AST 352K – STELLAR ASTRONOMY

FALL 2013, UNIQUE NO. 48555

Main course website: www.as.utexas.edu/astronomy/education/fall13/dinerstein/352k.html
Class meetings: Tu, Th 12:30-2 PM, in RLM 15.216B (the Astronomy Classroom)
Instructor: Prof. Harriet Dinerstein, 512-471-3449, harriet@astro.as.utexas.edu
Prof. Office Hours: M,W 2-3 PM in RLM 16.324 (all office hours are subject to change)
Weekly Help Sessions (for HW help & before exams): W 4-5 PM, RLM 13.132

Teaching Assistants:

Brian Mulligan, 763-772-3485
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Office Hrs: Tu 2-3 PM, RLM 16.216

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COURSE LEVEL & CONTENT:

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 in general. It is designed for undergraduates majoring in astronomy or physics or similar fields such as engineering, although students in other science majors should be fine as long as they have the prerequisites.

Stars are obviously fundamental to the field of astronomy: after all, the very name *means* "study of the stars." They are the ruling bodies of planetary systems, the building blocks of galaxies, and the nuclear ovens in which the elements heavier than helium were created. We will approach the subject the way professional astronomers do, by examining so-called "observable" properties of stars. These are quantities that can be even measured from great distances, through detailed and quantitative characteristics of their emitted light. By applying relevant physical principles, we will study how to deduce temperatures, radii, luminosities, composition, masses, etc. of stars from such measurements. Appreciating the power and limitations of these methods is one of the main goals of this course, as well as understanding the properties and life histories of stars and their role in the universe at large.

PREREQUISITES & BACKGROUND:

The prerequisites are Physics 316 and 301 or equivalents and the corresponding math courses. However, since astronomy draws on many specialized topics in physics, we will introduce these as we go along. The purpose of the prerequisite is to ensure familiarity with physical principles and practice at working problems, although you may find that astronomers have a unique perspective! Our main interest lies in *applying* physical principles rather than in carrying out derivations from scratch, and the math we will use will mostly be at the level of algebra, trigonometry, and simple calculus. We also love to make rough estimates of things – hence the term "astronomical accuracy" (which refers to knowing some quantity approximately, maybe only to an order of magnitude).

Some of you have previously taken an introductory astronomy course such as Ast 307, 301, or the equivalent. This is *not* a requirement, although such students may have the advantage of greater familiarity with astronomical terms. If you have not taken such a class and feel the lack of such background, feel free to consult most any introductory textbook (one of my favorites will be on reserve in PMA library). I will conduct a survey at the first class meeting to assess the backgrounds of students enrolled this semester, although I expect that there will be a broad range in experience.

TEXT & RESOURCES:

The primary text for Ast 352K is a set of Course Notes that were developed collaboratively by Profs. Dinerstein and Sneden over many years. Small changes and updates are incorporated each year. You will be able to download the notes one section at a time as pdf files from the course website or Blackboard. To comply with "fair use" policies and copyright laws, these notes are for your personal use ***only***; they may not be distributed (or resold for profit!) to any outside parties.

There are few textbooks that fully cover the content of Ast 352K. Most books at the advanced undergraduate level are either heavily weighted towards theory (e.g. Maoz's "Astrophysics in a Nutshell," used in Ast 353, Astrophysics), or focus on details of detectors and instruments. An exception is Ostlie & Carroll's comprehensive book, "An Introduction to Modern Astrophysics" (aka "the orange book"), as well as the smaller (blue or gray) volume that includes "only" half (!) of the material in the orange book, "An Introduction to Modern Stellar Astrophysics." Both include a lot of extra material that we will *not* cover, and they are very expensive if purchased new. However, if you plan to continue in astronomy, they are handy for reference, and used copies may be found through the usual sources. Copies of these and a few other possibly useful books are on reserve in the Physical-Math-Astronomy Library on the ground (=4th) floor of RLM.

