others. Any form of academic dishonesty is unacceptable to our community and will not be tolerated. Students should report any suspected violation of proper academic behavior to me. I will report suspected violations of standards of academic honesty to my Department Head, and/or the Dean. Complete regulations regarding academic dishonesty are at [http://www.uwyo.edu/generalcounsel/\\_files/docs/UW-Reg-6-802.pdf](http://www.uwyo.edu/generalcounsel/_files/docs/UW-Reg-6-802.pdf).

### **Personal Issues**

If you have any kind of disability, whether apparent or non-apparent, learning, emotional, physical, or cognitive, and you need accommodations or alternatives to lectures, assignments, or exams, please feel free to contact me to discuss reasonable accommodations for your access needs. Please also work with University Disability Support Services (UDSS) in SEO, room 330 Knight Hall, 766-6189, TTY: 766-3073.

## **Office Hours**

I will be physically in my office during the stated office hours, or will leave a note as to where I can be found. If I am unable to make my office hours (weather, scheduling conflict, etc), I will inform you as soon as possible. If you are unable to make my office hours, please schedule another time to meet with me.

I will not respond to homework questions over email, especially in the 24-hour period before the assignment is due. It is too difficult to answer complicated questions over email, and it is all too easy for miscommunication to occur.

## **Civil Rights Discrimination**

Civil rights discrimination is defined in University Regulation 1-5 as “Adverse treatment and harassment on the basis of race, sex, gender, color, religion, national origin, disability, age, veteran status, sexual orientation, genetic information, political belief, or other status protected by state and federal statutes or University Regulations.” Title IX makes it clear that violence and harassment based on sex and gender are civil rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources at the Office of Equal Opportunity Report and Response (EORR), or at this link:

<http://www.uwyo.edu/diversity/eorr/complaints/index.html>

## **Disclaimer**

Information in the syllabus was, to the best knowledge of the instructor, correct when distributed at the beginning of the term. The instructor, however, reserves the right, acting within the policies and procedures of the University of Wyoming, to make changes in the course content or instructional techniques during the term without notice or obligation. If any changes to the syllabus become necessary, students will be notified orally in class, by email, and on the web site.