Advanced Topics: Cosmology (Phys 518)
Syllabus

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1 How to Find Me

The best way to reach me is e-mail, *edis@truman.edu*. I usually respond within a few hours, even late at night.

My office is MG 3004, and my office hours are: Tuesdays 10:30–11:50 and 13:30-15:20, Wednesdays: 12:30–14:20, and Thursdays 10:30–11:50 and 14:30-15:20. If you want to see me then, come by my office.

I'm also available most times when I am not actually teaching or have another meeting scheduled: see my calendar (*edis.sites.truman.edu/schedule/*). We can also Zoom. Email me ahead of time to set up a time that is good for both of us; my Zoom meeting ID is `taneredis`.

I will be using the web to post course-related notices and documents. Bookmark the course page: *edis.sites.truman.edu/cosmology/*.

2 Course Description

To understand the large-scale structure and history of our universe, cosmology brings together ideas from many different areas of physics: astrophysics, general relativity, nuclear and particle physics, and thermodynamics, just to start. While some basic knowledge in such areas will be helpful, I won't assume that you have taken any courses beyond the prerequisites.

3 Schedule

Class: Tuesday 12:00–13:20, MG 3000.
Thurssday 12:00–14:20, MG 3000.

4 Course materials

The textbook is Barbara Ryden, *Introduction to Cosmology* (2nd edition).

This course will be different than the other upper-level physics courses I teach. I'm not a cosmologist, and astrophysics is not at all my specialty. I've published a few minor pieces involving philosophical questions concerning cosmology, but these can be summarized as "back off, it's just physics." In fact, one of my main motivations when I first taught this course was so I could learn a bit more of cosmology beyond what is common knowledge to any practicing physicist.

All this means is that I will keep my lectures closer than usual to the text—to some extent, I will be presenting you the highlights of my understanding on a close reading, and occasionally bringing in connections I can make to other questions in physics. I expect you to keep up by reading the textbook carefully as well. In some respects, I hope to model for you what a physicist has to do while learning a new subject on their own, reading an appropriate book and solving associated problems.

5 Homework and Recitations

Your homework assignments will determine 40% of your final grade. This is because, again, I intend for our coursework to model what we have to do when learning something new, largely on our own. Therefore the process of working through end-of-chapter questions is critical.

I will announce when each is due in class—normally about a week after we are done with each particular chapter.

I do not mind you discussing the homework with one another as well as with me. I will give hints if you come by my office and ask. However, I expect you to turn in the results of your own efforts—not group solutions, and certainly not solutions directly taken from someone else. If I find results too similar to each other, especially if they make the same mistakes, you will have some explaining to do.

Before each homework set is due, we will also solve the recitation problems in class. I won't grade you on the recitations, though I will ask you to come up and solve them before the class. You don't have to get them right, and getting stuck is fine—I'll be there to help. The idea is to have me see you how you approach these things and help set you on the right path.

Chapter	Recitation	Homework
2	2, 5	3, 4, 6
3	1, 2	3, 4, 5
4	1, 3	2, 5
5	2, 3	5, 6, 8
6	2, 7	5, 6, 8
7	3, 5	4, 6
8, 9	8.1, 9.1	8.4, 9.2, 9.3
10, 11, 12	11.2, 12.3	10.3, 11.1, 12.4

We will most likely do the last two homework sets and recitations as planned, but there is a chance I may have to change course. It will depend on our pace and other considerations.

6 Exam

I will also give you an exam at some point, after the midpoint of the semester. That will be worth 25% of your grade

7 Presentation and Paper

The remaining 25% of your grade will come from a short paper and associated presentation. I would like you to explore some published data or theoretical models that contradict the ΛCDM model that is the current front-runner, and then make your personal judgment, as best as you can, how strong the challenge is to ΛCDM from the research you found out about.

During the last week of classes, you will do a ten-minute presentation (plus five minutes for questions). Then, after receiving feedback, you will complete your short paper and hand it in to me during the week of finals.

8 Final grades

As with every other aspect of the course, I intend to be flexible. If you get less than 50% in your overall grade, you will certainly fail, and 90% or better will certainly be an A, but otherwise, I don't want to declare rigid boundaries such as "65%–77% is a C" and so forth. This is a small class and I will get to know how you do physics fairly well. What will matter most for your grade is my professional judgement about how well you come to understand the fundamentals of cosmology.

If you want to know how you are doing, or what sort of performance on the final you would need for an A, or have similar grade-related concerns, just email me or stop by my office and ask. I should be able to give you a fair estimate of where you stand.

9 Attendance Policy

You will need to be present in the classroom to do well in this course. But it's *your* responsibility to make sure you do well. I will not spend time keeping track of your attendance, and if you're not there, I will assume you have good reason to be absent. For example, if you are sick, please stay home! You don't need to tell me when you expect not to be present.

It is very hard to arrange for make-ups for exams or homework in a course like this. So I expect you will do everything possible to turn your work in on time, and so avoid later hassle for both me and yourself. I post solutions on the course web site; once they are up, it's too late to hand that work in.

Nevertheless, you may find you have missed something because of a legitimate excuse like being badly sick or a death in your family. In this case, come and speak with me, and I will decide, on a case-by-case basis, how to make up what you have missed. I will typically assign you some appropriate extra work, have you take a make-up exam in my office, or something similar.

10 Academic Integrity

I care about maintaining academic integrity, and I will apply all Truman policies concerning academic dishonesty. I expect you to be familiar with

the Student Conduct Code.

Do not present something that is not your own work as your own, whether you get it from another student or online.

11 Learning Objectives

By the end of the course, students should be able to:

- Understand the outline of the historical development of modern cosmology,
- See how general relativity is the basis of cosmological models,
- Work with some basic models and understand the roles of radiation, matter, and the cosmological constant,
- Understand the motivations for dark matter, dark energy, and inflation, and the large uncertainties associated with such ideas,
- Be able to understand possible challenges to the ΛCDM model.

12 Lawyer Avoidance

Some of the required small print.

Truman policy and federal regulations require that students demonstrate that they are academically engaged in the courses they take. You must meet this requirement within the first calendar week of the semester, beginning at 12:00 am on Monday, January 12 and ending 11:59 pm Saturday, January 17. Failure to do so, or to provide an explanation of an extenuating circumstance by that date and time will result in your removal from the course. Under certain circumstances, removal could impact your scholarship eligibility or financial aid. For the purposes of this class, establishing academic engagement requires, at a minimum, showing up at a lecture or lab.

The minimum investment of time by the average Truman student necessary to achieve the learning goals in this course are not less than one hour (50 minutes) of classroom instruction and a minimum of two hours of out of class student work each week per credit hour awarded or at least the equivalent of three hours (2:50) of laboratory work, internships, practica, and other academic work each week per credit hour awarded. This average time per week for an average student may have weekly variations. This class is worth 4 credit hours. Students will be expected to spend about 8 hours on coursework, which will consist of work on the current assignment due, extra problem solving, exam preparation, and finishing up of lab write-ups.

Education records are protected by the Family Education Right to Privacy Act (FERPA). As a result, course grades, assignments, advising records, etc. cannot be released to third parties without your permission. There are, however, several exceptions about which you should be aware. For example, education records can be disclosed to employees or offices at Truman who have an "educational need to know." These employees and offices may include your academic advisor, the Institutional Compliance Officer, the Registrar's Office, or Student Affairs depending on the type of information.

Behavior that persistently or flagrantly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be asked to leave class pending discussion and resolution of the problem and may be reported to the Office of Student Conduct.