COURSEWORK & GRADING BASIS:

The required coursework will include a number of homework assignments, three in-class hour exams, and a term paper on a relevant topic approved by the instructor. You are also expected to attend class regularly and participate in occasional activities. Since the term paper will be due the last week of class, we will not have a unit exam that week; instead, it will be given during the designated final exam time, **Friday, December 13, 2-5 PM**. Like any comprehensive final exam, you ***must*** take Exam 3 at this time (and there will also be an opportunity – the ***only*** opportunity! – to make up Exam 1 or 2), so plan your schedule in order to ensure that you are available then.

Grading Basis: Course grades will use the plus-minus (A^-, B^+, etc.) scale. The correspondence between scores and letter grades will be set early in the fall and will *not* be made tougher later on.

Hour Exams: 3 in-class exams, 20% each; total = 60% of the course grade
Dates: **Oct. 3** (definite), **Nov. 7** (subject to change), **Dec. 13** (definite)
Format: Essays, numerical problems, & mixed; some choice. Calculators (but not phones) are to be used. Closed-book but "open equations."

Homeworks: Up to 6 problem sets, (one) lowest score to be dropped = 15%
Due dates: Homeworks will usually be **due Thursdays at the beginning of class.**
We will hold help sessions on Wed. afternoons and several office hours during the week.

Term Paper: Research paper, on a topic related to the course material = 15%
This provides an opportunity for you to apply some of what you learn in this course to a topic of interest to you (subject to instructor approval). Details will be announced later, but it will be about 6-8 pages plus figures. The final draft is **due Thurs., Dec. 5**, with earlier deadlines for topic choices, outline, selected references, and optional first drafts.

Participation: Regular attendance plus some group activities = 10%
Attendance will be taken via sign-in sheets. Missing an excessive number of classes will result in the loss of participation credit, and possibly filing of an "absence/failing" report. We will also have a few exercises where students compare and discuss ideas and turn in a written summary, that will count towards participation.

TOPICS:

The following is a list of topics typically covered in Ast 352K. It is essentially an outline of the Course Notes. There may be modifications and substitutions compared to recent years.

I. Introductory Remarks; Positional Astronomy (locating and tracking objects on the sky)
II. Properties of Electromagnetic Radiation (radiation quantities, blackbody radiation)
III. Photometry: Measuring Stellar Brightness (definitions, uses, photometric systems)
IV. Effects of the Earth's Atmosphere on Astronomical Observations
V. Observational Tools and Techniques (more than just telescopes!)
VI. Spectroscopy and Stellar Spectra (a mostly empirical approach)
VII.A. Interpreting Stellar Spectra (the theoretical basis)
VII.B. Spectra of Gaseous Nebulae (similarities & differences from stellar spectra)
VIII. The Hertzsprung-Russell Diagram (the Rosetta Stone of astronomy)
IX. Stellar Motions and Orbits
X. Binary Stars (the key to stellar masses)
XI. Stellar Evolution (capsule review of stellar aging and endings)
XII. Other Possible Topics (if times permits; topics to be determined)

STELLAR ASTRONOMY LAB, AST 152M:

Simultaneously with Ast 352K, the Astronomy Department offers a 1-credit-hour laboratory course, Ast 152M. This lab class is optional, and typically has a smaller enrollment than 352K. While we will ("book") learn about observational methods in Ast 352K, if you want hands-on experience taking and processing astronomical data, you should also take Ast 152M. You will use the 16-inch telescope on the roof of RLM with a CCD detector to take data, and learn to analyze it with standard astronomical software packages such as IRAF. The lab has a separate syllabus, and activities will be directed by Brian Mulligan, one of the T.A.s for Ast 352K. Students enrolled in or interested in adding Ast 152M should stay after Ast 352K is dismissed on Tues., Aug. 27, at which time arrangements will be made for upcoming meetings of Ast 152M.

