

ASTR 320

Theoretical Astrophysics

Spring 2013

(TuTh 11:00 - 12:15 CSS 0201 Lecture)
(Wed 2:00 - 2:50 CSS 0201 Discussion)

Patrick Harrington
Derek Richardson

<http://www.astro.umd.edu/~jph/>
<http://www.astro.umd.edu/~dcr/>

Office: CSS 2347
Office: CSS 1249

Office Hours: M 2-3 (Richardson), Tu 2:30-3:30 (Harrington) [Other times by appointment.]

Teaching Assistant: **Qian Wang** (Office hours to be determined.) Office: CSS 0204

TEXTS:

The texts recommended for this course are:

"Astrophysics for Physicists" by Arnab Rai Choudhuri, (Cambridge University Press, 2010)
ISBN-13: 978-0521815536

"Astrophysics in a Nutshell" by Dan Maoz, (Princeton U Press, 2007)
ISBN-13: 978-0691125848

There is no *required* text for this course. We will emphasize the derivation of fundamental equations of importance in astrophysics, and there will be handouts for a lot of this material. The two recommended books treat most of the topics we will cover (and more!), with less emphasis on derivations but with more results and applications. One area that we will cover in some depth is gravitational astrophysics (orbits, etc.), a topic hardly covered in these two texts. Nevertheless, they are both very good books (which have good problems as well), and will give you a wider view of many of the topics we will treat in lectures. Either of these books are good to have on your shelf for current and future reference.

For exams, you are only responsible for material we present in class. We will make some lecture notes available electronically, but there will also be board work for which you are responsible. Homework may be based on questions the texts, but we will always write out the full problems. Also be aware that while there are many helpful free resources available on the Internet, online information varies in accuracy and quality, so you are advised never to rely on a single source.

Another Reference (good, but too big/expensive):

"An Introduction to Modern Astrophysics", B.W. Carroll and D.A. Ostlie (2nd edition, 2006)

GRADING: Grades will be based on the exams (two mid-terms and the final) and on homework (problem sets). Weighting will be: Final, 35%; mid-terms, 15% each; homework, 35%.

The Exams

There will be two midterm examinations, each given during class hours. All midterms are held in the lecture room. These exams (and the final) are closed book with no notes, but you are allowed a calculator. A formula sheet may be provided. Each test will cover material presented in the lectures and (possibly) discussion section. The second midterm will only cover new material since the first midterm (but may draw on some of the earlier material). If for whatever reason the University is closed officially on the exam date, the exam shifts to the next available lecture date.

According to the University examination schedule, the final exam for this course will be held on Saturday, May 11, from 8:00 am to 10:00 am, in CSS 0201 (the normal lecture room). This final exam is **cumulative**: it will cover **all** material presented in lecture and in discussion sections since the start of classes. However, since the material that comes after the second midterm will not have been covered by the midterm exams, the weight on this later material will be higher on the final.

Homework Assignments

Homework will be assigned usually every other week and is to be turned in at the beginning of class on the designated day (usually Thursday). Homework turned in after the beginning of class on the due date will be considered late. Late assignments will incur a 20% penalty automatically unless there are extenuating circumstances (see below). Late assignments must be completed before solutions are posted (typically one week from when the assignment is due) to get any credit. Homework must be neat, readable, on standard letter-size paper with no frayed edges, and stapled if there is more than 1 sheet (your name must appear on every sheet!), with all work shown, justification given for answers as required, and with the units in all quantitative questions indicated clearly. Marks will be deducted for failing to adhere to these requirements. At times, written work may be given to be completed during class, which will be graded, and should also be neat, etc. Do not throw away your homework when it's returned – you'll need to study it for the exams!

IMPORTANT: Homework generally will NOT be accepted by e-mail, either by ourselves or the TA. You must hand in your work on paper at the beginning of the class when it is due to receive full credit.

You may work in groups to discuss problem-solving strategy, but you must submit your own solution to each assignment. Note that you must cite your source(s) on any essay-style questions, and this includes any websites you referenced.

COURSE POLICIES

Missed Exams/Work

The University recognizes very few legitimate reasons for missing an exam, a homework deadline, or class or section work. Examples include absence due to illness or religious observance (see "<http://www.testudo.umd.edu/soc/atedasse.html>" for Attendance and Assessment Policy in "<http://www.testudo.umd.edu/ScheduleOfClasses.html>").

