

AST 307 - Introductory Astronomy

Fall 2023 - Unique No. 48225

TTh 11am – 12:30pm @ WEL 2.246

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Course Description: This course provides an overview of modern astronomy and astrophysics for science and engineering majors, including astronomy majors. We cover topics from how to measure the night sky, the formation and detection of planets, stellar evolution, galaxies across cosmic time, to the scale and history of the Universe from the Big Bang until the present day. We will also take a look at the historical context of some of the most important astronomical discoveries, from ancient to modern astrophysics. Intermixed with lectures, our course will incorporate techniques from an inquiry-based approach to learning, including group activities, critical thinking exercises, and open-ended analysis. The purpose of this approach is to introduce students to the methodology used by real scientists to solve real astrophysical problems.

Course-Level Learning Outcomes: After taking this course, you should be able to:

- Describe the primary ways that light interacts with matter,
- Derive basic physical quantities for astronomical objects from observables,
- Apply basic gravitational arguments to interpret bodies in orbital motion,
- Describe the major evolutionary stages of astronomical objects (including planets, stars, galaxies, and the Universe),
- Contrast the spatial, distance, and mass scales of astronomical objects, from black holes, planets, stars, planetary systems, star clusters, galaxies, and galaxy clusters,
- Explain the basic steps needed to obtain observational data with a telescope,
- Draw an astronomical problem and describe its components,
- Check the units of a solution to verify that they are correct,
- Demonstrate teamwork by working collaboratively to complete in-class assignments, ensuring all members of the group are heard and are active, and
- Present the steps of a calculation to peers and discuss the scientific reasoning that justifies these steps.

Pre-requisites and Core Requirements: No formal pre-requisite is required for this course, although students should feel comfortable with algebra, dimensional analysis, unit conversion, geometry and pre-calculus concepts including trigonometry. The course relies on knowledge of these concepts and they will not be reviewed during our lectures. This course is intended to be more mathematically rigorous than AST 301, a course which covers very similar material but not at as great a depth and not as quantitatively.

This course carries the Quantitative Reasoning flag. Quantitative Reasoning courses are designed to equip you with skills that are necessary for understanding the types of quantitative arguments you will regularly encounter in your adult and professional life. You should therefore

expect a substantial portion of your grade to come from your use of quantitative skills to analyze real-world problems.

Texts and Materials:

- **REQUIRED:** One dry erase marker for in-class activities on white-board surfaces
- **REQUIRED:** Access to *Modified Mastering Astronomy (MMA)*
MMA comes as a bundle with the Cosmic Perspective eText (see Canvas for more detailed instructions) and can be purchased through the Longhorn Textbook Access (LTA) program, which allows you to bill your textbook resources to your tuition and pay a lower price than paying directly. The bundle set should cost \$66 for the semester. If you prefer to pay directly, that should also be an option. Note that temporary access can be granted free of charge for the first two weeks of the semester, but registration will need to be completed in order to use it for the full semester.
- **OPTIONAL:** *The Cosmic Perspective*, 9th Edition. Bennett, Donahue, Schneider & Voit. The homework access is bundled with the eText, but if you prefer a physical copy (or to have access after the end of the semester) you can a physical copy pretty cheaply online, and older versions are fine. It's completely optional.
- **NO ACTION REQUIRED:** Class notes will be provided after each lecture by the instructor via *Canvas* class website
- You will need a non-wifi enabled calculator for exams. It is highly recommended to also bring it to class every day to help solve problems real-time.

Class Structure: This class will combine short lectures with discussions and group activities. It will not be a traditional University lecture course. You will only learn if you participate in class activities, thus attendance and participation is *required*. Do not pack up or leave class early or come late unless you have talked to the instructor in advance, as a consideration to both the instructor and your fellow students.

Class Website and email: The class website is hosted on Canvas and should be checked regularly for updates and messages from the instructor or TA regarding exam review sessions, course materials, or special events. In addition to the class website, email is recognized as an official mode of university correspondence, so you are responsible for reading your email for university course-related information, and canvas-delivered announcements. Please check your email regularly and frequently and make sure you are set to receive notifications from Canvas as appropriate.

Accommodations for disabilities and/or family responsibilities: If you have any kind of disability, whether apparent or non-apparent, learning, emotional, physical, or cognitive, and you need some accommodations or alternatives to lectures, assignments, or exams, please feel free to contact the instructor to discuss reasonable accommodations for your access needs. Students with disabilities may also request appropriate accommodations from the Division of Diversity and Community Engagement, and from UT's Services for Students with Disabilities. The official wording provided by the university is: The University of Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-6441 TTY or Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259, www.utexas.edu/diversity/ddce/ssd. We recognize that students with children or family care responsibilities might require special accommodations on occasion. Students with a gap in childcare should contact the instructor regarding missed or late work.

