1. Basic course information

**Instructor:** Prof. Rachel Mandelbaum, rmandelb@andrew.cmu.edu, 8402 Wean Hall  
**Textbooks:** *Introduction to Cosmology* (Ryden); *Modern Cosmology* (Dodelson)  
**Office hours:** 3-5pm on Mondays, or by appointment (rmandelb@andrew.cmu.edu).

2. Course description

This course is the second graduate course for students interested in cosmology. The goal is to provide a more complete and thorough coverage of cosmology (which is covered for just a few weeks in 33-777). The topics to be covered include a brief introduction to relevant concepts from General Relativity, we will cover our model of an isotropic, homogeneous, expanding Universe, inflation, the origin and nature of the Cosmic Microwave background, Big-Bang Nucleosynthesis and baryogenesis, dark matter, linear perturbation theory, large-scale structure beyond linear perturbation theory, and dark energy.

3. Course goals

Students will develop an understanding of diverse concepts in cosmology, and the physics that governs them. By the end of the semester, students should be able to do all of the following:

- state the basic physical principles that are relevant for the aforementioned physical systems, and derive equations by applying those principles;
- solve physical equations analytically and numerically, sometimes with the aid of basic mathematical software like Mathematica or Matlab;
- visualize quantitative results using plotting software like gnuplot or matplotlib; and
- understand some of the scientific discussion in journal articles and astrophysics seminars.
4. Communication

The course will use blackboard for distribution of grades, but otherwise we will use piazza.com for course communication, distribution of homework, etc. Rather than emailing questions about material, I encourage you to post your questions on Piazza (anonymously, if you wish).

5. Evaluation

Course grades will be based on:

- Class participation (10%)
- Mid-semester paper discussion (15%)
- End of semester project (20%)
- Homework assignments (25%)
- Final exam (30%)

The cutoffs for grades are > 90%, 80 – 90%, 70 – 80%, 60 – 70%, and < 60% for A, B, C, D, and F respectively.

Homework assignments will generally be given biweekly, and will be due at the start of lecture on Thursday during weeks when there is an assignment. Students are welcome to discuss the homework assignments but should ensure that the details of the solutions they submit are their own. Homework that is submitted late will be accepted until the graded homeworks are returned to the rest of the class, but grades will be reduced by 10% per day after the deadline.

The mid-semester paper discussion will be held during midterms week. The whole class will be assigned to read and prepare some questions related to the papers. There will be informal discussion only (no slides / powerpoint presentation).

The end of semester project involves researching a selected topic from a list of possible topics, and preparing a presentation. It involves submitting to me an outline 2 weeks before the presentation, and then talking about the topic for 20 minutes during class time. More details will be distributed after spring break.