ASTRONOMY & ASTROPHYSICS I

AST3018, 3 CREDITS, FALL 2023, SECTION 5858

INSTRUCTOR: *Naibi Mariñas*

E-mail address: marinas@ufl.edu *(use Canvas Inbox for class communication, outside class time)*

MEETING TIMES: *MWF (12:50 PM – 1:40 APM)*

CLASSROOM: *CSE E119*

FINAL EXAM: *To be announced*

OFFICE HOURS: *To be announced*

COURSE WEBSITE: *https://ufl.instructure.com/*

TA: *To be announced*

COURSE COMMUNICATIONS: *For any class-related logistic or content questions outside class time or office hours, students should use* ***Course Questions*** *discussion board. This will benefit all students that might have similar questions and avoid repetitive questions. The instructor will regularly answer all questions posted in the board.* ***If a student has a private question, the student should contact the instructor using the Inbox in Canvas instead or attend office hours.***

The instructor will use the ***Announcements*** *in the class website to communicate with the whole class outside class time. Students should frequently check the Announcement page. The class settings can be adjusted so that announcements are sent directly to emails.*

PREREQUISITE: PHY 2048 or PHY 2060 and MAC 2311 or MAC 3472

COREQUISITE: PHY 2049

REQUIRED TEXT: *Foundations of Astrophysics by Barbara Ryden & Bradley Peterson, Cambridge Press.* You can get the e-book or the paper copy. AST3018 will cover chapters 1 – 7 and 13 – 17.

COURSE DESCRIPTION: This course offers a broad overview of modern astrophysics. This course is the first of a two-semester sequence consisting of AST3018 and AST3019.

This sequence is intended for majors in a physical science or engineering who have completed the first semester (i.e. mechanics and optics) of a calculus based introductory physics course and are taking the second semester of a calculus-based physics course (i.e. electricity & magnetism and thermodynamics).

AST3018 will cover:

- Motions of the sky
- A historical development of our understanding of the solar system
- The generation of light and the interaction of light with matter
- Telescopes and modern astronomical instrumentation
- The properties and classification of stars
- The physics of stellar interiors and atmospheres
- The formation and evolution of stars

GRADING POLICIES:

See https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx for general UF grading policies. Grades for the course will be based on the following:

Assignment	Points or percentage
Attendance/Participation	5 %
Video Quizzes	15 %
Homework	20 %
Observing Project	20 %
Exams (Midterm exam 20%, Final Exam 20%)	40 %

GRADING SCALE:

Grade	% Points	GPA	Grade	% Points	GPA	Grade	% Points	GPA
A	> 90	4.0	B-	77 to < 80	2.67	D+	64 to < 67	1.33
A-	87 to < 90	3.67	C+	74 to < 77	2.33	D	60 to < 64	1.0
B+	84 to < 87	3.33	C	70 to < 74	2.0	D-	57 to < 60	0.67
B	80 to < 84	3.0	C-	67 to < 70	1.67	E	< 57	0

ATTENDANCE/PARTICIPATION (5 %): This class will have both synchronous and asynchronous components. You will be responsible for studying all the material assigned and for participating in all in-class assignments.

QUIZZES (15 %): A major responsibility for this class will be to read the book chapters and watch the lecture videos every week before we cover the material in class. Video quizzes will be due each week before class to help keep you on track with the material.

HOMEWORK (20 %): There will be approximately 6 graded homework assignments due every two weeks. The homework will include problems from the textbook and additional related problems.

OBSERVING PROJECT (20 %): One of the most enjoyable aspects of science is doing research and making discoveries. In the class project "Observing the night sky", you will conduct astronomical observations using telescopes and CCD detectors at the UF Campus Teaching Observatory. You must sign up in advance for an observing session during the first two weeks of classes.

At the Observatory, you will learn to:

- Acquire astronomical objects using an eyepiece
- Install CCD camera on the telescope and start up the computer interface
- Focus the telescope
- Obtain photometry of binary stars, and imaging of a nebula.
- Store images on computer and memory stick
- Close down CCDs and telescopes

After you obtain your observations, you will need to reduce and analyze your data. You will write a report that includes a log and description of your observations, data reduction, and analysis of the data (including answering questions posed in the

instruction manuals). Your report will also include a summary of your results and their significance.

EXAMS (40 %): There will be two exams, a midterm and a final. Both exams will be proctored. These exams will test your content knowledge, but will emphasize applying critical thinking skills and solving problems. The mid-term will take place during class time on one of our double periods. The Final will be at the assigned day/time by the college.

