Physics 160: Stellar Astrophysics
Fall 2013

Course Webpage:  http://pono.ucsd.edu/~adam/teaching/phys160


Instructor: Prof. Adam Burgasser
340 SERF, x26958
aburgasser@ucsd.edu
office hours: Th 10am-12pm or by appt.

TA: Ms. Petia Yanchulova
petiay@ucsd.edu
office hours: Mo 3-4pm physics tutorial center
We 3-4pm SERF 434

Course Manager: Ms. Patti Hey
plhey@physics.ucsd.edu

Lecture Schedule: TuTh 2:00-3:20pm in 2207 Warren Lecture Hall

Recitation Schedule: We 2:00-2:50pm in 2113 Warren Lecture Hall

Course Grading:

Homeworks (30%): 7 assignments due Fridays at 5pm except weeks 5, 9, 10; lowest HW grade is dropped

Midterm exam (20%): October 31st during lecture (happy Halloween!)

Term study (30%): Report and presentation on a topic related to the course: proposal due in class Nov 14th (5%), report due in class Dec 5th (15%), presentation during our “final exam” Dec 12th (10%)

Observing Labs (10%): One local (10/23) and one “remote” (date TBD)

Participation (10%): In-class assignments and general contribution to lecture and recitation

Important Dates:
Last day to Add: October 11th
Drop with no grade: October 25th
Drop with a “W”: December 2nd

Page 1 of 6
# Course Syllabus (subject to change)

<table>
<thead>
<tr>
<th>Week (starting)</th>
<th>Chapters covered</th>
<th>Tuesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>0* (9/23)</td>
<td>1.3-1.4</td>
<td>NO LECTURE</td>
<td>Course introduction, cosmological context</td>
</tr>
<tr>
<td>1 (9/30)</td>
<td>3.1-3.6, 8.2</td>
<td>Observing Stars I: Stellar astrometry</td>
<td>Observing Stars II: Kinematics &amp; magnitudes,</td>
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<tr>
<td>2 (10/7)</td>
<td>5.1-5.4, 8.1, 9.1-9.2</td>
<td>Stellar spectroscopy I: Blackbody radiation &amp; HR Diagram</td>
<td>Stellar spectroscopy II: Spectral classification, radiative transfer &amp; line formation</td>
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<tr>
<td>3 (10/14)</td>
<td>9.3-9.5, 10.1-10.3</td>
<td>Stellar spectroscopy III: Boltzmann &amp; Saha eqns</td>
<td>Stellar interiors I: Hydrostatic equilibrium, equations of state</td>
</tr>
<tr>
<td>4 (10/21)</td>
<td>10.3-10.5</td>
<td>Stellar interiors II: Energy sources</td>
<td>Stellar interiors III: Nuclear reaction rates and polytope models</td>
</tr>
<tr>
<td>5* (10/28)</td>
<td>10.4-10.6</td>
<td>Stellar interiors IV: Energy transport and modeling</td>
<td>IN-CLASS EXAM</td>
</tr>
<tr>
<td>6 (11/4)</td>
<td>11.1-1.3, 12.1-12.2</td>
<td>The Sun: interior structure, photosphere, magnetosphere</td>
<td>Star formation I: the interstellar medium, dark clouds, Jeans collapse</td>
</tr>
<tr>
<td>7 (11/11)</td>
<td>12.2-12.3</td>
<td>Star formation II: pre-main sequence and main sequence evolution</td>
<td>Star formation III: disks &amp; jets, planet formation PROJECT OUTLINE DUE</td>
</tr>
<tr>
<td>9* (11/25)</td>
<td>16.1-16.5</td>
<td>Stellar death I: degenerate matter, white dwarfs, planetary nebulae</td>
<td>NO LECTURE</td>
</tr>
<tr>
<td>10* (12/2)</td>
<td>15.2-15.4, 16.6, 17.3</td>
<td>Stellar death II: supernovae, gamma ray bursts</td>
<td>Stellar death III: neutron stars and black holes PROJECT REPORT DUE</td>
</tr>
<tr>
<td>FINALS* (12/9)</td>
<td></td>
<td>PROJECT PRESENTATIONS THURSDAY 12/12 3-6PM</td>
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</tbody>
</table>
Course Information

Physics 160 introduces the physics behind stars, stellar structure and star and planet formation. The goal of this course is to familiarize you with our current theoretical and observational understanding of stars and stellar processes, and provide a foundation for further studies of galaxies and the Universe. The topics we will cover include:

1. Basic astronomical concepts of position, magnitudes, distance scales, electromagnetic spectrum;
2. Stellar imaging and astrometry (parallax and proper motion, interferometry);
3. Stellar spectroscopy (blackbody radiation, line and band absorption/emission, stellar classification);
4. Stellar atmospheres (radiative transfer, opacities, line profiles);
5. Stellar interiors (hydrostatic and radiative equilibrium, stellar energy sources, elemental synthesis, pulsation);
6. The Sun (helioseismology, solar activity and cycles)
7. Star formation (properties of the interstellar medium and giant molecular clouds, protostellar formation, Jean’s criteria, pre-main sequence evolution, disks, planet formation); and
8. Stellar evolution (post-main sequence evolution, white dwarfs, neutron stars, supernovae and gamma ray bursts)

Stellar astrophysics touches upon many areas of physics: classical mechanics and gravitation, radiation, thermodynamics, nuclear physics, quantum mechanics, E&M and general relativity. Emphasis will be placed on how physics is used to explain our observations of the stars, and our current understanding of their interior structures. As such, you should have completed the Physics 2 or 4 sequence in order to take Physics 160 (exceptions will be considered). You should also be familiar with general computational techniques and tools (e.g., Mathematica, Matlab) and/or programming languages (Fortran, C, Python, IDL), which will be called upon for homework assignments.

