**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 will assume you have read them before the actual lecture.

**Schedule:**

Lectures on Mondays and Wednesdays from 2:00 to 3:15, ATL 0201.

**Textbooks:**

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

**Course Grading**

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. You do need to take a stand: saying "I think this might be wrong" with no details won't help you, and might hurt you if your answer is actually right. The midterm and final will both be in-class, and will be closed-book and closed-notes.

Homework sets will be available on the class webpage, at least two weeks before the due date. Due dates will be Wednesdays, 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 Monday.

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

**Table 1.** Grade weights

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

*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. **An additional component of the class participation grade is that by the night before a given class I want you to e-mail me (1) a short statement about an aspect of my notes and/or the Rybicki and Lightman reading for the class that you want elaborated or that you didn't understand, and (2) a short statement about something you *did* understand well.**

**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: A– for 85% to 100% of the points; B– for 70% to 85% of the points; C– for 55% to 70% of the points, and D– for 40% to 55% of the points. 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 Monday before the assignment is due. No credit will be given for homework turned in after the beginning of class the Monday after the due date, 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).

**COVID policies**

We will follow the policies of the University of Maryland, which may change in response to CDC and State of Maryland guidelines. Please see https://umd.edu/4Maryland/health-plan for the current policies.

**Tentative Course Outline**

**Aug 30–Sep 13:** Overview, specific intensity, scattering and absorption.
**Sep 15–20:** Source function and rate equations.
**Sep 22–27:** Quantum statistical mechanics and equilibria.
**Sep 29–Oct 11:** Electromagnetism applied to radiation.
**Oct 13–20:** Thomson, Rayleigh, and Compton scattering.
**Oct 18:** Midterm.
**Oct 25–Nov 1:** Bremsstrahlung, cyclotron/synchrotron, plasma processes.
**Nov 3:** Statistics and interpretation of spectra.
**Nov 8–17:** Atomic structure, transitions, bound-bound and bound-free, line broadening.
**Nov 22–Nov 29:** Molecules, rotation and vibration spectra.
**Nov 24:** Thanksgiving break.
**Nov 29:** Vibrational and rotational transitions.
**Dec 1:** Neutrino and gravitational radiation processes.
**Dec 6:** Class-selected topic.
**Dec 8:** Presentation of projects.
**Dec 13:** Recap, emphasis of points brought up during semester.
**Dec 18:** Final exam: 1:30-3:30 PM, normal classroom