GENERAL EDUCATION REQUIREMENTS:

AST 3018 & 3019 are GenEd physical science (P) courses. As the list of topics above demonstrates, the course covers not only the Universe and the bodies in it – planets, moon, stars, galaxies, etc. -- but also how we know about those things, making use of our understanding of the underlying physics of orbits and radiation. The course will focus on major scientific developments in astronomy & astrophysics and their impacts on society and the environment. A minimum grade of "C" is required for general education credit.

PHYSICAL SCIENCE: The physical and biological sciences provide instruction in the basic concepts, theories, and terms of science and the scientific method. Courses focus on major scientific developments and their impacts on society and the environment. You will formulate empirically-testable hypotheses derived from the study of physical processes and living things and you will apply logical reasoning skills through scientific criticism and argument.

STUDENT LEARNING OUTCOMES for a GenEd physical science course in astronomy are as follows:

I. Content

- Identify, describe and explain concepts, theories, and terminology of astronomy and astrophysics and the scientific method, as well as major scientific developments in the field of astronomy, and the relevant processes that govern physical systems in astrophysics. Student competency will be assessed through quizzes, in-class assignments, exams, and an observational project.

II. Critical Thinking

- Analyze quantitative data to formulate empirically-testable hypotheses derived from the study of physical processes in astronomy.

- Apply logical reasoning skills effectively through scientific criticism and argument in astronomy.
- Apply techniques of discovery and critical thinking effectively to solve problems and to evaluate outcomes. Student competency will be assessed through the observational project.

III. Communication

- Summarize and present scientific findings clearly and effectively using written, and graphic forms. Student competency will be assessed through the observational project report.

COURSE POLICIES:

AST3018 is a one term course and the first in the Astronomy and Astrophysics sequence. Each week students will be required to complete a set of assignments. All assignments are listed in the course schedule by week; specific due dates can be found in the Course Calenda, but they can change. Dates for assignments will be adjusted to the pace of the class. As this course has an online component, students must plan to have regular Internet access and time to explore the resources available.

REQUIREMENTS: *Students are expected to:*

- Complete all modules in a timely fashion. Each module includes reading assignments, lecture videos and additional material. **Assignments will begin on the first week of classes. If you do not login to the class website and work on the content weekly, the assignments will be late and will be penalized.**
- Attend classes and participate in class activities.
- Complete all weekly video quizzes by their due date.
- Complete all homework sets by their due date.
- Complete one observing project during the term and submit the project report. The class project will be time consuming and you will need to work on it throughout the semester to be able to finish the assignment on time.
- Complete two proctored exams.

- Check the **course announcements** and class e-mail regularly. You are responsible for knowing all the information posted in announcements.

COURSE TECHNOLOGY: Access to and on-going use of a computer is **required** for all students. Competency in the basic use of a computer is required. Course work will require use of a computer and a broadband connection to the Internet. For additional information on UF College of Liberal Arts and Sciences policy regarding computer requirements you can visit: http://it.clas.ufl.edu/policies/student-computer-requirement/

COURSE EVALUATION BY STUDENTS: 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/.

LATE ASSIGMENT POLICY: Students may submit individual assigned work after the stated deadline. A 10% grade penalty is assessed for work up to twenty-four hours late; an additional 10% is assessed for **EACH** additional day the work is late.

MAKE-UP POLICY: If a student misses an assignment due to an excused absence as specified in the undergraduate catalog and provides the instructor with timely notification, they will be allowed a reasonable time to make up the missed work. Students should contact the Dean of Student Office Care Area if they have personal or family issues that prevent them from attending class.

All make-up exams will be different from regular exams.

UF POLICIES:

UNIVERSITY POLICY ON ACCOMMODATING STUDENTS WITH DISABILITIES: Students requesting accommodation for disabilities must first register with the Dean of Students Office (http://www.dso.ufl.edu/drc/). The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to submitting assignments or taking the quizzes or exams. Accommodations are not retroactive; therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations.

UNIVERSITY POLICY ON ACADEMIC MISCONDUCT: Academic honesty and integrity are fundamental values of the University community. Students should be sure that they understand the UF Student Honor Code at https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

This is an excerpt from the Academic Honesty Guidelines and Student Conduct Code in the University of Florida Undergraduate Catalog:

"Academic Honesty: The university requires all members of its community to be honest in all endeavors. A fundamental principle is that the whole process of learning and pursuit of knowledge are diminished by cheating, plagiarism, and other acts of academic dishonesty. In addition, every dishonest act in the academic environment affects other students adversely, from the skewing of the grading curve to giving unfair advantage for honors or for professional or graduate school admission. Therefore, the university will take severe action against dishonest students. Similarly, measures will be taken against faculty, staff, and administrators who practice dishonest or demeaning behavior."

