

## Tensors and General Relativity

**Prerequisites:** Math 308; Phys 331 [currently offered as Phys 489] or Math 323 or Math 311; junior or senior classification. Some exposure to special relativity will be helpful.

**Class time and place:** MWF 3:00–3:50, ChEn 111

**Web page:** <http://calclab.math.tamu.edu/~fulling/m489GR/>

<p><b>Instructor:</b> S. A. Fulling 620H Blocker Bldg. 845-2237 fulling@math.tamu.edu <a href="http://www.math.tamu.edu/~fulling/">http://www.math.tamu.edu/~fulling/</a></p>	<p>If I am not in my office, you can leave a note in my mailbox (in the room opposite the Math Department office, 6th floor of Blocker) or in the plastic pouch beside my office door.</p>
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Tentative office hours: M 2:00–2:50, T 3:00–3:50, W 9:10–10:00

Permanent office hours will be announced later.

**Course description:** This course will cover the following topics: Vector and tensors in special relativity (3 weeks); curvature, manifolds, covariant differentiation (4 weeks); Einstein field equations (1 week); Schwarzschild geometry and black holes (3 weeks); cosmology (2 weeks); gauge field theories (1 week).

**Textbook:** B. F. Schutz, *A First Course in General Relativity*, 2nd edition (Cambridge University Press, 2009)

In addition to covering most of the material in Schutz’s relativity book, I’ll briefly discuss **gauge field theories** as another application of the concept of a covariant derivative, following Chapter 8 of my book *Aspects of Quantum Field Theory in Curved Space-Time* (Cambridge University Press, 1989). (Copies of that chapter will be provided.) Schutz has very little to say about electromagnetism in relativity, so we will fill in the details as a major homework project.

**Learning objectives:** The student will learn the basic facts about the mathematical structure and physical meaning of general relativity and will be able to carry out the simplest calculations. Proficiency at the level of graduate courses is not expected.

<b>Grading scheme:</b> Hour tests:	100 × 2 = 200
Final exam:	200
E&M paper:	50
Other homework and class participation:	<u>100</u>
Total	550

The “curve” will be at least as generous as the “standard” scale [i.e., 90% (= 495 pts) will guarantee an **A**, 80% **B**, 70% **C**, 60% **D**]. (Usually, grades in this course are more generous than that.)

Dates of hour tests: Oct.. 7 (Wednesday); Nov. 13 (Friday).

Final exam: Tuesday, Dec. 15, 10:30 a.m. – 12:30 p.m.

**Please bring your own paper for tests.**

First draft of electromagnetism paper due Oct. 14; final version due Oct. 28 (Wednesdays).

**Some boiler plate** (unnecessary for this audience, I hope)

**Make-up tests:** Make-up tests are very hard to grade fairly, and they absorb a large amount of my time which would be better spent for the benefit of the whole class. Please cooperate in making these incidents as rare as possible. If you miss (or foresee that you will miss) a test, it is *your* responsibility to contact me as soon as possible to request, justify, and schedule a make-up test. (If you can't reach me directly, you can leave a message at the Math Department office, (979) 845-3261.) If the absence is not clearly excused under the Attendance section of Student Rules, the request may be denied.

**An Aggie does not lie, cheat, or steal or tolerate those who do.** See Honor Council Rules and Procedures, <http://www.tamu.edu/aggiehonor> .

**Plagiarism:** Finding information in books or on the Internet is praiseworthy; *lying* (even by silence) about where it came from is academic dishonesty. Whenever you copy from, or “find the answer” in, some other source, *give a footnote or reference*. Otherwise, you are certifying that it is your own work.

**Joint work:** On a homework assignment (*not* a take-home test!) discussion with other students is permitted, even encouraged. However, you will not get homework credit for “work” that is parasitical (and your test scores will suffer, too!). To forestall problems, please follow these policies: (1) When two or more students work together on an assignment, they should all indicate so on their papers. (2) If the cooperation is of the divide-and-conquer variety, you are certifying that you *have studied and understand* every problem solution on your paper. Mindless copying is dishonest and academically worthless.

**Copyright:** Course materials (on paper or the Web) should be assumed to be copyrighted by the instructor who wrote them or by the University.

**Disabilities:** The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Disability Services Office in Cain Hall, Room B118, or call 845-1637.