SYLLABUS: ASTRONOMY 8700

RELATIVISTIC ASTROPHYSICS and COSMOLOGY

SPRING SEMESTER 2010

Instructor: Prof. Paul J. Wiita

Timings: Mondays & Wednesdays, 3:00 PM – 4:50 PM (incorporating a 10 minute break)

Location: GCB 627; however, I hope to move it to 732, 1 PP

Office hours: M&W 10:30–11:30 AM; T 11AM – noon, **and by appointment**

Primary Contacts: 715 1PP wiita@chara.gsu.edu (404) 413-6022

Other Contacts: Cell: (609) 273-7177; for evenings, most Fridays and weekends and some Thursdays.

Prerequisite: Astronomy 6000, Physics 8100 and Astronomy 8100 are helpful but not necessary.

This course is for 4 Semester Hours of credit and meets for two, "2 hour" lectures per week. Any classes I must miss will be made up by lengthening Monday lectures and/or on Fridays I am in Atlanta.

COURSE OBJECTIVES: This course will provide an introduction to some of the most exciting and important aspects of astrophysics today. We will review and expand upon our knowledge of special relativity, using the K-calculus as a preparation for a study of General Relativity (GR). For the sake of simplicity, you will learn and use tensor analysis instead of differential geometry in studying Einstein's equations. While the fundamental theory will be covered, the emphasis of this course will be on applications of GR to astrophysics. Therefore, the study of relativistic stars (neutron stars and black holes) will take center stage. We will then turn to a discussion of the important prediction of gravitational radiation and the exciting prospects for its direct detection with new instrumentation. The final portion of the course will be devoted to cosmology, including discussions of both the geometrical and physical aspects. Our current understanding of the Big Bang, the "consensus cosmology", and the subsequent origin of galaxies and large-scale structure in the universe will be discussed. If there is time, some non-standard cosmological models will be touched upon.

Required texts:

1) Michael Hobson, George Efstathiou & Anthony Lasenby, **General Relativity: An Introduction for Physicists**, 2006 (Cambridge U.P.).

2) Peter Coles & Francesco Lucchin, **Cosmology**, 2nd edition – 2002 (Wiley)

Because neither of the main texts is particularly inexpensive, you might want to share a copy of each with a classmate.

Recommended text:

3) Stuart L. Shapiro & Saul A. Teukolsky, **Black Holes, White Dwarfs & Neutron Stars** (Wiley Interscience)

Other books you might wish to look at to get alternative presentations of some of the material include Ray d'Inverno "Introducing Einstein's Relativity", John Peacock "Cosmology"; Hans Stephani, "General Relativity", Steven Weinberg, "Gravitation and Cosmology", Hans Ohanian & Remo Ruffini "Gravitation and Spacetime", & Jim Peebles "Physical Cosmology".

COURSE SCHEDULE

TOPIC	**NUMBER OF LECTURES**
Review of Special Relativity	2
Tensor Formalism for General Relativity	3
Einstein's Equations	3
The Schwarzschild Metric and Classical Tests of GR	3
Neutron Stars and Pulsars	3
Midterm Exam	1
Black Holes and the Kerr Metric	4
Gravitational Radiation	2
Introduction to Relativistic Cosmology	2
The Very Early Universe: Quatum Gravity, Inflation & Baryogenesis	3
Physical Cosmology: Cosmic Background Radiation & Structure Formation	4

HELPFUL INFO: This syllabus and all assignments will be posted on my web-site: www.chara.gsu.edu/∼wiita/teaching.html The note summaries will also be posted to that site, most likely shortly after the lecture in which they are presented. Thus, if you have great difficulty in simultaneously taking notes and understanding the material being presented, you should concentrate on the latter. You will want to to take notes on material that is not projected, since that stuff won't be posted on the web-site. Questions are always welcome!

GRADES: will be based 40% on five or six assignments, 30% on an in-class mid-term (closed book) and 30% on a take-home final. Plus–minus grading will be used.

All students are expected to understand and abide by the University Policy on Academic Honesty. In particular, no collaboration on any assignment is permissible unless I explicitly say otherwise in a particular case. Of course you are free to ask your colleagues to share notes they have taken but not calculations they have made. All questions concerning assignments are to be directed to me, unless I let you know that working together is acceptable on a particular assignment or part thereof.

Of course, this syllabus may be revised if necessary.