

Astronomy 241: Stellar Astrophysics

Stellar Atmospheres, Interiors and Evolution

Spring 2009

For astronomers, this is a course in the physical details of stars; we will derive expressions for the emission by, and internal structure of, stars of various masses and stages of development from first principles, to elucidate the processes that give rise to their observed properties. For non-astronomers, this is a first course in the transport of electromagnetic radiation through matter, and in fluid mechanics, using one of the simplest classes of natural objects (stars) as the venue. For all, this is a physics course that involves application of techniques you have learned, from all four basic parts of the physics curriculum: mechanics, E&M, thermal physics and quantum mechanics.

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Textbook: *An Introduction to Modern Astrophysics, Second Edition*, by Bradley W. Carroll and Dale A. Ostlie (Addison-Wesley, 2007).

WWW Site: <http://www.pas.rochester.edu/~emamajek/AST241> . In these pages one will find complete class-meeting presentations, and much additional reference material that we will be using on homework and/or during class meetings.

Software: For some exercises in this class, you will need a means of manipulating data, doing complex (and/or mindnumbing) calculations, and plotting your results. You are strongly recommended to use either commercially available software on your favorite operating system (e.g., Mathcad, Excel, Mathematica, etc.) or other options (e.g., Python). We will discuss software options in the coming weeks.

Format: brief lecture/tutorial. Class meetings will be used principally for discussion of the textbook readings – including the performance of derivations and examples – and the homework problems by the whole class. I will provide summaries of the material in the textbook, additional material to illuminate the text, facilitation of the discussions, and a great deal of personal attention to each student, but will rarely lecture at great length. The idea is to get you as much practice and problem-solving experience as possible. The emphasis on student involvement obviously has the potential to make the course a much richer and more worthwhile experience than the standard lecture-recitation-examination format usually used in larger courses. However, it will be hard to realize much of the potential unless everyone in class keeps up with the reading and homework.

Class meetings: The main meetings are Mondays, Wednesdays, & Fridays (except March 9-13), 11:00-11:50 AM, in 209 Meliora Hall. Most Fridays will be devoted to facilitating team homework assignments (see below). Location is subject to change; in particular, we may occasionally need to decamp to a room full of PCs.

Homework assignments: Twelve problem sets, to be assigned weekly during the semester. The assignments will be distributed and collected during the Wednesday class meetings, and returned for error correction (see below) during the meeting after they are handed in. The use of Mathcad for preparation of homework is very strongly encouraged, as is the electronic submission of your homework, either on diskette or by electronic mailing of attached Mathcad documents. All homework solutions, however mathematical or graphical, must include sufficient narrative, in the form of complete sentences and properly constructed paragraphs,

to approach the style and detail of a journal paper.

Team homework: Most of the problems on each set will be designated as solo problems, on which students are required to work independently. The others, designated team problems, will be solved by groups of 3-4 students, working together, and hopefully contributing equally to the team's work. The team problems will generally be the more challenging ones. Solo problems will of course be written up and handed in separately by each student, but each team will turn in only one writeup of their solutions, and each team member will receive the same grade for this work. I remind you that, as an educational technique, learning from fellow students is second in effectiveness only to figuring it out yourself: the "student" gets an explanation at the appropriate level, from someone who learned it recently enough to remember the pitfalls; the "teacher" has to resolve issues about the problem that may get glossed over if an explanation to someone else is never attempted; and in a good group, everyone gets many opportunities to be "student" and "teacher."

Homework error correction: Every Wednesday, homework sets are due. They will be returned either Friday or Monday, with points deducted for errors and with occasional comments and clues. If you correct the errors and resubmit the homework set by the following Wednesday (a week after the original due date), 50% of the originally-deducted points will be restored. This second chance to get it right applies both to solo and team homework assignments.

Examinations: none. The homework is intended to be debilitating enough.

Grades: based completely on the homework assignments. Homework scores, expressed as a percentage, will be determined for each problem set either from adding the scores from the solo and team problems. Each homework set is worth 8.33% (1/12) of the total score for the course. Final grades will be set by an absolute scale, rather than "by the curve." In terms of the maximum possible percentage score, the grading scale will be as follows:

% Score	>85	>80	>75	>70	>65	>60	>55	>50	>40	>40
Grade	A	A-	B+	B	B-	C+	C	C-	D	E

Extra help: I can be found most afternoons in my office, or somewhere thereabouts on the fourth floor of B&L. I am obviously most accessible during office hours (MW 2:30-3:30pm), but you are welcome to stop by and talk with me whenever you want. I will be happy enough to answer any questions you have concerning the course, but even happier to help those who find the material or presentation sufficiently confusing that they're not even sure what to ask.

Course Outline: The schedule showing dates, subjects, and reading assignments is posted on the web at: <https://www.pas.rochester.edu/emamajek/AST241/index.html> .