Cheating is not tolerated in this class. Everyone in this class is expected to follow the University of Florida Honor Code: *We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.* Any student suspected of academic misconduct will be automatically referred to the Honor Code Chancellor as required by UF.

On all work submitted for credit by students at the university, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

NETIQUETTE: COMMUNICATION COURTESY: All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats. http://sfrc.ufl.edu/courses/distance/NetiquetteGuideforOnlineCourses.pdf

UF ONLINE HANDBOOK: Additional information can be found on http://handbook.ufonline.ufl.edu/

INFRASTRUCTURE (CANVAS)

- Privacy PolicyLinks to an external site.
- AccessibilityLinks to an external site.

ZOOM

- Privacy Policy (Links to an external site.)
- Accessibility (Links to an external site.)

YOUTUBE (GOOGLE)

- Privacy Policy (Links to an external site.)
- https://about.google/belonging/disability-inclusion/product-accessibility/ (scroll all the way down for YouTube accessibility information)

HONORLOCK

- Privacy Policy (Links to an external site.)
- Accessibility

GETTING HELP:

For issues with technical difficulties for E-learning, **do NOT contact the instructor**, please contact the UF Help Desk at:

- Learning-support@ufl.edu
- (352) 392-HELP - select option 2
- https://elearning.ufl.edu/keep-learning/

Any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from LSS when the problem was reported to them. The ticket number will document the time and date of the problem. Students MUST contact the instructor within 24 hours of the technical difficulty to request a make-up.

Other resources are available at http://www.distance.ufl.edu/getting-help for:

- Counseling and Wellness resources
- Disability resources
- Resources for handling student concerns and complaints
- Library Help Desk support

Should students have any complaints with their experience in this course they should visit http://www.distance.ufl.edu/student-complaints to submit a complaint.

COVID-19:

In response to COVID-19, the following recommendations are in place to maintain your learning environment, to enhance the safety of our in-classroom interactions, and to further the health and safety of ourselves, our neighbors, and our loved ones.

- If you are not vaccinated, get vaccinated. Vaccines are readily available and have been demonstrated to be safe and effective against the COVID-19 virus. Visit one.uf for screening / testing and vaccination opportunities.
- **If you are sick, stay home**. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 to be evaluated.
- Course materials will be provided to you with an excused absence (documentation required), and you will be given a reasonable amount of time to make up work.

ANNOTATED TENTATIVE WEEKLY SCHEDULE:

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
Week 1	Topic	Chapter 1. Celestial Sphere
	Summary	Introduction to class. The Celestial Sphere. Equatorial Coordinate System. The Observer's Sky. Stellar motion. Finding your latitude.
	Readings/Works	Foundation of Astrophysics. Chapter 1
	Assignment	Watch all Chapter 1 lecture videos Take Lecture Video Quiz for Chapter 1 Calculating Maximum and minimum altitude
Week 2	Topic	Chapter 1. Celestial Sphere
	Summary	Solar Motion. Precession of the equinoxes. Calendar and Seasons. Equation of Time. Apparent, mean, and standard time. Finding your longitude.
	Readings/Works	Foundations of Astrophysics, Chapter 2
	Assignment	Watch all Chapter 2 lecture videos Take Lecture Video Quiz for Chapter 2

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
		Sign Up for Observing Sessions at the Campus Teaching Observatory
Week 3	Topic	Chapter 2. Emergence of Modern Astronomy
	Summary	Aristarchus, Eratosthenes, Hipparchus and Ptolemy. Retrograde motion and the geocentric model. Copernicus and the heliocentric model. Kepler's Laws of Motion.
	Readings/Works	Foundation of Astrophysics, Chapter 3
	Assignment	Synodic and sidereal periods worksheet Measuring the solar system activity Watch all Chapter 2 lecture videos Take Lecture Video Quiz for Chapter 2
Week 4	Topic	Chapter 3. Orbital Mechanics
	Summary	Huygen's centripetal force and gravitational force. Newton's laws of motion. Newton's derivation of Kepler's laws. Understanding Hohmann's transfer orbits. Calculate masses of orbiting bodies.
	Readings/Works	Foundations of Astrophysics, Chapter 4
	Assignment	Deriving Kepler's Laws worksheet Transfer Orbits activity HW1 (Chapters 1 and 2) Due Watch all Chapter 4 lecture videos

