AST3018 ASTRONOMY & ASTROPHYSICS I

3 CREDITS, FALL 2024, SECTION 0823, CLASS 27081

I. General Information

MEETING TIMES: *T (10:40 AM – 11:30 AM), R (10:40 AM – 12:35 PM)*

CLASSROOM: *CSE E121*

FINAL EXAM: *12/10/2024 @ 3:00 – 5:00 PM*

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

INSTRUCTOR: *Naibi Mariñas*

E-mail address: marinas@ufl.edu *(use Canvas Inbox when possible)*

Office: Bryant Space Science Center 224

Office Hours: Wednesdays 12:00 – 1:00 PM

TEACHING ASSISTANT: Makayla Frisse

E-mail address: (use Canvas Inbox when possible)

Office Hours: To be announced on second week of class

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 and TAs will regularly answer all questions posted in the board. If a student has a private question, the student should contact the instructor or TA using the Inbox in Canvas 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 emphasizing the use of the scientific method and the application of mechanics and electromagnetism to understand the Universe and the bodies in it. Throughout this course, students will develop the ability to discern scientific knowledge from non-scientific claims by using critical thinking (P).

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

II. Graded Work

Grades for the course will be based on the following:

Assignment	Points or percentage
Attendance/Participation	10 %
Video Quizzes	10 %
Homework	10 %
Observing Project	30 %
Exams (Midterm exam 20%, Final Exam 20%)	40 %

See UF Grades and Grading Policies for more information.

ATTENDANCE/PARTICIPATION (10 %): 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 (10 %): 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 (10 %): 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 (30 %): 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. The date of observing sessions can change depending on weather.

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 imaging and photometry of a celestial object.
- 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.

Students will be collecting the data in groups, but all the reduction, analysis and report is individual. The project due date will depend on the date your observations are taken.

EXAMS (40 %): There will be two exams, a midterm and a final. Both exams will be in person. The midterm exam will be during class time. The Final exam will be at the date and time assigned by the college during Finals week. These exams will test your content knowledge but will emphasize applying critical thinking skills and solving problems.

III. General Education Objectives and Student Learning Outcomes (SLOs)

AST 3018 & 3019 are GenEd physical science (P) courses. As the list of topics above demonstrates, the course covers not only the Universe, 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.

COURSE AND GEN ED STUDENT LEARNING OBJECTIVES AND OUTCOMES:

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.

  See https://undergrad.aa.ufl.edu/general-education/gen-ed-program/subject-area-objectives/ for General Education objectives for all physical science courses.

IV. 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 Calendar, 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.
- 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 multiple weeks to complete the assignment on time.**
- Complete two exams.
- Check the **course announcements** and class e-mail regularly. You are responsible for knowing all the information posted in announcements.

LATE ASSIGMENT POLICY: With the exception of class participation assignments, students may submit other 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: Students need to contact the Dean of Student Office Care Area and notify the instructor if they have personal or family issues that prevent them from attending class and completing assignments. After the instructor receives the information from the Care Area, students will be given a reasonable amount of time to complete the missed work.

ATTENDANCE POLICY: *See UF Academic Regulations and Policies for more information regarding the University Attendance 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/). See the *"Get Started With the DRC" webpage on*

the Disability Resource Center site. 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: 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 either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Conduct Code specifies a number of behaviors that are in violation of this code and the possible sanctions. See the UF Conduct Code website for more information. This includes the use of AI: except where explicitly instructed, no student is allowed to use any AI tools (e.g., including Grammarly) to assist with any assignments in this course. Doing so will be considered a violation of the student honor code. If you have any questions or concerns, please consult with the instructor or TAs in this class.

UF EVALUATION PROCESS: 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/.

NETIQUETTE: COMMUNICATION COURTESY: All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats. See Netiquette Guide for Online Courses for more information.

PRIVACY AND ACCESSIBILITY POLICY:

INFRASTRUCTURE (CANVAS)

- Privacy Policy.
- Accessibility.

ZOOM

- Privacy Policy.

- Accessibility.

YOUTUBE (GOOGLE)

- Privacy Policy.
- Accessibility (scroll all the way down for YouTube accessibility information).

HONORLOCK

- Privacy Policy.
- Accessibility

V. Getting Help

- Health and Wellness

  U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit U Matter, We Care website to refer or report a concern and a team member will reach out to the student in distress.

  Counseling and Wellness Center: Visit the Counseling and Wellness Center website or call 352-392-1575 for information on crisis services as well as non-crisis services.

  Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the Student Health Care Center website.

  University Police Department: Visit UF Police Department website or call 352-392-1111 (or 9-1-1 for emergencies).

  UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 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: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392- 1601. Career assistance and counseling services.

Library Support: Various ways to receive assistance with respect to using the libraries or finding resources. Call 866-281-6309 or email ask@ufl.libanswers.com for more information.

Teaching Center: 1317 Turlington Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring.

Writing Studio: Daytime (9:30am-3:30pm): 2215 Turlington Hall, 352-846-1138 | Evening (5:00pm-7:00pm): 1545 W University Avenue (Library West, Rm. 339). Help brainstorming, formatting, and writing papers.

Academic Complaints: Office of the Ombuds; Visit the Complaint Portal webpage for more information.

Enrollment Management Complaints (Registrar, Financial Aid, Admissions): View the Student Complaint Procedure webpage for more information.

VI. Annotated 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 Sign Up for Observing Sessions at the Campus Teaching Observatory

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
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 3 lecture videos Take Lecture Video Quiz for Chapter 3
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) 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)

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
Week 7	Topic	Chapter 5 - Spectroscopy
	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 Midterm – Chapters 1 - 6
	Summary	Solar structure. Solar activity and magnetic field of the Sun.

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
	Assignment	HW 3 (Chapters 5 and 6) Midterm exam covering chapters 1 – 6 in class
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 13 and 14
	Assignment	Watch all Chapter 13 lecture videos Take Lecture Video Quiz for Chapter 13 Stellar Magnitudes worksheet
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	Watch all Chapter 14 and 15 lecture videos Take Lecture Video Quiz for Chapter 14 and 15 Hydrostatic Equilibrium worksheet HW 4 (Chapters 7 and 13)

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	Radiative Transport worksheet 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	HW 5 (Chapters 14 and 15) Watch all Chapter 17 lecture videos Take Lecture Video Quiz for Chapter 17
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.

WEEK/ DATE	ACTIVITY	TOPIC/ASSIGNMENT (QUESTION/SUBJECT)
		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
12/10 3-5 PM	Final Exam	Chapters 7 - 13