None of the exams are scheduled on major recognized religious holidays. Except in the case of emergencies, you will know beforehand if you will miss a scheduled exam. If you provide a **valid written** excuse BEFORE the exam, a make-up exam will be given at a mutually agreed upon time. In the case of emergencies, you must contact us **promptly** following the missed exam with a **valid written** excuse in order to be able to take a make-up exam. Make-up exams may be written or oral, at our discretion. If you do not have a valid written excuse, you will NOT be allowed to make up the exam. The University has established new policy for medically necessitated absences: see "<http://www.president.umd.edu/policies/v100g.html>" For the purpose of this course, "Major Scheduled Grading Events" are the two midterms and the final exam.

If you miss the final exam, a **valid written** written excuse must be provided within TWO DAYS after the missed final exam. In addition, you must arrange with us a time for a make-up exam within two days after the exam date listed in the University course schedule. This is fixed because course grades are due 48 hours after the final exam has been held.

If you miss in-class work, you must present a valid excuse the next time that you are able to attend class. We will make arrangements for you to make up (or waive) the work.

Course Evaluation (Spring 2013)

Your participation in the evaluation of courses through "<https://www.courseevalum.umd.edu/>" is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. "<https://www.courseevalum.umd.edu/>" is open for you to complete your evaluations during the final two weeks of the semester. Please go directly to the website "<https://www.courseevalum.umd.edu/>" to complete your evaluations during that time. By completing all of your evaluations each semester, you will have the privilege of accessing online, at "<http://www.testudo.umd.edu/>", the evaluation reports for the hundreds of courses for which 70% or more students submitted their evaluations.

The Honor Code

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit "<http://www.studentconduct.umd.edu/>".

To further exhibit your commitment to academic integrity, remember to sign the Honor Pledge on all examinations: "I pledge on my honor that I have not given or received any unauthorized assistance on this examination/assignment."

There are a couple of potential gray areas that arise naturally in this course. For homework, you are permitted to work with other students in the class. This includes discussion of the problem and solution in a cooperative, mutually contributing fashion. However, you should write out your answer in your own words. You should NOT, under any circumstances, simply copy someone else's homework and call that "working together." You should NOT seek out or use "solution sets" from previous students. You may seek help on homework problems from the TA or instructors. Failure to abide by these rules could result in the case being brought before the Student Honor Council.

If you have questions regarding what is appropriate and what is not, please talk to us.

SCHEDULE OF LECTURES

Date	Topic	Text pages
Jan	24 General introduction and overview of the course	
	Gas Physics:	
	29 Macroscopic properties of gases - thermodynamics	
	31 Statistical mechanics of gases, thermal radiation	
Feb	5 Cosmology - a Newtonian model	
	7 Cosmology - the Friedmann equation	213-216
	12 Cosmology	220,222
	14 Hydrostatic equilibrium - planetary/stellar atmospheres	
	19 Hydrostatic equilibrium - stellar structure	32-36
	21 Polytropes, equations of stellar structure	
	26 Convection; review for mid-term	
	28 *** 1st Mid-Term Exam ***	
	Gravitational Astrophysics:	
Mar	5 Gravitation; central force motion	
	7 Integration of the orbit equation	
	12 Conic sections; <i>vis-viva</i> equation	
	14 Orbits; analysis of binary star systems	22-27
	19 – Spring Break —	
	21 – Spring Break —	
	26 Kepler’s equation; extrasolar planetary systems	22-27
	28 Restricted 3-body problem; Roche potentials	99-101, 107-108
Apr	2 Tidal forces; N-body problems	
	4 The virial theorem; dynamic friction	
	9 Galactic potentials and orbits	140-151
	11 *** 2nd Mid-Term Exam ***	
	Quantum Processes:	
	16 Quantum principles - historical review	
	18 Schroedinger equation - wavefunctions	
	23 Particle in a box - eigenfunctions, counting states	
	25 Fermions and bosons; electron degeneracy	70-85
	30 White dwarfs and neutron stars	70-85
May	2 The hydrogen atom - structure and states	
	7 Spectrum of hydrogen and other atoms	16-21
	9 Review	
May	11 *** FINAL EXAM: 8:00 AM - 10:00 AM ***	