Physics 160 **GENERAL INFORMATION SHEET** Spring 2008

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Office Hours: MWF11, Th 1:15 pm or by arrangement.
Textbook: Moore, *A General Relativity Workbook* (available in the COOP store).

Preparing for Class: Each chapter has three sections, a **Concept Summary** that describes the core issues you need to understand, a **Details** section (with **exercises**) that discusses complexities omitted from the summary (such as derivations), and **Homework problems**. My experience is that the only way to learn general relativity is to make it truly your own, and doing that requires working many of the derivations yourself. Therefore, **before coming to class**, you should *read the chapter* and *work out the exercises* in the spaces provided. Spend an honest amount of effort on each exercise, but if you are stuck for more than ~10 minutes, go on, and bring your questions to class. This will enable us to efficiently focus class time on discussing the difficulties that you are (collectively) having.

Homework: Homework sets (consisting of about 6 problems) will be due Mondays at 5 pm (either submit work in class or to my mailbox in the main office). I will "pre-grade" your initial efforts and return them by class on Wednesday. You will then use the solutions to correct the problems and return them to me by Friday before 5 pm. This pattern changes a bit when close to test times (see the syllabus for details).

Correcting Your Problems. When you correct your solutions, use a ***green or purple pen*** to clearly distinguish your correction from your initial work or my marks. Here are guidelines for correcting your work:

1. Mark each algebraic or mathematical error and correct any subsequent work.
2. If you made a conceptual error, write a very short statement that describes the error, then re-write the solution from that point *in your own words*. (This may sometimes entail rewriting the entire problem.)
3. If your original solution was incomplete (or missing), flesh it out as necessary using *your own words*.

Grading Scheme: After you initially turn your problems in, I will "pre-grade" each solution for completeness and effort on a 4-point *Original Effort* scale shown below and return them to you. When you return your corrections, I will then grade your correction effort according to the 3-point *Correction Effort* scale and award up to three *Original Effort Quality* points as described below. Note that you can earn up to 10 points per problem. Note also that you can get all 4 Original Effort points *even if your problem is completely wrong*.

Original Effort Scale	**Correction Effort Scale**	**Original Effort Quality**
4 = satisfactory effort	3 = satisfactory correction	3 = no correction needed
3 = missing explanations, steps	2 = minor errors escaped correction	2 = minor errors needed correction
2 = missing major portions	1 = major errors escaped correction	1 = major errors needed correction
1 = very little done	0 = no correction attempted	0 = problem needed rewriting
0 = no original effort		

Grading Rules and Indulgences: If you hand in the original effort late but before I return solutions, I will take two points off per problem. After solutions are provided, late *initial efforts* cannot be accepted (without prior arrangement), though you can still get all correction points. I will also take one point per problem off for every 24 hours the *corrected* problem is late (weekend = 24 hrs) up to a maximum of 5 points off. Your **five (5)** lowest problem scores will be dropped from your homework grade: this should give you the flexibility that you need to deal with ordinary illnesses, short-term family emergencies, term papers, unexpected romances, and the like.

Tests: Note that two weekends are marked TEST on the syllabus. On those Fridays, I will give out a take-home exam which you may do in no more than two sittings (the first of no more than three hours, and the second of no more than one hour). You should hand in the test on Monday by 5 pm. Each test will be open book and open notes, but you are not to talk to anyone but me about it (of course). There will a short homework assignment due the Friday of the exam (so that you have some practice and feedback about the material discussed earlier in the week), but no homework due Monday. There will be a third test of roughly the same length offered at the end of the course. This test is due from seniors no later than 9 am on Friday May 9 (so I can turn in your grades by noon). For non-seniors, the test will be due no later than noon on Tuesday, May 13 (the end of our designated exam period).

Class Preparation Grade: A modest part of your grade will depend on your preparation for class. Each class day, I will pick one student at random to give me their workbook at the end of class. I will look over the workbook, and grade it on a 10-point scale depending purely on the *effort* displayed, emphasizing the work for that day's reading assignment but also noting work done previously. You may be the "winner" any given day, even if you were selected the previous session. You will get a maximum of 6 points if you are absent on your day but turn your in book later. Your class preparation grade will be the *average* of however many workbook grades you earn (dropping the lowest). Note that I plan to be pretty generous -- just show me that you have seriously thought about each exercise.

Grading Weights: Each test will count as 19% of your grade, the homework as 30%, class preparation as 13%.

