ASTRONOMY 352K: STELLAR ASTRONOMY

FALL 2007 – UNIQUE NO. 50620

Class Meetings: Tues. & Thurs., 9:30 AM – 10:45 AM, RLM 15.216B

Instructor: Prof. Harriet Dinerstein, RLM 16.324, 471-3449
E-mail: harriet@astro.as.utexas.edu

Office Hours: Mon. 1 – 2 PM and Wed. 10:30 – 11:30 AM

Teaching Assistant: Amanda Bayless, RLM 16.304B, 232-5461
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T. A. Office Hours: Wed. 1 - 2 PM and Thurs. 11 AM – 12
(Amanda is the primary instructor for Ast 152M, the Stellar Astronomy Laboratory.)

SUBJECT MATTER:

Stars are obviously fundamental to the subject of *astro*nomy; its very name means "the study of stars"! Stars are the building blocks of galaxies, the central bodies of planetary systems, and the nuclear ovens in which all of the elements heavier than helium were created. Astronomy 352K is a junior/senior-level introduction to stellar astronomy and astrophysics designed for students majoring in astronomy or physics, or closely related majors. We will approach the subject the way observational astronomers do, by starting from the observable properties of stars. "Observables" are quantities that we can measure even from great distances, such as the color and brightness of the light they emit. By applying basic physical principles, we will show how one can infer the intrinsic (true) properties of stars – such as surface temperature, radius, and luminosity (total energy output in the form of radiation) – from these observables. This requires us to understand the properties of light quantitatively, and how to interpret its characteristics in terms of the physical conditions in and chemical composition of the light source. We will discuss the various instruments and measurement techniques used by astronomers and what each can tell you. Some of the topics to be covered near the end of the semester will be determined the interests of the students in this class, through your choices of topics for oral presentations.

PREREQUISITE & APPROACH:

Physics: The prerequisites are Physics 316 or equivalent (lower-division E&M), and its prerequisite, Physics 301 (Mechanics), as well as the accompanying math courses. However, astronomy draws on such a wide range of branches of physics – e.g. atomic structure, statistical mechanics, and the theory of radiation – that we cannot expect you to have previously seen all of them. So we will introduce the necessary physics as we go along. Furthermore, our main interest will lie in *applying* physical principles to astronomical situations, rather than in carrying out derivations from scratch, and the mathematical manipulations you will perform in the homework problems will mostly be at the level of algebra, trigonometry, and simple calculus.

Astronomy: Some of many of you have previously taken an introductory astronomy course such as Astronomy 307 or 301, or even other upper-division astronomy courses. None of these are prerequisites, although it may be helpful to have some familiarity with common astronomical terms. If you find yourself confused by our obscure vocabulary, please ask us (the instructor or T.A.) and we will be happy to explain what the terms mean!

TEXTBOOK:

The primary text for Ast 352K this semester will be a set of Instructor's Notes, which will be posted on the course website, in several-page segments, as pdf documents. We will institute a password-protected interface in order to avoid running into copyright problems. There are not many textbooks for courses like Ast 352K, although some instructors use "An Introduction to Modern Stellar Astrophysics," by Ostlie and Carroll. The second edition of this book came out within the past year. Since it is expensive, I have chosen to list it as only *recommended*, not required, for Ast 352K. If you plan to continue your studies in astronomy, you may wish to own this book for later reference. For those who don't wish to purchase such an expensive book, I have placed one copy on reserve in the PMA Library. (There is also a copy of the first edition.) I will be posting information on the relevant pages in Ostlie & Carroll for each topic we cover, but the primary text will remain the (free!!) Instructor's Notes.

REQUIRED WORK & GRADING BREAKDOWN:

Hour and Final Exams: There will be three in-class hour exams during the semester, and a comprehensive final exam at the official time: **Thursday, December 13, 2 – 5 PM.** The final exam is worth 20% of the grade, the same as each of the hour exams. If you take all three hour exams and are satisfied with your grades, you don't have to take the final. If you choose to take it anyway, and get a better score than on one of the previous exams, the higher score replaces the lower one. **I do not give make-ups for missed exams**, even if they were missed for a good reason; instead, the final exam serves as the universal make-up exam. It is *your* responsibility to make sure that you will be available on the day of the final exam, if there is any chance that you may need or wish to take it.

Homeworks: The required work for this course will include homework (problem sets). Truth in advertising: These will be fairly long, but there be only about 5 or 6 of them over the whole semester. Depending on how many are assigned, the lowest one or possibly two homework grades will be dropped. Please note: ***homeworks are not group projects.*** You may talk with your fellow students about the general ideas, but the work you turn in must be your own. In cases of duplicated answers to the problems, neither paper will receive credit.

