

Department of Astronomy and Planetary Science

AST 280: INTRODUCTION TO ASTROPHYSICS **FALL 2019 TTh 12:45-2:00 PM SCIENCE & HEALTH 212**

Total Units of Course Credit: 3

Course Prerequisites: PHY 161 or 171 (or one semester of calculus-based physics) and MAT 136 (or first semester of calculus). I will *not* assume that you have had an introductory astronomy course. Course is specifically designed for astronomy majors or minors.

Mode of Instruction: In-Person

Instructor: Dr. Nadine G. Barlow (Please call me Dr. Barlow)

Office: Physical Sciences (Building 19), Room 200

Office Telephone: 928-523-5452 **E-mail:** Nadine.Barlow@nau.edu

Office Hours: TR 11:30-12:30, 2:00-3:00 PM; and by appointment

Course Purpose: This course is an introduction to astrophysics and is required for astronomy majors/minors. The course provides a physics-based introduction to the following topics: the sky and coordinate systems, celestial mechanics, light, radiation, the solar system, the Sun, stellar properties, stellar evolution, the Milky Way, other galaxies, and cosmology. This course gives the background needed for the more detailed discussions in the AST 300-level courses.

Course Student Learning Outcomes:

- (a) Be able to apply the physics you have learned to astronomical problems.
- (b) Continue to develop your problem-solving skills in physics, but in an astrophysical context.
- (c) Look at every answer you calculate, judge whether the answer is “sensible”, and understand its implications.
- (d) Understand enough astronomy and astrophysics to be able to comprehensibly read articles in magazines such as *Sky and Telescope*, *Astronomy*, and *Scientific American*.

Assessment:

Attendance/In-Class Activities: ***Class attendance is mandatory!*** For every three unexcused absences, your grade will be dropped by one full letter grade. If you have more than two unexcused absences during the first three weeks of class (August 26-September 13), you will be administratively dropped from the class. Class attendance will be determined by your daily reading summaries and participation in-class activities. Reading summaries will be over the assigned reading for the day (see below). Class activities will consist of discussing questions you may have about the material, discussing the more difficult aspects of the material, and participating in small group activities and problem-solving sessions. *Reading summaries and in-class activities cannot be made-up if you miss class.* Class participation is 14% of your grade.

Reading and Reading Summaries: The reading assignment for each class is listed on the calendar in Blackboard Learn—please read the assigned chapter sections before coming to class. All chapters are posted on Blackboard Learn. You are required to submit a summary of the major points of the assigned reading material at the start of each class period. The summary should be half a page in length summarizing the major points of the assigned reading ***in your own words.***

Reading summaries must be submitted at the start of class on the day that the reading is assigned for—no late summaries will be accepted. Reading summaries are 19% of your grade.

Homework: 5 quantitative homework assignments are distributed throughout the semester. You may work with other people in the class on the assignments, but each student must turn in his/her own work. Homework which is copied, xeroxed, or suspiciously similar to others will receive a zero. Homework is due on the day specified—5 points will be subtracted for *each working day* (i.e., Monday through Friday) that the homework is late. Homework will not be accepted if it is more than 1 week late. Homework is 37% of your grade.

Homework Format:

Students will be required to adhere to the following problem-solving steps when submitting written homework problems. Failure to follow this format will result in the loss of points.

INTERPRET AND ANTICIPATE:
<ul style="list-style-type: none">• State known quantities relevant to solving this problem• State goal of the problem solving exercise• Create a sketch if needed• Make a guess as to the approximate magnitude of the result you expect
SOLVE:
<ul style="list-style-type: none">• Written explanation in left column• Mathematical calculations in right column
INTERPRET RESULTS:
<ul style="list-style-type: none">• Compare results of calculations to expected results. Is result reasonable? Explain.

