

# AST 352K – STELLAR ASTRONOMY

## FALL 2019, UNIQUE NO. 46015

Website and email platform for contacting the professor and T.A.: **Canvas**  
Class meetings: Tues., Thurs. 12:30-1:45 PM, in RLM 15.216B (Astronomy Classroom)  
Instructor: Prof. Harriet Dinerstein, contact via Canvas email  
Teaching Assistant: Duo Xu, contact via Canvas email  
Office Hours, Prof.: Wed. 1:30-2:30 PM, RLM 16.324, or by appointment  
Office Hours, T.A.: Mon. 1:30-2:30 PM and Wed. 10:30-11:30 AM  
Help Sessions: Wed. 4:30-5:30 PM, RLM 15.216B  
**No Final Exam** during exams week

### **COURSE LEVEL AND SUBJECT:**

Astronomy 352K is an upper-division course on stellar astronomy that approaches the subject from the perspective of how we obtain and interpret astronomical measurements. It carries a Quantitative Reasoning flag and is designed for students majoring in astronomy, physics, engineering, or geology. Students in other majors should check that they have the needed prerequisites (see below).

Stars are clearly fundamental to astronomy. They are the ruling bodies of planetary systems, the building blocks of galaxies, and the nuclear ovens where elements heavier than helium are created. We will address the subject by examining so-called “observable” properties of stars. These are the characteristics that can be measured from great distances, through the analysis of the light they emit. By applying well-established physical principles, we can deduce stellar surface temperatures, radii, luminosities, composition, masses, etc. from such measurements; it is truly amazing how much we can learn from starlight! Appreciating the power and limitations of these methods are goals of this course, as well as understanding the history and role of stars in the universe at large.

### **PREREQUISITES, COURSE PHILOSOPHY AND OBJECTIVES:**

The prerequisites are Physics 301 and 316 or the equivalent: two semesters of college level calculus-based physics. Previous astronomy courses are not required but may be helpful. Since astronomy draws on specialized topics in physics that students may not have encountered yet, we will introduce them as needed. The purpose of the prerequisite is to ensure familiarity with certain physical principles and practice solving problems. In this course you will mainly be *applying* principles rather than carrying out extensive theoretical derivations. The math used will mostly be algebra, trigonometry, and simple calculus. We will often make rough estimates: “astronomical accuracy” means knowing a quantity only approximately (sometimes to only a factor of a few). In this class we will use math as a tool to explore and uncover interesting results and relationships. Since our purpose is *not* simply to obtain numbers but rather to obtain insight, you will be expected to comment on your answers: Are they surprising? What are their significance and implications?

### **TEXT AND RESOURCES:**

The primary text for Ast 352K is a set of course notes developed by Professors Harriet Dinerstein and Chris Sneden, which are updated each semester. You will be able to download the notes in sections, as they are posted, from Canvas. To comply with “fair use” policies and copyright laws, the notes are for your personal use *only*; they may not be distributed (or sold!) to others. There are few textbooks that are a good match to the content of Ast 352K. Most textbooks at the advanced undergraduate level are either heavily weighted towards theory or are primarily about observing

methods, instruments, and detectors. An exception is Ostlie & Carroll's "An Introduction to Modern Stellar Astrophysics," which contains about half the material in their "An Introduction to Modern Astrophysics." Both books include material we will *not* cover and are expensive. However, if you plan to continue in astronomy, they are useful reference volumes. One copy of "Modern Stellar Astrophysics" is on reserve in the Physical-Math-Astronomy Library (ground floor, RLM).

If you have not previously taken an introductory astronomy course, you may encounter many unfamiliar terms. If this is case for you, you may consult an introductory astronomy textbook such as Bennett's "The Cosmic Perspective." There are several copies on permanent reserve at the PMA Library that you can check out for 2 hours or 3 days depending on the edition; older editions are fine for our purposes. Or see the free OpenStax book "Astronomy" by Fraknoi, Morrison, and Wolff at <https://openstax.org/details/books/astronomy> although has less detail and math than Bennett.

