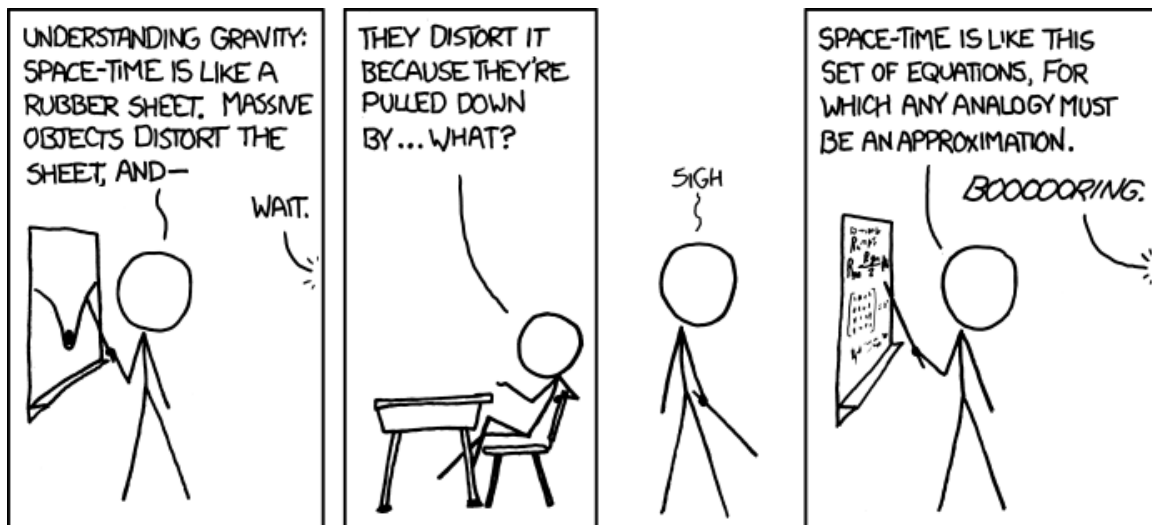


PHYS 4900/6900: Special Topics (General Relativity) Syllabus

University of Georgia, Spring 2022
TuTh Period 3 (11:10 am–12:25 pm), Room 327



(Credit: xkcd)

Introduction

General relativity is one of the foundations of modern physics. Starting with fairly simple assumptions about mass and reference frames, general relativity shows that the gravitational field is intimately connected with the geometry of spacetime. The theory of general relativity is at the heart of our understanding of the structure of the universe (from Big Bang cosmology to black holes to gravitational waves), and has surprising relevance to modern technology. It also, importantly, has been verified to extraordinary precision by every experimental test performed to date.

And yet, as a purely classical theory, general relativity is necessarily incomplete. It has proved to be extraordinarily difficult to marry the geometric description of gravitation and spacetime with the principles of quantum field theory. While there are some contenders for such a theory (e.g., string theory, loop quantum gravity, causal set theory), none has emerged as the unambiguously clear and experimentally verified winner.

Basic Information

Instructor:	Dr. Craig Wiegert 215 Physics Building	Phone: 706-363-3937 Email: cwiegert@uga.edu
Office hours:	TBA	
Required textbook:	<i>A General Relativity Workbook</i> , by Thomas A. Moore (University Science Books, 2012). Note: there are errata for the textbook on eLC.	
Web site:	eLearning Commons (check this daily for announcements)	
Prerequisites:	PHYS 3700 (Modern Physics) and PHYS 3900 (Math Methods)	

Grading Policies

Your course grade will depend on formative and summative assessments, weighted as follows:

20% Pre-class preparation
35% Homework
45% Projects

Letter grade cutoffs will be *no higher* than the following percentages:

A- = [85, 89)	A = [89, 100]	
B- = [70, 74)	B = [74, 81)	B+ = [81, 85)
C- = [55, 59)	C = [59, 66)	C+ = [66, 70)
	D = [40, 55)	
	F = [0, 40)	

Actual grade ranges may end up having lower cutoffs.