Exams: There will be two semester exams (7.5% each or 15% total of your grade) and a final exam (15% of your grade)—dates for each are given on the schedule/Blackboard Learn calendar. Exams will consist of a combination of qualitative and quantitative questions. *The final exam will be comprehensive.* Makeup exams are not given except in extreme circumstances (hospitalization; death of a close family member; etc.) and I **must** have written documentation of the emergency before the exam. **All work on the exams must be done individually. The final exam is comprehensive and everyone must take it at the scheduled time during finals week.**

Grading Scale:

Final grades in the class will be computed from the following:

Class Attendance and Participation	100
Reading Summaries (26 summaries @ 5 pts each)	130
Homework Assignments (5 @ 50 pts each)	250
Semester Exams (2 @ 50 points each)	100
Final Exam	<u>100</u>
TOTAL POINTS POSSIBLE	680

At the end of the semester, I will add up all the points you have earned, divide by 680, and assign your grade based on the following grading scale:

90% - 100%	A
80% - 89%	B
70 - 79%	C
60 - 69%	D
<59%	F

This is the guaranteed grading scale. I reserve the right to lower the curve but I will not raise it.

Text and Required Materials: Please bring paper, pencil, ruler, and calculator to class every day—we will typically spend some of the in-class period working on problems/activities. There is no required textbook for this class—chapter readings are posted on Blackboard Learn.

TENTATIVE SCHEDULE (Subject to Change):

<u>DATE</u>	<u>TOPIC</u>	<u>READING</u>	<u>OTHER</u>
Aug. 27	Introduction/Celestial Sphere	Ch. 1.1-1.2	
Aug. 29	Time and Coordinate Systems	Ch. 1.3-1.5	Hwk 1 Assigned
Sept. 3	Ancient and Greek Astronomy	Ch. 2.1-2.2	
Sept. 5	Later Astronomers	Ch. 2.3-2.4	
Sept. 10	Kepler's Laws	Ch. 3.1	
Sept. 12	Newton's Laws	Ch. 3.2	Hwk 1 Due
Sept. 17	Velocities and Orbits	Ch. 3.3-3.5	Hwk 2 Assigned
Sept. 19	Light	Ch. 4.1-4.3	
Sept. 24	Light and Spectroscopy	Ch. 4.3-4.4	
Sept. 26	Radiation	Ch. 4.5	
Oct. 1	Telescopes	Ch. 4.6	Hwk 2 Due
Oct. 3	EXAM 1 (Chapters 1-4)		
Oct. 8	Solar System Structure, Formation	Ch. 5.1-5.2	Hwk 3 Assigned
Oct. 10	Tides, Temperatures	Ch. 5.3-5.4	
Oct. 15	Terrestrial Planets	Ch. 5.5	
Oct. 17	Giant Planets	Ch. 5.6	
Oct. 22	Dwarf Planets; Small SS Bodies	Ch. 5.7-5.8	
Oct. 24	Exoplanets	Ch. 5.9	
Oct. 29	Sun and Solar Wind	Ch. 6.1-6.3	Hwk 3 Due; Hwk 4 Assigned
Oct. 31	Stellar Distances, Motions, And Magnitudes	Ch. 7.1-7.3	
Nov. 5	Binaries, Classes, and H-R Diagram	Ch. 7.4-7.6	
Nov. 7	EXAM 2 (Chapters 5-7)		
Nov. 12	ISM and Star Formation	Ch. 8.1-8.2	
Nov. 14	Stellar Structure and Evolution	Ch. 8.3-8.4	Hwk 4 Due
Nov. 19	Stellar Remnants	Ch. 8.5	Hwk 5 Assigned
Nov. 21	Milky Way Galaxy	Ch. 9.1-9.4	
Nov. 26	Normal Galaxies; Distances	Ch. 10.1-10.4	
Nov. 28	THANKSGIVING HOLIDAY—NO CLASS		
Dec. 3	Active Galaxies	Ch. 10.5-10.7	Hwk 5 Due
Dec. 5	Cosmology	Ch. 11	
Dec. 10	FINAL EXAM 12:30-2:30 PM (Chapters 1-11)		

University Academic Deadlines:

- Sept. 5: Last Day to Add without late fee
- Sept. 5: Last Day to Drop a class without it appearing on your transcript
- Oct. 7-25: Mid-term grades submitted
- Nov. 1: Last Day to Withdraw from a course
- Dec. 2: Last day to withdraw from NAU (all classes)
- Dec. 9-12: Final Exams
- Dec. 13: Commencement

CLASS POLICIES:

Late Work and Make-ups of Missed Classes:

- In-class activities cannot be made-up if you miss class.
- Reading summaries are due at the beginning of the class for which the reading is assigned. No late summaries will be accepted.
- Homework is due by 5 PM on the day specified—5 points will be subtracted for *each working day* (i.e., Monday through Friday) that the homework is late. Homework will not be accepted if it is more than 1 week late.
- Makeup exams are not given except in extreme circumstances (hospitalization; death of a close family member; etc.) and I **must** have written documentation of the emergency before the exam.

