General Relativity

Phys 411

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Lectures: Monday, Wednesday, Friday 9:00-9:50 am (P240A)

Office Hours: Tuesday 1-3 pm (P124)
Wednesday, 10 am-12 pm (P124)

Text: Sean Carroll, "An Introduction to General Relativity: Spacetime and Geometry". This book is available new at the bookstore for $167 (cheaper elsewhere, though).

Course Website: Linked to from my Reed website: http://people.reed.edu/∼larkoski/

Course Description: General Relativity is the theory of gravity developed in the early 20th century. It is often said to be the most beautiful physical theory constructed and its consequences are still being tested today. This class is an introduction to this topic and its application to understanding cosmological phenomena.

This course develops the theory of general relativity from a geometric perspective. This requires an introduction to a significant amount of concepts from geometry and topology to describe and mathematically formulate gravity. Some of the necessary background you would have seen in electromagnetism, but the necessary mathematical background will be introduced as the course progresses. Topics that will be covered include black holes, early universe cosmology, gravitational waves, and Hawking radiation.

As this is one of the few classes which (essentially) exclusively has seniors, I feel it's important to have an opportunity to learn and discuss more than just gravity in this class. In most lectures, we'll end a few minutes early, and open up the floor to any question you'd like to ask: about gravity, physics, academia, applying to graduate school, my favorite brand of performance socks, etc.

Course Requirements: I plan to run this class much like a graduate level-class. The main graded requirement of the course will be weekly homework assignments. Homeworks will be assigned by the end of the week and due at the beginning of class the following Friday. I will drop the lowest homework score from your final course grade.

On Fridays, three students will each present their worked-through solution to one of the homework problems for the week. Students will have about 15 minutes each to present and complete their problem. Each week, a different three students will present their solutions and all students will present about 3 times. If you are unable to attend your scheduled homework presentation, please let me know before that Friday. Only in extremely extenuating circumstances will absenteeism for your assigned presentation be acceptable.

Within the first three weeks of the semester, students are required to attend office hours at least once. There's no requirement about what we talk about in office hours through! I just want to get to know you better and lower the barrier for student-professor interaction. If you don't particularly have a question for office hours, then come to talk about what you find most interesting about physics. If you aren't able to attend during regularly scheduled office hours, talk to me and we can schedule another time. You're also more than welcome to stop into my office whenever I am in.

As a final project, all students will be required to read, review, and present on a recent-ish paper on an aspect of general relativity. During the final few class days, each student will present in front of the rest of the class a 10 minute review (+ questions) of their chosen paper. A suggested list of papers or topics will come after fall break.

Finally, there will be a final homework/exam assigned in the last couple weeks of class and due during finals week. There will be no in-class final exam.

Grading: The amounts to which the homework, presentations, and the final exam contributes to your grade are:

Homework	20%
Homework Presentations	30%
Paper Presentation	30%
Final Exam	20%

Weekly Lecture Topics: The following page shows a list of topics we'll discuss this semester during each week. This isn't a final schedule, and may possibly change as the semester goes on.

Week:	Date:	Topic:	Textbook:
1	8/27	Introduction	Secs. 1.1–1.2
	8/29	Special Relativity	Secs. 1.3–1.8
	8/31	Special Relativity	Secs. 1.8–1.10
2	9/3	**Labor Day**	
	9/5	Manifolds	Secs. 2.1–2.4
	9/7	HW 1 presentations	
3	9/10	Manifolds	Secs. 2.5–2.7
	9/12	Manifolds	Secs. 2.8–2.10
	9/14	HW 2 presentations	
4	9/17	Curvature	Secs. 3.1–3.4
	9/19	Curvature	Secs. 3.5–3.7
	9/21	HW 3 presentations	
5	9/24	Curvature	Secs. 3.8–3.10
	9/26	Gravitation	Secs. 4.1–4.3
	9/28	HW 4 presentations	
6	10/1	Gravitation	Secs. 4.4–4.6
	10/3	Gravitation	Secs. 4.7–4.8
	10/5	HW 5 presentations	
7	10/8	Schwarzschild	Secs. 5.1–5.4
	10/10	Schwarzschild	Secs. 5.5–5.8
	10/12	HW 6 presentations	
		Fall Break	
8	10/22	Black Holes	Secs. 6.1–6.3
	10/24	Black Holes	Secs. 6.4–6.5
	10/26	HW 7 presentations	
9	10/29	Black Holes	Secs. 6.6–6.7
	10/31	Radiation	Secs. 7.1–7.3
	11/2	HW 8 presentations	
10	11/5	Radiation	Secs. 7.4–7.5
	11/7	Radiation and LIGO	Secs. 7.6–7.7
	11/9	HW 9 presentations	
11	11/12	Cosmology	Secs. 8.1–8.2
	11/14	Cosmology	Secs. 8.3–8.5
	11/16	HW 10 presentations	
12	11/19	Cosmology	Secs. 8.6–8.7
	11/21	Inflation	Sec. 8.8
	11/23	**Thanksgiving**	
13	11/26	Quantum Mechanics + Gravity	Secs. 9.1–9.4
	11/28	Quantum Mechanics + Gravity	Secs. 9.5–9.6
	11/30	Presentations	
14	12/3	Presentations	
	12/5	Presentations	