Other materials will be posted on our Canvas pages. These will include diagrams from slides shown in class (these are posted *after* class to ensure consistency), supplemental materials, activity and homework questions (but not solution sets), study guides for exams, and useful links.

## TOPICS:

The following is the list of topics we hope to cover in Ast 352K in Fall 2019, although we may have to skip some subtopics depending on the pace that proves optimal for the class.

- I. Positional Astronomy (locating and tracking objects on the sky)
- II. Properties of Electromagnetic Radiation (e-m spectrum; blackbodies; radiation quantities)
- III. Photometry: Measuring Stellar Brightness (magnitudes; photometric systems; colors)
- IV. Observational Methods & Atmospheric Effects (beyond telescopes; Earth's atmosphere)
- V. Spectroscopy and Stellar Spectra (the uses of spectroscopy; stellar spectral types)
- VI. The Hertzsprung-Russell Diagram (the Rosetta Stone of astronomy; star clusters)
- VII. Interpreting Astronomical Spectra (stellar spectra; abundances; nebular spectra)
- VIII. Motions, Orbits, and Binary Stars (the key to determining stellar masses)
- IX. Stellar Life Stories (stellar aging, deaths, and end states; role of initial stellar mass)

## COURSEWORK AND GRADING BASIS:

The required coursework will consist of: (a) three in-class hour exams, each on roughly three of the Roman numeral sections above; (b) 6 or 7 homework assignments; and (c) regular attendance and participation in the activities in class. *There will not be a comprehensive final exam.*

**Grading Basis:** We will use the plus-minus (A<sup>-</sup>, B<sup>+</sup>, etc.) scale. A correspondence table between numerical scores and letter grades will be fixed after the first hour exam and will *not* be made tougher later on. These correspondences will also apply to the overall semester grade.

**Hour Exams:** 3 in-class exams: Total credit, 56% of the course grade

Exam 1: Thurs., Sep. 26 – 16% of the course grade

Exam 2: Thurs., Oct. 24 – 20% of grade

Exam 3: Thurs., Nov. 21 – 20% of grade

**Format:** Primarily numerical and algebraic problems, with some narrative responses. You will use calculators but may not use computers, tablets, or smartphones. These are closed-book, closed-notes exams, but a relatively complete list of constants and equations will be provided.

Make-up Policy: If you miss any of the hour exams, your **only** make-up opportunity will be Thurs., Dec. 5. You may also retake an exam for a chance at a better grade (it will count only if it helps). However, you will have to request and specify *in advance* which exam you want to make up.

**Homework**: About 6 or 7 graded problem sets - 24%

Homework (HW) will be **due on Thursdays at the beginning of class**. If you have questions about HW, seek help at office hours or help sessions. You may discuss HW with classmates, but the work you turn in must be your own (see below). HW must be turned in *as hard copy*, on standard sized paper (8 × 11 inches), with multiple pages stapled together. Write your name on each page in case pages get separated (also do this on exams). The last HW will be due Dec. 5, and if you turn in all HWs, the lowest score will be dropped. However, I strongly recommend against skipping HWs if this can be avoided, as we will drop only one HW score.

Lateness Policy: Only HWs turned in on time (at the beginning of class) can receive full credit. We will accept late HWs for reduced credit until 2:00 PM on the next day after it is due (this will generally be a Friday), with a penalty of losing 25% of the credit. No HW will be accepted after 2 PM on the day following the due date. Late HWs must be turned in to the T.A. (**not** the Instructor). If the T.A. is not in his office when you bring in your HW, it may be turned in to the Academic Program Coordinator, Abby Black, in RLM 15.210, who will record the time.

