Physics 5240: Introduction to the Theory of General Relativity, Spring 2023

**Basics:**


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| Instructor: | Julian Heeck |
| Office: | Physics 320 |
| Lectures: | 9:00–9:50 a.m., MWF, Dell 2 100 |
| Office hours: | TBA |
| e-mail: | heeck@virginia.edu |
| Grader: | TBA |


Class Web Page: UVA Collab *23Sp PHYS 5240*

**Textbook:**

- Bernard F. Schutz, *A First Course in General Relativity*.

**Other Books and References:**

- Sean M. Carroll, *Spacetime and Geometry*
  A little more advanced than Schutz. Will use this frequently.
- Carroll, *Lecture Notes on General Relativity* (that the textbook was based on):
  ⟨⟨https://www.preposterousuniverse.com/grnotes/⟩⟩.
  Try the 24-page *No-Nonsense Introduction to General Relativity*!
- Hartle, *Gravity*
  Similar level to Schutz, more on physics than maths.
- Misner, Thorne, and Wheeler, *Gravitation*
  1280 pages, useful as a reference book.
- Landau and Lifshitz, *The Classical Theory of Fields*
  Nice and concise.
- Weinberg, *Gravitation and Cosmology*
  Non-geometric, field-theory approach; cosmology part outdated and replaced by separate book.
- Wald, *General Relativity*
  Advanced and mathematical.
- Sauer, *Albert Einstein's 1916 Review Article on General Relativity*
  ⟨⟨https://arxiv.org/abs/physics/0405066⟩⟩.
  Quick history of Einstein's path to the correct field equations.

**Attendance:**
Attendance is not taken, but you are responsible for the material presented in class, turning in your homework on time, knowing problem assignments, and knowing any administrative announcements made, such as changes to the syllabus or changes to the scheduling of homework or exams.

**Homework:**
Homework assignments will be posted Wednesdays on Collab. Homework is due the following Wednesday at the **beginning** of the lecture, either by uploading a single pdf to Collab or by handing in actual paper. In a limited number of occasions, you may ask for an extension of due dates **in advance** provided you have good reasons to do so. Discussing the problems with each other is encouraged, but I expect each individual to write up their own solutions without direct copying. Copying another person's solution that you did not substantially participate in is unacceptable.

You may be able to find some of the solutions online or from students who have taken the course before, but **try solving problems by yourself first**. The primary purpose of assigning these problems is for you to **struggle and learn**. Also, don't just write down answers, **show derivations**!

I will adapt some of the problems for mid-term and final exams from the homework problems, so take them seriously and make sure that you can solve them on your own.

**Exam Dates:**

**MID-TERM EXAM: Wednesday, March 1st, 9:00–9:50 a.m.**

**FINAL EXAM: Monday, May 8th, 2:00–5:00 p.m.**

**Grade weighting:**

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| 40% | Homework |
| 25% | Midterm exam |
| 35% | Final exam |

**Topics to be covered**

Here is a tentative plan on what topics will be covered.

1. Special Relativity
2. Vector Analysis in Special Relativity
3. Tensor Analysis in Special Relativity
4. Curved Spacetime and Manifolds
5. Geodesics
6. Curvature
7. Gravitation
8. Black Holes
9. Experimental Tests of Relativity
10. Compact Stars
11. Gravitational Waves

**Finally...** YOUR COMMENTS AND FEEDBACK ARE WELCOME!