Grading Components and Policies: You will receive the grade you earn in this course. There will be no extra credit awarded after the final class period of the semester, so please be sure to put in your best effort throughout the semester to earn the grade you would like. Your final grade will be composed of the following elements:

Exams = 40%

Online homework = 40%

In-class Participation = 15%

In-class Group Assignments = 5%

Here is more information on each of the grade components:

Exams: There will be three closed-notes, closed-book exams covering material discussed in class, as outlined in the class schedule. These exams will be held **during class** and are scheduled for **September 28th, October 31st, and November 30th**. If you have a legitimate and unavoidable conflict with these exam times (University related conflict or religious holiday), let the instructor know via email at least 14 days before the exam date so that accommodations can be made; in the case of illness or emergency let the instructor know at earliest convenience. There will be no opportunity for after-the-fact make-up exams.

There will be an OPTIONAL final exam held during the University pre-scheduled time for our course, **Monday, December 11, 8:00am-10:00 pm**. The final exam is available to anyone who would like to replace their lowest test score with this cumulative, multiple-choice exam; it will only be able to improve your grade.

Homework: Online homework will be assigned roughly 8 times in the semester (roughly on a weekly or biweekly basis, with more homeworks in the first half of the semester, see schedule below) through “Modified Mastering Astronomy” which you can access through Canvas (see instructions given there). The homework will generally be due at 11:59pm on the date specified in the calendar, usually Friday, but is subject to change for any given assignment depending on where we are in the material in class; ample notice will be given if such a change is made. It is your responsibility to keep track of due dates in Modified Mastering Astronomy. The system will automatically cut off access to the homework at the designated due date and time. No late credit will be given but you will still be able to complete the assignment for practice. Each homework assignment is worth a different number of points depending on length and difficulty, and at the end of the semester those points are added together to form your overall homework grade. The equivalent of one homework assignment (average point value thereof) will be forgiven at the end of the semester. Group work and discussion is allowed (and encouraged) for homework assignments, but each student must be responsible for their own understanding of the material from each assignment and independently complete the work.

Class Participation: In-class participation is a significant component of this class, and thus your grade. You will carry out many group discussions and in-class activities with a set group with an assigned seating arrangement. Special requests for seating arrangements should be sent to Dr. Casey before Wednesday, August 30th. Your attendance will be recorded every single class period by the TA. If you are late or leave early (more than 10 minutes) you will only receive half participation credit for the day, unless you have discussed a special reason to excuse your tardiness or early departure with the TA beforehand. **You can miss four class periods** without it affecting your attendance grade.

In-class Group Assignments: Specific in-class activities (that are advertised as G.A.'s = Group Assignments) will be graded for accuracy of submitted answers and work shown. Your assigned group will receive a set grade for each Group Assignment and all Group Assignments will be worth the same number of points. There will be approximately five G.A.'s over the course of the semester. If a Group Assignment is not finished in class the group can meet to complete it outside of class and turn in the work during the next class period. If group members are missing or we determine that a group dynamic is unhealthy, disrespectful, unengaged, or inequitable, this can impact your In-class Group Assignment score. If a group dynamic is causing harm to your learning, please notify both the instructor and TA immediately so we may make adjustments.

Grades: This class will *not* be graded on a curve. Your grade is calculated to the nearest 1/100th of a percentage point. The average percentage in each of the above grade components will be weighted by the indicated percentage to derive the final course grade, assigned as follows:

93.00 — 100% = A	80.00 — 82.99% = B-	67.00 — 69.99% = D+
90.00 — 92.99% = A-	77.00 — 79.99% = C+	63.00 — 66.99% = D
87.00 — 89.99% = B+	73.00 — 76.99% = C	60.00 — 62.99% = D-
83.00 — 86.99% = B	70.00 — 72.99% = C-	0 — 59.99% = F

Regarding harassment/assault: Harassment of any sort will not be tolerated in this classroom or related workspaces. Title IX and Title VII makes clear that violence and harassment based on sex, gender, race or national origin are Civil Rights violations subject to investigation and disciplinary action on behalf of the University. The same kinds of accountability and support will be applied to offenses against other categories such as sexual orientation and gender identity. If you or someone you know has been harassed or assaulted, either in the classroom or outside of the classroom space, you can find the appropriate resources through the University Title IX Coordinator (512-232-3992), UT Austin Campus Police (512-471-4441), the Student Ombuds Services (which can provide *confidential* advice, resources and help; 512-471-3825), and the UT Counseling and Mental Health Center (512-471-3515).

Mental Health Services: College life can be challenging and stressful. We are also (still) in the midst of a multi-year pandemic. Diminished mental health, including significant stress, mood changes, excessive worry, or problems with eating and/or sleeping can interfere with optimal academic performance. Similarly, problems with relationships, family worries, loss, or a personal struggle or crisis can also contribute to decreased academic performance. UT Austin's Counseling and Mental Health Center (<https://cmhc.utexas.edu>; 512-471-3515) provides mental health services to support the academic success of students. This includes counseling services, wellness workshops, free and confidential therapy groups, and general information. I encourage you to browse their website and actively seek support if you're experiencing any of these difficulties.