Class Preparation

Each textbook chapter has three sections: a **Concept Summary** with a succinct description of the core ideas, a **Details** section with exercises that work through some of the missing steps from the summary, and **Homework Problems**.

The best way to learn a mathematically challenging and non-intuitive topic like general relativity is to engage with the material consistently, in small pieces, and working through derivations yourself. So, before each class, you should read the assigned chapter(s) and work out the exercises. Make an honest effort on each exercise, but if you get stuck for more than 10 minutes or so, move on. Take note of your questions and difficulties with the reading and exercises, and bring them to class.

Each class day, I'll randomly pick a few students to hand in their workbook at the end of class for a 10-point grade. This is a purely formative grade (based on *effort* not correctness) for all work done since the last hand-in, but emphasizing the most recent material. If you're absent the day you're chosen, you can hand in your workbook late, but can earn only a maximum of 5 points. Your overall class prep grade will be the average of however many hand-ins you've had (but see below for drops).

Homework

Homework sets (consisting of roughly 1–2 problems per chapter) will be due on a regular basis. Homework is meant to be both formative (developing understanding) and summative (demonstrating mastery), so I will grade each solution partially on effort and partially on correctness, 10 points per problem. After homework is handed back, you'll have an opportunity to make corrections to earn back up to half of the “correctness” credit.

At the end of the semester, *provided that you complete a course evaluation*, I will drop your lowest two prep scores and two lowest homework scores when calculating your course grade. If you don't submit a course evaluation during the allotted time, then all scores will count. This policy compensates for the unavoidable circumstances that may prevent you from submitting materials completely or on time (e.g., illness, scheduled event, emergency, etc.).

Projects

You will have three problem-solving projects to complete over the course of the semester (including one due during final exams). These projects will be based on problems similar to, but significantly more involved than, homework problems. You will be asked to demonstrate your understanding through more detailed explanations of your reasoning, in the form of a short manuscript and/or an oral (video) presentation.

Graduate/Honors Credit

Graduate students in this course enroll in PHYS 6900. Undergraduates wishing to receive Honors credit for the course must complete the necessary paperwork with the Honors Program and then transfer into PHYS 6900.

Students taking the course at the 6000 level will occasionally be given “graduate/challenge problems” as a part of homework assignments. These will be due at the same time as the normal assignments unless otherwise specified. These problems are mandatory for graduate and Honors-option students; other students can complete them for extra credit.

A final graduate project will be assigned separately, will be of longer duration, and will be available only to the 6000-level students.

The purpose of these 6000-level tasks is to merit the distinction of graduate/Honors credit. This is *not* designed to give PHYS 6900 students an opportunity that PHYS 4900 students don't have. As a result, in most cases satisfactory work on these tasks will not change the letter grade of 6000-level students. However, truly exceptional work will be rewarded with a one-step increase in letter grade (e.g., B+ to A–). If the work is unsatisfactory but at least attempted, the final letter grade will be one step lower (e.g., B+ to B). If the work is missing or late, the final letter grade will be lowered by two steps (e.g., B+ to B–).

Course and University Policies

Academic Honesty

“I will be academically honest in all of my academic work and will not tolerate academic dishonesty of others.”

UGA has a comprehensive academic honesty policy, *A Culture of Honesty*, which is available from the Office of Instruction at <https://honesty.uga.edu/>. This policy covers all academic work. All students are responsible for fully understanding and abiding by this policy. If you have *any* questions about what’s acceptable, you are obligated to ask me for clarification.

I take issues of academic honesty very seriously, and it is my responsibility to uphold the University’s policy. This means, among other things, that I will report suspected incidents of dishonesty to the Office of Academic Honesty. Typical consequences of academic dishonesty can range from receiving a zero for that grade, to failing the course, to being suspended. Going through the academic honesty process is not usually a pleasant experience, as some of my students have discovered.