Cheating and Plagiarism: Passing other's work off as your own (plagiarism) and cheating are not accepted at NAU and are not tolerated in my class. Cheating includes (but is not limited to) the use of any materials other than those provided with the exam, use of cell-phones/laptops/tablets, etc. on exams, direct copying and submission of someone else's homework as your own, etc. If I catch you cheating or if I find assignments/exams which are suspiciously similar (such as exact same wording on written responses—note, changing a few words or the order of certain words is still plagiarism!), all students involved will receive zero points on that assignment or exam. I don't care who cheated off whom—everyone involved gets the same score of zero. If cheating/plagiarism continue, you will receive an F in the class and the Dean's office will be notified. The bottom line: ***Do your own work and don't let others copy off of you.***

UNIVERSITY POLICIES

Please read the following information about NAU Policies. If you have questions or need clarification regarding these stated policies, please ask me.

NAU POLICY STATEMENTS

ACADEMIC INTEGRITY

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full academic integrity policy available at <https://policy.nau.edu/policy/policy.aspx?num=100601>.

COURSE TIME COMMITMENT

Pursuant to Arizona Board of Regents guidance (Academic Credit Policy 2-224), for every unit of credit, a student should expect, on average, to do a minimum of three hours of work per week, including but not limited to class time, preparation, homework, and studying.

DISRUPTIVE BEHAVIOR

Membership in NAU's academic community entails a special obligation to maintain class environments that are conducive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not interfere with normal class activities or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's disruptive behavior policy at <https://nau.edu/university-policy-library/disruptive-behavior>.

NONDISCRIMINATION AND ANTI-HARASSMENT

NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, or veteran status. Due to potentially unethical consequences, certain consensual amorous or sexual relationships between faculty and students are also prohibited. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's Safe Working and Learning Environment (SWALE) policy. EAO also assists with religious accommodations. For additional information about SWALE or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at equityandaccess@nau.edu, or via the EAO website at <https://nau.edu/equity-and-access>.

TITLE IX

Title IX is the primary federal law that prohibits discrimination on the basis of sex or gender in educational programs or activities. Sex discrimination for this purpose includes sexual harassment, sexual assault or relationship violence, and stalking (including cyber-stalking). Title IX requires that universities appoint a "Title IX Coordinator" to monitor the institution's compliance with this important civil rights law. NAU's Title IX Coordinator is Pamela Heinonen, Director of the Equity and Access Office located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011. The Title IX Coordinator is available to meet with any student to discuss any Title IX issue or concern. You may contact the Title IX Coordinator by phone at 928-523-3312 (TTY: 928-523-1006), by fax at 928-523-9977, or by email at pamela.heinonen@nau.edu. In furtherance of its Title IX obligations, NAU will promptly investigate and equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. Additional important information about Title IX and related student resources, including how to request immediate help or confidential support following an act of sexual violence, is available at <http://nau.edu/equity-and-access/title-ix>.

ACCESSIBILITY

Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-6906 (TTY), 928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at <https://nau.edu/disability-resources/student-eligibility-process> or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.

RESPONSIBLE CONDUCT OF RESEARCH

Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at <https://nau.edu/research/compliance/research-integrity>.

MISCONDUCT IN RESEARCH

As noted, NAU expects every student to firmly adhere to a strong code of academic integrity in all their scholarly pursuits. This includes avoiding fabrication, falsification, or plagiarism when conducting research

or reporting research results. Engaging in research misconduct may result in serious disciplinary consequences. Students must also report any suspected or actual instances of research misconduct of which they become aware. Allegations of research misconduct should be reported to your instructor or the University's Research Integrity Officer, Dr. David Faguy, who can be reached at david.faguy@nau.edu or 928-523-6117. More information about Misconduct in Research is available at <https://nau.edu/university-policy-library/misconduct-in-research>.

SENSITIVE COURSE MATERIALS

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.

Last revised August, 2019