Participation: A significant portion of the grade will be determined by an oral presentation on a topic of special interest to you, but that is also relevant to stellar astronomy. Topics must be approved in advance by the instructor. The presentation grade will be based on written materials prepared for distribution to the class, as well as on the quality of the visual materials and the effectiveness of delivery. Another aspect of the participation portion of the grade will be an occasional assignment to prepare a 2-3 minute summary of one of our class sessions, to be presented at the beginning of the next class. Finally, regular attendance and participation is expected, and constitutes a small part of the grade. Attendance is recorded by means of a sign-in sheet at the beginning of class.

Grading Breakdown: The grading scheme will be:

In-class and/or final exams: 60% (3 equally weighted exams, each 20%)
Homework: 20% of grade
Class Presentations: 15 %
General Participation: 5 %

IMPORTANT DATES FOR FALL 2007:

First class meeting: Thursday, Aug. 31
Last day of official add/drop period: Tuesday, Sep. 4
Last day an undergraduate may add a course, or drop a course with a possible refund (this is the12th class day, when class rosters are finalized): Friday, Sep. 14
Last day to drop a course with an automatic Q: Wednesday, Sep. 26 (but in practice I will grant a Q-drop up until Oct. 24, due to the drop-one-exam policy)
Last day to drop a course, except for a *non-academic* reason: Wednesday, Oct. 24
Last class meeting: Thursday, Dec. 6
Final Exam: Thursday, Dec. 13, 2:00 – 5:00 PM

CLASSROOM POLICIES AND EXPECTATIONS:

The projected enrollment in Ast 352K this semester is fairly small, so RLM 15.216B, the Astronomy classroom, provides lots of room to spread out. However, I ask that you sit in the front half of the room, in order to promote interaction. Furthermore, it is hard to hide distracting behavior in such a small classroom. Please be courteous to the instructor and your fellow students: *turn off your cell phone ringer before the beginning of class.* (The first time your phone rings, I will just make faces at you; subsequent incidents will have more serious consequences!) Also, the classroom is no place for private conversations. If you have a comment or question about what is being said in class, everyone can and should hear it. If you want to talk to a fellow student about something unrelated to class business, save it for later. Finally, I find it distracting to face a room full of laptop lids. Please keep your computer stowed away during class.

The University now encourages the use of e-mail as a primary form of communication for university business. Among other things, they have made it 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 your use of this group email function, unless I have specifically given my approval for the message. I will gladly answer questions, set up appointments, etc., if you email me *directly;* the same goes for the Teaching Assistant. But I do not want to see emails being sent to the whole class discussing homework answers, conducting opinion surveys for an unrelated class, or looking for someone to sublet an apartment to (all of which has happened in classes of mine!).

SCHOLASTIC INTEGRITY (AND LACK OF):

It's never fun to bring up this topic, but I have been told that it should be part of any UT course syllabus. I will not tolerate scholastic dishonesty in Ast 352K. This can encompass copying or plagiarism on homework or other course work, collusion (working together on an assignment for which it was forbidden), bringing unauthorized materials into exams, etc. The University has an Honor Code, but it is rather general and vague. More specific information can be found at:
http://deanofstudents.utexas.edu/sjs/scholdis.php
and http://deanofstudents.utexas.edu/sjs/acint_student.php . Be warned: I have encountered cases of scholastic dishonesty in my classes, and have responded with appropriate academic penalties, including filing cases with the Dean of Students Office.

STUDENTS WITH DISABILITIES:

Upon request, the University of Texas at Austin provides appropriate academic adjustments for qualified students with disabilities. Contact the Office of the Dean of Students for information on how to register for a qualified disability (note: you can have a temporary disability, as well as a permanent one). Their phone number is 471-6259, or see the following website for further contact information: http://deanofstudents.utexas.edu/ssd/ . (I will make accommodations for an officially approved disability, but not for undocumented claims.)

POLICIES ON LATENESS AND ABSENCES:

I expect homework to be turned in at the announced time, generally before the start of class on the due date. It is inconvenient for us to grade a homework paper that is not turned in with the others, and hearing another lecture may give the student who does the homework late an unfair advantage. In order to have a chance at full credit on homework, it must be turned in on time. If you turn in a homework late, but within 24 hours of the deadline (by 9:30 AM the next day), we will take off a fraction of the total points; no homework will be accepted for credit if it is more than 24 hours late. You are also expected to attend class regularly. (Note: I do keep track of attendance!) The penalty for excessive absences is loss of participation credit.

