AST 4211 - ESSENTIALS OF ASTROPHYSICS

INSTRUCTORS: Prof. Rana Ezzeddine &
Prof. Desika Narayanan

Semester: Spring 2025

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Office Location:
324 (Ezzeddine) & 216 (Narayanan) - Bryant Space Science Center

Office Hours:
Ezzeddine: Fridays 2 pm
Narayanan: Fridays 2 pm
or by appointment via email

Class Periods:
MWF 3:00-3:50 pm

Class Location:
TUR 005

Course Overview

This is an advanced astrophysics course meant to build a solid foundation in the subject of stellar astrophysics, their properties and their interactions with their nearby environments. The topics covered will include stellar structure and evolution, analysis of their radiation emitted from their stellar atmospheres, as well as their interaction with the Interstellar Medium (ISM). We will discuss both the theoretical and observational aspects of the topics. In all facets of the course, relevant journal articles from the active research in the literature will be used to augment and extend the topics discussed in lecture.

Recommended Textbooks

- *"Stars and Stellar Processes", M. Guidry, 1st edition, Cambridge University Press publication, ISBN: 9781107197886*
- *"An Introduction to Modern Astrophysics", Carrol & Ostlie, Cambridge University Press, 2nd edition, ISBN: 9781108422161*
- *"Radiative Processes in Astrophysics", George B. Rybicki & Alan P. Lightman, ISBN: 9783527414499*

Online Resources

- *"Radiative Transfer in Stellar Atmospheres", R.J. Rutten, 2003, (free online: http://www.staff.science.uu.nl/~rutte101/Course_notes.html)*
- *"Stellar Structure and Evolution", Onno Pols, 2012, (free online: https://www.astro.ru.nl/~onnop/education/stev_utrecht_notes/)*

Course Objectives and Goals

The course Goals are:

- To understand the global properties of stars
- To derive the equations necessary to model the internal structure of stars
- To survey how stars of different masses evolve and end their lives
- To learn about the basics of radiation transfer in stars
- To learn how stellar spectral lines form and how we use them as diagnostics of stellar properties
- To understand thermal emission processes from astrophysical media
- To learn about statistical equilibrium, emission and absorption processes
- To learn about free-free and synchrotron emission

Course Schedule

Week	Subject	Details	Assignments
Jan 13 - Jan 17	Introduction	Intro + Basic concepts, Observable quantities, Fundamental equations	HW1 due Jan 24
Jan 20 - Jan 24 (Jan 20 Holiday)	Stellar Structure	Stellar Structure Equations I	
Jan 27 - Jan 31	Stellar Structure	Stellar Structure Equations II	HW2 due Feb 7
Feb 3 - Feb 7	Nuclear Energy In Stars	Nuclear burning processes and element formation in stars	
Feb 10 - Feb 14	Stellar Evolution	Evolution of stars: Massive stars	HW3 due Feb 21
Feb 17 - Feb 21	Stellar Evolution	Evolution of stars: Low-mass stars	
Feb 24 - Feb 28	Review + MIDTERM		
Mar 3 - Mar 7	Thermal Emission		HW4 due Mar 14
Mar 10 - Mar 14	Radiative Transfer and Kirchhoff's Laws		
Mar 17 - Mar 21	Spring Break		
Mar 24 - Mar 28	Statistical Equilibrium and the Saha Equation		HW 5 due April 4

Course Schedule

Week	Subject	Details	Assignments
Mar 31- Apr 4	Free-Free Emission		HW6 due April 11
Apr 7 - Apr 11	Synchrotron Radiation		
Apr 14 - Apr 18	[Catch up and Review]		
Apr 21 - Apr 25 (Apr 24/25 reading days)			
Apr 28 - May 2	FINAL		

Assignments & Grading Percentages

Assignment	Modality/Date	Percentage
Midterm	Feb 28 (In class)	25%
HWs	Bi-weekly (take home)	40%
Final Exam	TBD	25%
Participation	In class discussions and problem solving	10%

Communication & Email Policy

Canvas messaging or email are the preferred methods of communication outside of class time and office hours. The professors check their emails regularly Monday-Friday from 9am-5pm and reply within 24 hrs. Note that an email received after 5:00pm on a Friday may not be answered until Monday.

Attendance Policy and Class Expectations

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies.
Point assignments will be associated with each problem in each homework. Homework assignments must be completed on time to receive full credit. Partial credit will be assigned where work has been carried out the full correct answer is not provided. Homeworks handed in after the graded corrected versions have been distributed out to the rest of the class will not be accepted.

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center. Click here to get started with the Disability Resource Center. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Grading Policy

The following is given as an example only:

Percent	Grade
90-100	A
87.0-89.9	A-
84.0-86.9	B+
81.0-83.9	B
78.0-80.9	B-
75.0-77.9	C+
72.0-74.9	C
69.0-71.9	C-
66.0-68.9	D+
63.0-65.9	D
60.0-62.9	D-
0-59.9	F

More information on UF grading policy may be found at:
https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals.

Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/ public-results/

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is

The Honor Code (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor in this class.

Campus Resources

Health and Wellness:

U Matter, We Care: If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS) Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/

UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 52-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; Visit the UF Health Emergency Room and Trauma Center website.

GatorWell Health Promotion Services: For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the GatorWell website or call 352-273-4450

Academic Resources:

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601.

Career assistance and counseling, https://www.crc.ufl.edu/.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

General study skills and tutoring, https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall, 846-1138; Help brainstorming, formatting, and writing papers: https:// writing.ufl.edu/writing-studio/.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: http://www.distance.ufl.edu/student-complaint-process.