PHYSICS 160 *TENTATIVE* SYLLABUS **SPRING 2008**

	Monday	Wednesday	Friday
JAN		23 INTRODUCTION (no reading assignment)	25 FLAT SPACETIME 2. Review of Special Relativity
	28 FLAT SPACETIME 3. Four-Vectors **Due:** P1.1, 1.3, 2.3, 2.4	30 FLAT SPACETIME 4. Index Notation	1 TENSORS 5. Arbitrary Coordinates **Due:** Corrections
FEB	4 TENSORS 6. Tensor Equations **Due:** P3.3, 3.5, 4.2, 4.4, 5.3, 5.4	6 TENSORS 7. Maxwell's Equations	8 TENSORS 8. Geodesics **Due:** Corrections
	11 BLACK HOLES 9. The Schwarzschild Metric **Due:** P6.2, 6.4, 7.2, 7.7, 8.2	13 BLACK HOLES 10. Particle Orbits	15 BLACK HOLES 11. Precession of the Perihelion **Due:** Corrections
	18 BLACK HOLES 12. Photon Orbits **Due:** P9.1, 9.3, 10.2, 10.6, 11.2, 11.4	20 BLACK HOLES 13. Deflection of Light	22 BLACK HOLES 14. The Event Horizon **Due:** Corrections
	25 BLACK HOLES 15. Alternative Coordinates **Due:** P12.2, 12.4, 13.2, 13.3, 14.1, 14.3	27 BLACK HOLES 16. Black Hole Thermodynamics	29 CATCH-UP / REVIEW (no reading assignment) **Due:** P15.3, 15.7, 16.3, 16.4 **TEST**
MAR	3 CURVATURE MATH 17. The Absolute Gradient **Due:** Test, Corrections	5 CURVATURE MATH 18. Geodesic Deviation	7 CURVATURE MATH 19. The Riemann Tensor
	10 EINSTEIN EQUATION 20. The Stress-Energy Tensor **Due:** P17.3, 17.4, 18.5, 18.6, 19.1, 19.5	12 EINSTEIN EQUATION 21. The Einstein Equation	14 EINSTEIN EQUATION 22. Interpreting the Equation **Due:** Corrections
	24 EINSTEIN EQUATION 23. The Schwarzschild Solution **Due:** P20.1, 20.3, 21.1, 21.3, 22.1, 22.2	26 COSMOLOGY 24. The Universe Observed	28 CESAR CHAVEZ DAY **Due:** Corrections
APR	31 COSMOLOGY 25. A Metric for the Cosmos **Due:** P23.1, 24.1, 24.2, 25.1	2 COSMOLOGY 26. Evolution of the Universe	4 COSMOLOGY 27. Cosmic Implications **Due:** Corrections
	7 COSMOLOGY 28. The Early Universe **Due:** P25.3, 25.6, 26.1, 26.3, 27.3, 27.5	9 COSMOLOGY 29. CMB Fluctuations & Inflation	11 CATCH-UP / REVIEW (no reading assignment) **Due:** P28.2, 28.4, 29.2, 29.4 **TEST**
	14 GRAVITATIONAL WAVES 30. Gauge Freedom **Due:** Test, Corrections	16 GRAVITATIONAL WAVES 31. Detecting Gravitational Waves	18 GRAVITATIONAL WAVES 32. Gravitational Wave Energy
	21 GRAVITATIONAL WAVES 33. Generating Gravity Waves **Due:** 30.1, 30.3, 30.4, 31.1, 32.2, 32.3	23 GRAVITATIONAL WAVES 34. Gravitational Wave Astronomy	25 SPINNING BLACK HOLES 35. Gravitomagnetism **Due:** Corrections
	28 SPINNING BLACK HOLES 36. The Kerr Metric **Due:** 33.1, 33.2, 34.1, 34.4, 35.1, 35.2	30 SPINNING BLACK HOLES 37. Kerr Particle Orbits	2 SPINNING BLACK HOLES 38. Ergoregion and Event Horizon **Due:** Corrections
MAY	5 SPINNING BLACK HOLES 39. Negative-Energy Orbits **Due:** 36.3, 36.5, 37.4, 37.5, 38.3, 38.4	7 CATCH-UP / REVIEW (no reading assignment) **Due:** 39.1, 39.3	9 TESTS and corrections due from seniors at 9 am (others: Tuesday 5/13 at noon)