Grading

Homework constitutes 30% of your grade. There will be 7 homework assignments throughout the quarter; the first is due on October 4th. I will drop your lowest homework grade. Assignments will be posted weekly
by the end of the week, and will be due the following Friday by 5pm at my office. *Late assignments will be accepted up to 5pm on Monday with a 50% reduction.* Assignments will consist primarily of problems within and outside of the textbook. Some problems will require numerical computation, so please be (or become) familiar with computational programs such as Mathematica, Matlab, IDL or any programming language.

*You may work together on homeworks, but the work you hand in must be your own. You may not use prior year’s solutions, online solution or solutions from the book.* Anyone suspected of copying solutions is in violation of UCSD’s *integrity policy and will receive a failing grade and be referred to the Office of Academic Integrity. This has happened in Physics 160 in the recent past!* 

A midterm exam will constitute 20% of your grade. It will be held in-class on Thursday, October 31st and will cover material up through the 5th week of the course (see syllabus). The exam will consist of short answer and calculation problems, and an equation sheet will be provided. More details on the exam will be provided later in the term. *There is no final exam.*

A term project constitutes the 30% of your grade. The term project can be on any topic covered during the course, and must be based on one or more primary sources that will be provided after the midterm. A completed project consists of:

1. A proposal, including outline and additional references beyond the primary source, due at the end of lecture on Thursday, November 14th (5%);
2. A report (5-10 pages, including figures and references), due at the end of the last lecture on Thursday, December 5th (15%);
3. A 5-7 minute presentation during the “final exam” on Thursday December 12th from 3-6pm (10%);

Term projects must be done on your own. Plagiarism rules will be strictly enforced. *Copying any portion of your paper or presentation from anyone or any source is not allowed, with the exception of short passages that should be explicitly quoted and properly attributed.* Details of the term paper will be provided by the 3rd week.
Observing labs constitute 10% of your grade. We will have two types of observing labs during the quarter: a local lab using some of the small (Mead-style) telescopes maintained at CASS, and a remote lab using the 1m Nickel Telescope at Mt. Hamilton, San Jose, CA. These labs will be scheduled at night, and you are expected to participate in both labs to receive full credit (there will be at least two opportunities to participate in each lab).

Participation comprises the remaining 10% of your grade. This will be judged based on in-class written assignments and general contributions to lecture and recitation discussion.

Grades will be posted on the course webpage; you will be assigned a random identifier to maintain anonymity.

Class attendance is not formally required for the lectures, but strongly recommended (and necessary for the 10% participation grade)

Here is a rough breakdown in letter grades (plus and minus grades will be awarded within these ranges):

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>% Required</th>
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<tbody>
<tr>
<td>A</td>
<td>≥ 90</td>
</tr>
<tr>
<td>B</td>
<td>80-90</td>
</tr>
<tr>
<td>C</td>
<td>70-80</td>
</tr>
<tr>
<td>D</td>
<td>60-70</td>
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<tr>
<td>F</td>
<td>&lt; 60</td>
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Grade appeals over the grading of any assignment are allowed but must be emailed to Prof. Burgasser within one week of receiving the assignment’s grade.

Scheduling conflicts due to athletic or artistic performance must be reported at least one week in advance and must be accompanied with a letter from coach/instructor. Homework must be turned in before the conflict; exams must be taken before the conflict.

Medical excuses must be accompanied by a physician’s note.

Other Course Details

Add/Drop:
Use WebReg to add/change/drop, drop from waitlists. If you have any
problems using TritonLink, see Sharmila Poddar (spoddar@physics.ucsd.edu) in 2561 Mayer Hall Annex.

**Special Needs:**
The UCSD Office for Students with Disabilities (OSD) is available to work with students with disabilities to facilitate accommodations due to disabilities. These include adaptive software and technologies, captioning and interpreters, AS and peer notetakers and exam modifications. Students requesting these services must obtain and submit an Authorization for Accommodation (AFA) letter to the instructor no earlier than 3 working days prior to receiving accommodations (i.e., exam date). For more information, see the OSD website ([http://disabilities.ucsd.edu](http://disabilities.ucsd.edu))

**Academic Integrity:**
Please read “UC Policy on Integrity of Scholarship” in the UCSD General Catalog. Any students caught cheating or plagiarizing will be reported to the Office of Academic Integrity and may be expelled from the course.