**In-Class Activities**: Exercises worked in small groups – 20%

Meaningful effort will be sufficient to earn most of the credit, and activity credits will be “overbooked.” This means that more than 20% of credit will be offered but the total amount that can be earned will be capped at 20%. Activities also track attendance; on days without activities we will have a sign-in sheet. Excessive absences will result not only in loss of credit but also in the filing of “absence/failing” reports. **This is not a course to be taken for credit “by exam.”**

**IMPORTANT DATES FOR FALL 2019**: (some of these apply to any UT class)

First class meeting: **Thurs., Aug. 29**

Last day to add this class (end of free adds/drops period): **Tues., Sep. 3**

Last day to add any class, or to drop with a possible refund: **Fri., Sep. 13**

Last day to drop a class for academic reasons or to change grading basis between letter grade and credit/no-credit: **Thurs., Oct. 31**

Last class meeting: **Thurs., Dec. 5** (this is the date for make-ups for any earlier missed exam)

## **COURSE POLICIES, GOALS, AND EXPECTATIONS:**

**Classroom Behavior**: Class meetings are a communal activity. We expect that you will treat your classmates and instructor with consideration and respect at all times. **Please try to arrive on time** (yes, we understand that the elevators in RLM can be slow). **Turn off the volume on your phone** before class begins. We prefer that you avoid using laptops, tablets, and smartphones during class, except when they are being used for assigned activities. The displays are distracting to the people around you, and there is documented evidence that they lead to poorer academic outcomes for your classmates as well as for yourself. If you do wish to use such a device, you must discuss it in advance with the instructor and sit in the back; however, if your use becomes disruptive *in the instructor’s opinion*, you may be required to discontinue it. In addition, please do not talk to your neighbors during class unless it is part of a class activity. Personal conversations belong outside of class. If you have a question or comment about what is being discussed in class, share it with everyone!

**In-Class Activities:** You should plan to bring a calculator to class, although you may use laptops etc., for in-class activities requiring calculations. These exercises are intended to introduce you to new equations or problem-solving approaches. Direct practice working problems is one of the most effective ways to learn, and you should expect similar questions on future homework and exams.

**Homework Goals:** The homework is intended to make you engage with the course material and discover points that are unclear to you. Some homework questions may require you to seek out additional information, and others may have multiple correct approaches. Since I do not want to encourage rigid packaging of answers, I will *not* be posting solution sets for homework.

**Getting Help:** If you are confused or stuck on the homework, we encourage you to attend the office hours provided each week by the instructor and T.A., or to attend the Wednesday help sessions. If none of these times work for you, please contact one of us to make an alternate appointment.

**Working with Others:** Many students like to work on assignments in groups. It is fine to discuss general ideas and problem solving strategies with other students, but also essential for you to work through the problems yourself. The paper you turn in must represent your own work. Copying of answers from other students will be treated as academic dishonesty and credit will be withheld for all parties involved. See discussion of academic integrity below, under General University Policies.

**Out-of-Class Communications:** It is University of Texas policy that email is an official form of communication for university business. For purposes of this class *you need to use the email function in Canvas*, rather than the instructor's or T.A.'s directory email address. Additionally, Canvas can be easily used to send email simultaneously to everyone affiliated with the class. Please avoid inappropriate uses of this tool, which are in violation of University policies. (Some examples of inappropriate usage include students taking surveys for other classes, soliciting for a business or sub-leasing offers, etc.). We also caution students against electronically sharing HW solutions in advance of the due dates, which is a form of academic dishonesty.

## **ASTRONOMY DEPARTMENT INFORMATION:**

If you have questions or problems regarding this class, please start by consulting the Instructor or T.A. However, if this does not resolve the problem, you may consult the following people.

Academic Program Coordinator: Ms. Abby Black, RLM 15.210, [black@austin.utexas.edu](mailto:black@austin.utexas.edu)  
Chair, Undergraduate Studies: Prof. Adam Kraus, RLM 15.310B, [alk@astro.as.utexas.edu](mailto:alk@astro.as.utexas.edu)  
Department Chair: Prof. Volker Bromm, RLM 15.214, [chair@astro.as.utexas.edu](mailto:chair@astro.as.utexas.edu)

Additional information can be found at [astronomy.utexas.edu](http://astronomy.utexas.edu) at the Undergraduate Program tab on the Academics Menu. See the *Memo to Undergraduate Astronomy Students*, although this document is primarily aimed at students taking lower-division non-science-major classes.