OBSERVANCE OF RELIGIOUS HOLIDAYS:

The University respects the fact that students may wish to observe religious holidays that occur on a class day. If such a conflict arises, the student is responsible for notifying the professor at least 14 days in advance. If the holiday occurs during the first two weeks of the semester, notification is due on the first class day. Because of my flexible policies regarding exams and homeworks (dropping the low scores), I will not assign make-ups for the missed work. However, I *will* try, to the best of ability, to avoid scheduling exams or due dates for significant assignments on known religious holidays. Please let me know as soon as possible if you have these kinds of problems with particular dates.

DEPARTMENTAL INFORMATION:

In case you are not aware of the following resources, if you have questions or problems regarding this class that is not resolved by discussions with the instructor or T.A., you may consult other departmental personnel with responsibility for student matters. The key people include:

Char Burke, Student Coordinator, RLM 15.202AA, 471-3350, char@astro.as.utexas.edu
Prof. Gregory Shields, Undergraduate Studies Chair, 471-1402, shields@astro.as.utexas.edu
Prof. Shardha Jogee, Undergraduate Majors Advisor, 471-1395, sj@astro.as.utexas.edu
Prof. Neal Evans, Department Chair, 471-3302, chair@astro.as.utexas.edu

Finally, you should be aware of the Astronomy Weekly Calendar, which lists all seminars and colloquia for the current week, at http://www.as.utexas.edu/calendar . The Astronomy department sponsors a lively set of talks on current research in astronomy every week, given by members of our community ranging from graduate students (and sometimes undergraduates), postdoctoral fellows, faculty and research scientists, and visitors. As long as a seminar is listed on the calendar, it is open to anyone. You should feel free to sit in on talks that look interesting. Even if you only understand a small fraction of what is said, you'll have learned *something!* In particular, keep an eye on the Stellar Seminar, on Wednesdays from noon to 1 PM. (Yes, you can bring your lunch!)

PRELIMINARY LIST OF TOPICS:

Below is a list of topics that I have included in previous offerings of Ast 352K. The order in which we cover these topics may be somewhat different from that shown below, and some topics may be omitted while others are added. In particular, some topics that are not on the list may be covered in the student presentations. (Note: One of the reasons for covering positional astronomy and the basics of stellar photometry early in the semester is to coordinate this classroom-style course with the accompanying lab, Ast 152M.)

- Positions of Stars on the Sky: celestial sphere, astronomical coordinate systems, precession
- Radiation: electromagnetic spectrum, quantities of radiation (intensity, flux), blackbodies
- Photometric Properties of Stars: luminosity, magnitude scale, filter photometry, color index
- Effects of the Earth's Atmosphere: extinction, refraction,"seeing," emission
- Telescopes and Techniques, astronomical instrumentation and detectors
- The Physics of Spectral Lines: Bohr atom, absorption and emission lines, Doppler shift
- Spectroscopic Properties of Stars: spectral types, Boltzmann and Saha equations
- The Hertzsprung-Russell Diagram: the key to understanding stellar evolution
- General Motions of Stars: proper motion and radial velocity, moving groups
- Orbital Motions of Stars: types of binary stars, derivation of stellar masses
- Stellar Ensembles: star clusters, stellar populations in the Milky Way

ORAL PRESENTATIONS:

The University of Texas at Austin requires students to take a certain number of courses with a substantial writing component (SWC), in order to provide training in a skill – effective communication through writing – that is essential for almost any profession or career. A similar skill, that is also necessary for professional scientists and people in many fields of endeavor, is the ability to give oral presentations that engage an audience and effectively convey information. In Ast 352K, I include practice in oral communication as a secondary goal for the course. Towards the end of the semester – either in mid-November or during the last two weeks of the semester (to be determined) – each student in the class will give a roughly 20 minute presentation on a topic which they have researched in depth. This research will include dipping into the professional astronomical literature. Some sample topics from previous years include Adaptive Optics, Spectra of Brown Dwarfs, Searches for Exoplanets, Protostars, and many others. (Note: If you pick a popular topic, you may have to split it with someone else!)

As a warm-up for this exercise (and an incentive for taking good notes in class), students will also have to prepare brief summaries of the material covered in a given class and present them at the beginning of the following class. This task includes preparing a 1 – 2 page written version of the summary. On average, each student will have to give two summaries. The summaries will be posted on the class website, and will also be used as study tools.