

Tensors and General Relativity

Prerequisites: Math 308 (ODEs); Phys 331 or Math 323 or Math 311 (linear algebra); junior or senior classification. Some exposure to special relativity will be helpful.

Class time and place: MW 4:10–5:25, BLOC 164

Web page: <http://calclab.math.tamu.edu/~fulling/m460/>

Instructor: S. A. Fulling
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<http://www.math.tamu.edu/~fulling/>

If I am not in my office, you can leave
a note in my mailbox (in BLOC 226).

Tentative office hours: M 3:00–3:50, T 2:00–2:50, R 3:00–3:45

Permanent office hours (probably the same as these) 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 available.) 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.

Grading scheme:	Hour test:	100
	Final exam:	200
	E&M paper:	50
	Other homework and class participation:	<u>100</u>
	Total	450

The “curve” will be at least as generous as the “standard” scale [i.e., 90% (= 405 pts) will guarantee an **A**, 80% **B**, 70% **C**, 60% **D**]. (Usually, grades in this course are more generous than that.)

Date of hour test: Monday, Oct. 7

Final exam: Monday, Dec. 9, 3:30–5:30 p.m.

Please bring your own paper for tests.

First draft of electromagnetism paper due Oct. 2; final version due Oct. 23 (Wednesdays).

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 Disability Services, currently located in the Student Services at White Creek complex on west campus, or call (979) 845-1637. For additional information, visit <http://disability.tamu.edu> .

Title IX and Statement on Limits to Confidentiality: Texas A&M University and the College of Science are committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws provide guidance for achieving such an environment. Although class materials are generally considered confidential pursuant to student record policies and laws, University employees — including instructors — cannot maintain confidentiality when it conflicts with their responsibility to report certain issues that jeopardize the health and safety of our community. As the instructor, I must report (per Texas A&M System Regulation 08.01.01) the following information to other University offices if you share it with me, even if you do not want the disclosed information to be shared:

Allegations of sexual assault, sexual discrimination, or sexual harassment when they involve TAMU students, faculty, or staff, or third parties visiting campus.

These reports may trigger contact from a campus official who will want to talk with you about the incident that you have shared. In many cases, it will be your decision whether or not you wish to speak with that individual. If you would like to talk about these events in a more confidential setting, you are encouraged to make an appointment with the Student Counseling Service (<https://scs.tamu.edu/>). Students and faculty can report non-emergency behavior that causes them to be concerned at <http://tellsomebody.tamu.edu> .