The Astronomy Department hosts several graduate seminars and departmental colloquia on a variety of topics each week. These talks are on a technical level and the intended audience consists of the astronomy faculty, research staff, postdocs, and graduate students, so you may not understand everything that is presented, but it can still be an interesting experience to sit in. Most of the seminars are held in the Astronomy Classroom and are open to everyone.

As you may already know, the Astronomy Department also hosts free Star Parties three evenings per week (Wednesdays, Fridays, and Saturdays, in a couple of locations), that are open to students and the public. There is also an undergraduate Astronomy Students Association (ASA) that holds regular meetings, talks, activities, etc. and is open to interested students of any major.

## GENERAL UNIVERSITY POLICIES AND RESOURCES:

**Religious Holidays:** University policy is to make reasonable allowance for students who miss a class or assignment due to observance of religious holidays. If this applies to you this semester please notify the professor no later than Tues., Sep. 3. In most cases these circumstances will be covered by flexibilities built into class policies, such as make-up exams or dropped HWs.

**Students with Disabilities:** Students with disabilities may request appropriate academic accommodations if so certified by SSD, Services for Students with Disabilities. Their contact information is [ssd@austin.utexas.edu](mailto:ssd@austin.utexas.edu), (512) 471-6259, <https://diversity.utexas.edu/disability>. Since students are required to reapply for accommodations each semester, do this as soon as possible. In particular, if an accommodation requires extra time or an alternate environment for taking exams, you will need to be proctored by SSD, which must be arranged in advance. If you need such accommodations, you must meet with the instructor *in her office and in person* during her office hours or by special appointment and present your documentation as hard copy; these arrangements will not be made by email. Your exam times must fully overlap with the exam period for the rest of the class, but you may start early or end late in order to allow more time.

**Academic Integrity and Code of Conduct:** Academic integrity is a fundamental principle for the University of Texas at Austin, and students are expected to maintain the highest standards of integrity in their scholastic work. The University's Code of Conduct says: "The core values of the University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the University is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community."

Academic dishonesty includes cheating, plagiarism, unauthorized collaboration, falsifying records, misrepresenting facts, submitting a paper for multiple classes without approval, and other acts attempting to represent the work of others as your own work. More information is at [deanofstudents.utexas.edu/conduct](http://deanofstudents.utexas.edu/conduct). We take these rules seriously and will not tolerate copying or cheating on exams, homework, or other classwork. In the case of duplicated work or other evidence of cheating, neither student will receive credit. We may also impose more severe academic penalties, not excluding an F for the course and a report to the Dean of Students.

**Diversity and Inclusivity:** College of Natural Sciences policy states "A climate conducive to learning and creating knowledge is the right of every person in our community. Bias, harassment, and discrimination of any sort have no place here. If you notice an incident that causes concern, please contact the Campus Climate Response Team [diversity.utexas.edu/cert](http://diversity.utexas.edu/cert)."

**Emergencies & Safety:** In the event of an evacuation, follow the instructions of your instructor or official personnel. Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Do not re-enter a building until given instructions by members of the Austin Fire Department, the University of Texas at Austin Police Department, or the Fire Prevention Services office. Information and updates on emergency procedures and situations are at [www.utexas.edu/emergency](http://www.utexas.edu/emergency).

If you are in crisis and need immediate assistance, please contact the Office of the Dean of Students Emergency Services: 512-471-5017, <http://deanofstudents.utexas.edu/emergency/>. They can help you in various ways including contacting your professors if an emergency prevents you from attending class. Another resource is BCAL, the Behavior Concerns Advice Line, which you may contact if you have concerns about another individual's behavior. Call 512-232-5050 or make a report online at [besafe.utexas.edu/behavior-concerns-advice-line](http://besafe.utexas.edu/behavior-concerns-advice-line).