Astronomy 601: Radiative Processes

Professor:

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Class web page: http://www.astro.umd.edu/∼miller/teaching/astr601

I will post lecture notes a few days before each class, and assume you have read them before the actual lecture.

Schedule:

Lectures on Tuesdays and Thursdays from 12:30 to 1:45, CSS 0201.

Textbooks:

Required: *Radiative Processes in Astrophysics* by Rybicki and Lightman.
Recommended: *The Physics of Astrophysics Volume 1: Radiation* by Shu.

Course Grading

Homework	25%
Midterm Exam	25%
Final Exam	35%
Individual Project	10%
Class Participation	5%

Feel free to discuss homework with other students, but you must work out and write up the solutions yourself. Web research is also okay unless specified otherwise in the problem (it's part of the learning process), but I do recommend that you work on the problems yourself first, and please indicate in your answer if some substantial component came from a webpage or other resource. I will grade each problem (in the homework and in the exams) on a four-point scale. One point is awarded if you demonstrate understanding of the physical issues associated with the problem. One point is awarded if you use the correct equations (assuming equations are needed). Two points are awarded for correct solution of the equations. If you come up with an answer that is obviously incorrect (e.g., a velocity 1000 times the speed of light!), but correctly say why it is incorrect and approximately what the right answer is, you will get one of those possible two points. If your answer is incorrect and this can be shown by simple units, limits, or symmetry arguments and you do *not* note this, more points might be taken off. The midterm and final will both be in-class, and we can negotiate whether they are open-book or closed-book.

Homework sets will be available on the class webpage, at least two weeks before the due date. Due dates will be Thursdays, typically two weeks apart (except for special cases such as Thanksgiving and the week of the midterm). Homework will be due right at the beginning of class, because I want it to be possible for you to absorb the content of that lecture instead of worrying about the problems! I will therefore enforce this policy strictly, and will take off points for, e.g., homework turned in at the end of class. I will do my best to return graded homeworks to you, with a solution set, by the next Tuesday.

Starting with the second homework, I will ask you to write computer codes as part of your homework. In addition to giving me the output of your code (in graph form, usually), I will require that before the due date, you send me a copy of your code. This can be in any language that you want *provided* that the code compiles and runs on my departmental computer without my having to do anything but compile and run it (you can send me instructions about the compilation). Thus I will not install libraries or download anything to make your code run!

The individual project will be a report on one current topic in radiative processes in astrophysics. This will typically be represented by a single short paper in the literature, but it can be more extensive if you want. I'll want you to have selected the topic you'll discuss by the week after the midterm, so that we can talk about it and make sure it's a good project. The report will be both a written report (4-5 pages in double-spaced 12pt format) and an oral report, which will be given in class at the end of the semester. For this project you will be graded on both content and presentation in the oral and written reports; the presentation in the oral report will be judged based on the criteria in the guides to talks that I give on the webpage. The "class participation" portion involves both your questions to me and answers to my questions during class; I don't expect you to get the "right" answer every time but I do want you to try.

Letter Grades

I will guarantee that you will receive no worse than the following letter grades for a given percentage of the total available points:

85%–100%	A
70%–85%	B
55%–70%	C
40%–55%	D

I may grade on a curve if the class average is significantly lower than suggested by the table; + and – additions to the letter grades will be determined based on the class distribution. There will be no extra credit.

Late Policy and Make-Up Policy

Partial credit for late homework assignments may be given if you give me a valid and documented reason by the Tuesday before the assignment is due. No credit will be given for homework turned in after the beginning of class that Tuesday, because I will hand out solution sets then. If you cannot make the midterm or the final exam, then we can arrange a different time if you tell me at least a week before the exam (to be fair to other students, the alternate time should be before the scheduled time).

Tentative Course Outline

Sep 3–12: Overview, specific intensity, scattering and absorption.
Sep 17–19: Source function and rate equations.
Sep 24–26: Quantum statistical mechanics and equilibria.
Oct 1–10: Electromagnetism applied to radiation.
Oct 15: Midterm.
Oct 17–22: Thomson, Rayleigh, and Compton scattering.
Oct 24–31: Bremsstrahlung, cyclotron/synchrotron, plasma processes.
Nov 5: Statistics and interpretation of spectra.
Nov 7–19: Atomic structure, transitions, bound-bound and bound-free, line broadening.
Nov 21–26: Molecules, rotation and vibration spectra.
Nov 28: Thanksgiving.
Dec 3–5: Presentation of projects.
Dec 10: Neutrino and gravitational radiation processes.
Dec 12: Recap, emphasis of points brought up during semester.
Dec 20: Final exam: 1:30-3:30 PM, normal classroom