IMPORTANT DATES FOR FALL 2013: (some apply to any UT class)

First class meeting: **Thurs., Aug. 29**
Last day to add Ast 309N (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 Ast 309N for academic reasons or to change grading basis between letter grade and credit/no-credit: **Tues., Nov. 5** (After this date, if you want to drop the course you will need a dean-approved *non*-academic reason, or to use your "one-time" last-minute Q-drop if you are eligible – there are restrictions on this.)
Last class meeting: **Thurs., Dec. 5. (Term paper is due!)**
Exams during Finals Week: **Required** Exam 3 - **Fri., Dec. 13, 2:00 – 3:30 PM**
Optional Make-up for Exam 1 or 2 - **Fri., Dec. 13, 3:30 – 5:00 PM**

COURSE POLICIES, LATENESS, MAKE-UPS, ETC.:

Classroom Behavior: Since we have a large enrollment, the Astronomy Classroom will be fairly crowded this semester. It is therefore particularly important for you to treat your classmates and instructor with consideration and courtesy. **Please arrive on time** and sign in before taking your seat, to avoid having to climb over other students in the narrow aisles between the tables. **Turn off the ringer on your phone** before class begins. I also ask you to minimize and if possible avoid using laptops, tablets, and phones during class; their displays are distracting to the people around you, as well as diverting your attention away from class. Initially, I will simply ask you to minimize such use; however *if these become disruptive to the instructor or classmates, I reserve the right to tighten the policy* and disallow use of these devices in class. In addition, please do not talk to your neighbors during class, unless it is part of a class activity; personal conversations belong elsewhere.

Homework Goals: The homework is intended to make you engage with course material and discover points that are unclear to you; it is often hard to recognize such gaps in understanding until you confront them in a problem. 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 the 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.s, or to attend the **Wednesday help sessions** (strategically scheduled on the afternoons before exams and homework due dates). If none of these times work for you, please contact one of us to make an individual appointment.

Academic Integrity: Many students like to work on assignments in groups. It is fine for you 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 be your own work. Copying of detailed answers from other students will be treated as academic dishonesty and credit will be withheld for *both* (or all) parties involved. This is partly for your own sake: if you just pass along someone else's answer, the homework will not have served its purpose of preparing you for exams.

Lateness Policy: Homework will be collected at the beginning of class on Thursday, but will be accepted up to 5:00 PM on the same day *if delivered to the T.A*. Papers that meet this schedule will be considered for full-credit grading (no late penalty). Late homework turned in to the T.A. by 3:00 PM the next day (Friday) will have 20% of the credit automatically deducted for lateness. No homework will be accepted for credit if turned in later than 3:00 PM on the second day. Allowance has been made for emergencies, illness, or having a really tough week, by dropping one homework score.

Exam Make-up Policy: I have always been skeptical about the feasibility of true equivalence in make-up exams, particularly in an advanced course. Therefore, there will be **no make-ups** for missed exams during the semester. There will, however, be an opportunity to take a make-up exam that can be substituted for either Exam 1 or 2 (it will cover the material on both exams), on the regular final exam day. This make-up exam may be taken even if you did not miss an earlier exam, and thus offers a "re-take" opportunity for everyone in the class; the better score counts towards your course grade.

Taking Exams: The purpose of my exams is to find out what you understand and can apply, *not* whether you can memorize exponents in equations and values of physical constants. Therefore I will provide everyone with the same "cheat sheet" of equations and constants at the exams. Some exam questions will require substituting numbers and working equations. I strongly prefer that students bring simple calculators to exams; if smartphones are to be used, the internet and communications functions will have to be disabled (i.e. by putting them in "airline mode").

Out of Class Communications: The University encourages the use of email as a primary form of communication for university business. Using Blackboard, is easy for a student to send email simultaneously to everyone registered in the class. I want to make it clear that I *do not approve* of use of this group email function that has not been approved by the instructor or T.A. In the past, I have seen students abuse this resource by using class email lists for personal purposes (taking surveys, subletting an apartment, etc.). I also caution students to be wary of classmates who solicit or share study guides or homework solutions. Sharing homework solutions (or term paper materials) this way will be regarded as academic dishonesty (collusion), and another student's study guide is bound to be less authoritative than the study tools provided by the instructor or T.A.! Also, much of the value of a study guide comes from creating it yourself.