Collaboration

Science is inherently collaborative; therefore, I strongly encourage and even expect you to interact with classmates, more advanced students, and me as you work on problem sets.

Nevertheless, you’re ultimately responsible for your own learning. I expect each student to turn in assignments that have been independently written up. *Under no circumstances* is it acceptable to copy or paraphrase from someone else’s written work, or allow your solutions to be copied.

Here’s a good model for how to work on a problem:

1. First try to make progress on your own.
2. If you find that you’ve worked for a half-hour or so without making any forward progress, that’s a good sign to seek help to overcome a specific hurdle. Then try to make further headway on your own.
3. Don’t allow your helper to guide you all the way through.
4. Once you’ve solved the problem on scratch paper, rewrite your solution, explaining the steps as you go, as you would to a novice problem solver. The less you refer to previous notes, the better.
5. The end product should be a unique solution that teaches you something about what you really understand.
6. Don’t get discouraged if you find that some problems require hints and help all the way through. Worthwhile learning is often a struggle.

A good test of your understanding is to explain a solution to someone else. However, be conscious of your role in a collaboration. If you’ve mastered a problem and a peer is still stuck, limit your help to getting them back on track. If you’re working with someone at a comparable level of understanding, keep mutually challenging each other.

Homework problems will come mostly from our textbook (occasionally others), but may differ from these sources in some details. It's likely that many of these problems have solutions on the Internet or elsewhere. **These solutions are off limits.** It is unacceptable for you to solve homework problems by “mining” existing solutions, even for hints; this is plagiarism. Limit yourself to office hours and verbal help from study partners. Please sketch a picture of Einstein on your agreements sheet, and keep reading.

Likewise, the homework solutions I provide are for *your* use only. Sharing them with other students sabotages their learning and could jeopardize your school career.

Disability Accommodations

I will make every reasonable effort to accommodate students with documented disabilities. Students requesting accommodations must provide documentation from the Disability Resource Center in a timely fashion.

Withdrawals/Incompletes

The [Undergraduate Bulletin](#) and the [Registrar's Office](#) website describe the University policies regarding [withdrawals and incompletes](#). If you are considering withdrawing from the course, you should discuss your choice with me beforehand. Often, students are doing better in a physics course than they think they are.

A grade of Incomplete can help in situations where an unexpected event prevents you from completing a portion of the course (say, a project or a few assignments). An Incomplete isn't appropriate when a student has missed a large fraction of the course assessments, for whatever reason.

Student Distress and Mental Health

If you or someone you know needs assistance, or your course performance is significantly affected by issues beyond your control, I urge you to let me know and to contact [Student Care and Outreach](#) promptly. It is always easier to address these situations when you raise concerns as early as possible. Waiting until the end of the semester to take action may limit my ability to provide appropriate support.

UGA has several resources for students seeking [mental health services](#) or [crisis support](#). If you need help managing stress anxiety, relationships, etc., please visit [BeWellUGA](#) for a list of *free* workshops, classes, mentoring, and health coaching led by licensed staff in the University Health Center. Additional resources can be accessed through the UGA app.

Student Responsibilities

- Above all, you have the responsibility to act courteously toward your classmates and the right to expect the same from others. Courtesy includes coming to class on time, ready and willing to learn and interact for the full period. It means asking questions, and helping the class with your own responses. It also means being supportive of others' mistakes, and comfortable making your own.
- It's your responsibility to show me what you do and don't understand through your questions, so that I can help you learn. Silent confusion benefits no one.

- Class attendance is crucial, because this is the best time for you to clarify and deepen your understanding of the pre-class prep material in the textbook.

The most common causes of missed classes are lack of sleep and time pressure from other obligations. If this starts happening to you, you need to seek out advice on how to set priorities and manage your time effectively.

- Ask for clarification on anything you find unclear, ambiguous, or unspecified. This includes both course policies and physics topics. Ignorance is never a valid excuse.