Syllabus for Math 401, The Geometry of Physics

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

Additional Texts
- *The Geometry of Physics*, Theodore Frankel
- *General Relativity*, Robert M. Wald
- *The Large-Scale Structure of Space-Time*, S.W. Hawking and G.F.R. Ellis

Prerequisites
Grade of C or higher in Math 303 or 305 or equivalent, and Math 310 or equivalent. Unofficially, if you are comfortable with partial derivatives, path integrals, vector spaces, and linear transformations, you should be okay.

Course outline
Starting with special relativity, we will develop the mathematical language necessary for understanding General Relativity and the invariant Maxwell equations. Along the way we will learn enough math and physics that students can start understanding the modern research in these areas. The material will be divided into 5 topics:

- Special relativity
- Linear algebra, Tensor analysis
- Global geometry: geodesics, energy, and variation
- Infinitesimal geometry: metrics, connections, and curvature
- The mathematics of General Relativity

We will have regular quizzes and homework assignments to make sure everyone stays current with the material. We will have a test after we conclude each topic.

Exams
We will have 4 in-class tests and a final exam.
- **Test 1**: Friday Feb 13 (10% of grade)
- **Test 2**: Friday Mar 6 (20% of grade)
- **Test 3**: Friday Mar 20 (10% of grade)
- **Test 4**: Friday April 17 (10% of grade)
- **Final**: TBA (30% of grade)

Homework (10% of grade)
One problem set will be due each week. The problems will be turned in at the beginning of class each Wednesday. As a fair warning, you will have to work hard to be successful in this class. If you fall seriously behind on the homework, you will not be able to keep up in class and will not be prepared for the exams. You are encouraged to work in groups, but you must write up your own solutions.

Quizzes (10% of grade)
There will be a short quiz at the beginning of class each Friday (except the Fridays of scheduled tests). The purpose is to help everyone stay current with the mathematical techniques introduced during the prior week.
Makeup policy
All of your responsibilities for this class have been announced well ahead of time, namely in the first week of classes. Thus almost no requests for makeup homeworks or exams will be granted. The only exceptions, assuming evidence is provided, will be for serious illness, family emergency, or an unforeseeable catastrophe (tornado, car wreck, etc).

Academic Integrity
Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person’s work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/uaa/academicjudiciary/.

Course Withdrawals
The academic calendar, published in the Undergraduate Class Schedule, lists various dates that students must follow. Permission for a student to withdraw from a course after the deadline may be granted only by the Arts and Sciences Committee on Academic Standing and Appeals or the Engineering and Applied Sciences Committee on Academic Standing. The same is true of withdrawals that will result in an underload. A note from the instructor is not sufficient to secure a withdrawal from a course without regard to deadlines and underloads.