RELIGIOUS HOLIDAYS:

It is the University's policy to make reasonable allowance for students who miss a class or assignment due to observance of religious holidays. Normally, the student is responsible for notifying the instructor at least 14 days in advance, although this semester, some holidays of major religions fall earlier than this. If this applies to you, please notify the professor as soon as possible, but no later than Tues., Sep. 4 (the end of the free add-drop period).

STUDENTS WITH DISABILITIES OR SPECIAL REQUIREMENTS:

Upon request, the University of Texas at Austin provides appropriate academic adjustments for qualified students with disabilities. Supporting documentation for requests for accommodations can be obtained from the SSD office, http://www.utexas.edu/diversity/ddce/ssd. If this applies to you, it is important that you provide this information as soon as possible, so that we can make the best and most convenient arrangements, such as an alternate site and additional time on exams. In our small department, we rely on SSD to provide these venues, and such requests must be made in advance. Students with schedule constraints due to other university obligations should bring this to the instructor's attention as early as possible, if we are to address them effectively.

ACADEMIC INTEGRITY (AGAIN):

This topic has already been mentioned in the context of homework, but further elaboration is called for, to explain how it applies to other aspects of the coursework. Needless to say, any copying or collaboration on exams is completely unacceptable. Academic dishonesty on a term paper is a more complicated issue. There are two kinds of transgressions that may occur in the preparation of a term paper. The first is when two or more students attempt to "share the work" by choosing the same topic and sharing sources, or even divide up writing the paper (with the others just changing a few words here and there). Be assured that we are extraordinarily skilled at noticing such collusion! The penalties for such behavior will be severe and may include an "F" in the course, not just on the assignment.

A second, subtler effect has to do with the proper use and citation of research sources. It may surprise you to learn that the term plagiarism covers far more than just word-for-word quotations without citing your source. It also includes overly extensive paraphrasing, and even cases where large chunks of text are presented in quotation marks. We realize that you may be unfamiliar with scholarly attribution procedures, and will provide you with information in class on how to properly use and reference your sources. Additional information on the UT Honor Code (Standards of Conduct link) and academic integrity is at http://deanofstudents.utexas.edu/sjs/ .

EVACUATION & SAFETY PROCEDURES:

The University requests that the following information be included in class syllabi:

The Office of Campus Safety and Security, 512-471-5767, http://www.utexas.edu/safety/ has made the following recommendations:

Familiarize yourself with University policies on responding to emergencies by visiting the site, www.utexas.edu/emergency .

If an alarm sounds in Robert Lee Moore Hall and an announcement is made that the building is to be evacuated, occupants are required to exit the building. Depending on circumstances, it may be necessary to use the stairs rather than the elevators (yes, it's 11 flights, but at least it's 11 flights down!). Generally, those who have evacuated the building will assemble outside and wait for an announcement that it is safe to re-enter the building. The order to re-enter may be given by uniformed members of the Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.

If any student would require assistance in order to be able to evacuate the building in an emergency situation, please inform the instructor in writing during the first week of class so that we can make contingency plans.

ASTRONOMY DEPARTMENT INFORMATION:

If you have questions or problems regarding this class, please start by consulting the Instructor or Teaching Assistant in order to clarify and try to solve them. However, if this does not lead to resolution of the problems, you may consult the following people. All offices are in RLM.

Student Coordinator: Ms. Rachel Walker, 15.210, rachelw@astro.as.utexas.edu
Chair, Undergraduate Studies: Prof. Craig Wheeler, 17.320, wheel@astro.as.utexas.edu
Department Chair: Prof. Dan Jaffe, 15.214, chair@astro.as.utexas.edu

The Astronomy Calendar lists all seminars and colloquia at http://www.as.utexas.edu/calendar . There are talks on a wide variety of topics every week, by faculty, postdocs, students, and sometimes visitors (especially for Tuesday colloquia). Nearly all talks are held in the Astronomy Classroom and are open to everyone. While these are technical in nature, the further you progress in the semester, the more likely you are to find that you understand quite a lot of what you hear!

Finally, if you are not already aware of it, there is a very active undergraduate Astronomy Students Association (ASA) that offers many activities such as special talks, outreach activities, and **free pizza**! For more information, see www.as.utexas.edu/~asa/ or flyers posted in the hall.