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
		Take Lecture Video Quiz for Chapter 4
Week 5	Topic	Chapter 4. Earth-Moon System
	Summary	Lunar motion and phases. Eclipses. Formation of the moon. Evolution of the Moon-Earth system. Tides, tidal force and acceleration. Origin of precession. Roche and Hill radius.
	Readings/Works	Foundations of Astrophysics – Chapter 5
	Assignment	Tides worksheet Lunar phases Watch all Chapter 5 lecture videos Take Lecture Video Quiz for Chapter 5
Week 6	Topic	Chapter 5 – Radiation and Matter
	Summary	Light and matter (polarization, diffraction, interference, reflection, refraction). Fermat's principle of least time. Doppler effect. Rayleigh-Jeans Law, Planck equation, Wien's Law and Stefan-Boltzmann Law.
	Assignment	Radial velocities, stellar temperature and luminosities worksheet Blackbody worksheet HW 2 (Chapters 3 and 4) Due
Week 7	Topic	Chapter 5 - Spectroscopy

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
	Summary	Model of the atom, transition of electrons and spectra. Rydberg formula, Kirchhoff's Laws, line broadening.
	Readings/Works	Foundation of Astrophysics – Chapter 6
	Assignment	Spectral Line Broadening Worksheet Watch all Chapter 6 lecture videos Take Lecture Video Quiz for Chapter 6
Week 8	Topic	Chapter 6 – Detection of Light
	Summary	Types of telescopes. Focal ratio, plate scale, sensitivity and resolving power. Image quality. Active and adaptive optics. Earth atmosphere and telescopes.
	Readings/Works	Foundations of Astrophysics – Chapter 7
	Assignment	Watch all Chapter 7 lecture videos Take Lecture Video Quiz for Chapter 7
Week 9	Topic	Chapter 7 – The Sun
	Summary	Solar structure. Solar activity and magnetic field of the Sun.
	Readings/Works	Foundations of Astrophysics – Chapter 13
	Assignment	HW 3 (Chapters 5 and 6) Due Midterm exam

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
		Watch all Chapter 13 lecture videos Take Lecture Video Quiz for Chapter 13
Week 10	Topic	Chapter 13 – Stellar Properties
	Summary	Distances and stellar parallax. Brightness and magnitude system. Binary stars. Stellar temperatures, masses, radii, and luminosities. Stellar lifetimes.
	Readings/Works	Foundations of Astrophysics – Chapter 14
	Assignment	Deriving stellar properties worksheet Watch all Chapter 14 lecture videos Take Lecture Video Quiz for Chapter 14
Week 11	Topic	Chapter 14 – Stellar Atmospheres
	Summary	Hydrostatic equilibrium. Spectral classification and luminosity classes. Hertzsprung-Russell diagram.
	Readings/Works	Foundations of Astrophysics – Chapter 15
	Assignment	Properties of main sequence stars and the HR diagram worksheet HW 4 (Chapters 7 and 13) Due Watch all Chapter 15 lecture videos Take Lecture Video Quiz for Chapter 15

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
Week 12	Topic	Chapter 15 – Stellar Interiors
	Summary	Equations of stellar structure. Stellar pressure. Energy transport inside stars. Coulomb barrier. Nuclear fusion reactions. Origin of elements. Modeling stellar interiors.
	Readings/Works	Foundations of Astrophysics – Chapter 16
	Assignment	Worksheet Radiative Transport Watch all Chapter 16 lecture videos Take Lecture Video Quiz for Chapter 16
Week 13	Topic	Chapter 16 – ISM
	Summary	Interstellar dust and gas. Properties. Atomic and molecular clouds. Extinction, reddening, and color excess.
	Readings/Works	Foundations of Astrophysics – Chapter 17
	Assignment	Derivation of stellar properties and extinction worksheet HW 5 (Chapters 14 and 15) Due Watch all Chapter 17 lecture videos Take Lecture Video Quiz for Chapter 17 Submit Observational Project

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
Week 14	Topic	Chapter 17 – Star Formation and Evolution
	Summary	Star formation theory. Virial theorem. Jean's mass and length. Evolution of low and high mass stars. Chandrasekar limit. Supernova Type I and II. Standard candles
	Assignment	Virial theorem worksheet
Week 15	Topic	Chapter 17 – Star Formation and Evolution
	Summary	Tracking stellar evolution on the HR diagram.
	Assignment	Tracking stages of stellar evolution on the HR diagram worksheet Final Exam