Community Building: Astronomy belongs to all people, independent of race, religion, gender, gender identity, gender expression, or sexual orientation. Incidents of discrimination, assault, harassment, threats, intimidation, profiling, or coercion based on membership or perceived membership will not be tolerated. Also let's build a community where all can thrive and grow together in their knowledge. Get to know your classmates, and treat others with respect and kindness.

Academic Dishonesty: The minimum penalty for cheating — in any way whatsoever — is receiving a zero on the assignment on which you cheated. The instructor reserves the right to seek a penalty the instructor deems appropriate for the given case of academic dishonesty, including failing the class and being reported to Student Judicial Services. In this class, in addition to all the traditional types of cheating (looking at someone else's answer, utilizing "cheat sheets" of any form or fashion either paper or digitized, getting an advance copy of an assessment), we also consider allowing someone else to use your Mastering Astronomy account cheating. If the academic honesty is sufficiently serious, the instructor will proceed by filing a formal report to the Judicial Services in the Dean of Students Office as is policy. Judicial Services would decide the final penalty after a hearing on the matter. For more information, read in the General Information Catalog about scholastic dishonesty (i.e. cheating).

Drop date: The last day to Q-drop the class (or withdraw or change to pass/fail) is October 23rd. This will require you to go to your college for appropriate approval. After this deadline, students must go to the Dean's office, WCH 2.112, to begin the appeal for substantiated non-academic reasons.

Class Material and Schedule: Below is the approximate course schedule and material we will cover on those days. It is subject to some minor changes.

<u>Class Date</u>	<u>Class Material</u>	<u>Relevant Sections of Textbook</u>
Aug 22	Introduction & Logistics, Scale of Universe	Sec 1.1, 1.2
Aug 24	Geometry of Earth/Moon system	Sec 3.2
Aug 29	Seasons, Moon Phases and Eclipses	Sec 2.2, 2.3, S1.1, S1.2
Aug 31	Measuring flux, angle of incidence	Sec 15.1 (inv sq law only)
	<i>September 1 — Homework #1 Due @ 11:59pm</i>	
Sep 5	Kepler's Laws, "Weighing" planets	Sec 3.3, 4.1–4.4
Sep 7	Telescope Basics Part 1	Sec 6.1, 6.2, 6.3
	<i>September 8 — Homework #2 Due @ 11:59pm</i>	
Sep 12	Telescope Basics Part 2	Sec 6.1, 6.2, 6.3
Sep 14	Basics of light, understanding temperature	Sec 5.1, 5.2
Sep 19	Thermal Radiation, Spectra and EM Radiation	Sec 5.4, 5.3
Sep 21	Stars part 1: Magnitudes & Classification	Sec 15.1 (all)
	<i>September 22 — Homework #3 Due @ 11:59pm</i>	
Sep 26	Stars part 2: The Herpsprung-Russell diagram	Sec 15.2
Sep 28	EXAM #1 — FUNDAMENTALS OF ASTRONOMY	NA
Oct 3	Stars part 3: Structure & Composition	Sec 17.2

Oct 5	Stars part 4: Lives, Deaths, and Afterdeaths	Sec 16.2, 17.3
	<i>October 6 – Homework #4 Due @ 11:59pm</i>	
Oct 10	Stellar binaries & Doppler Effect	Sec 15.1 (stellar mass), 5.4 (doppler effect)
Oct 12	Radial Velocities and Transits	Sec 13.1, 13.2, 13.4
	<i>October 13 – Homework #5 Due @ 11:59pm</i>	
Oct 17	Planet formation theory & Habitability	Sec 8.2, 13.3, 10.1, 24.4
Oct 19	Cosmic Distance Ladder	Sec 15.1 (parallax), 20.2
	<i>October 20 – Homework #6 Due @ 11:59pm</i>	
Oct 24	Shapley/Curtis Debate, and Hubble's Law	Sec 20.2
Oct 26	Big Bang Cosmology	Sec 22.1–22.3
Oct 31	EXAM #2 – LIGHT & STARS	NA
Nov 2	Dark Energy	Sec 23.4
Nov 7	Dark Matter	Sec 23.2
Nov 9	Galaxy Formation & Evolution	Sec 23.3, 21.1, 21.4
	<i>November 10 – Homework #7 Due @ 11:59pm</i>	
Nov 14	Gravitational Lensing	Sec S3.4, 23.3
Nov 16	Supermassive blackholes	Sec 21.3
	<i>November 17 – Homework #8 Due @ 11:59pm</i>	
Nov 21	<i>Thanksgiving Break – No classes</i>	
Nov 23	<i>Thanksgiving Break – No classes</i>	
Nov 28	Astrophysical oddities / Pursuing Science as a Career / A.M.A.	NA
Nov 30	EXAM #3 – PLANETS, GALAXIES & COSMOLOGY	NA
Dec 11	Optional Final Exam: Monday, December 11th 8:00am - 10:00am in the classroom	NA