Revised Syllabus after Hurricane Irma (Sept 20, 2017)

Special and General Relativity (PHZ 4601/5606 – Fall 2017)

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Due to Hurricane Irma we lost 4 lectures (200 minutes), which we will make up by starting the remaining 30 classes 7 minutes earlier at 8:58 am instead of 9:05 am.

To keep the original schedule mostly intact, I intend to eliminate the second midterm, the review for it, and one of the final reviews. This implies then minor, but important, adjustments of the grading scale, which require the agreement of all students in class and I will keep a paper record of the vote on this (if the second midterm cannot be canceled due to disagreement by one or more student(s), I will post another revision of the syllabus).

- Class: MWF 9:05–9:55 am at UPL 0110; 8:58–9:55 am after September 22.
- Office hours: Thursdays 10:30-11:45 am and 1:45-3:15 pm, and by appointment (send e-mail).
- Grader: David Clarke, e-mail clarke dot davida at gmail dot com, Office hours Thursday 5–6 pm at 614 Keen, and by appointment (send e-mail).
- Midterm (tentative): Friday October 20.
- Test on Homework (tentative): Monday November 20.
- **Final:** Thursday, December 14, 3 – 5 pm at UPL 0110.

Required Text: Wolfgang Rindler, *Relativity, Special, General and Cosmological*, Second Edition, Oxford University Press, New York, 2006.

Overview and Goal

The course gives an introduction to the fundamentals of space, time and matter. As a systematic, mathematically rigorous treatment is beyond the scope of an undergraduate course, we intend in essence to learn by explaining (often omitting proofs) sections from the textbook by Rindler. **Bring the book to the lectures!** Under the title *Essential Relativity* the book started off as a one semester course for senior undergraduate students, but has since then been expanded to a two semester course. Therefore, we will have to omit about half of the material, though we will try to touch on most chapters. For an overview see the tentative schedule at the end of this syllabus as well as the preface and the table of contents of the textbook. Should we proceed slower than presently anticipated, the lectures on cosmology are at our disposal as they are beyond our core narrative.

After this course students should be able to explain the fundamental ideas of special and general relativity and master to solve by themselves standard problems to which the methods apply.

Homework and Classwork: Weekly homework assignments will be posted on the web, which have to be turned in **before** the beginning of the class indicated. After the class started problem can be still turned in at the end of the class, but 10% is taken off. After that solutions will only be accepted if there is a valid excuse. If you have to miss class communicate this by e-mail as early as possible. Each problem counts ten points unless stated otherwise.

Some problems will be solved in class. Therefore, you have to **bring paper, pencil(s) and a calculator to each class.** These (unannounced) Classwork assignments count towards the homework score. They are turned in at the end of the class and students missing such a class unexcused will get no credit. The decisive difference from the tests is that you can talk to anyone during classwork, whereas during tests you may only ask the instructor for clarifications. Classwork is to some extent teamwork, while tests reflect individual skills. At the price of 20% off you can complete your classwork at home and turn it in at the beginning of the next class. In that case, leave a note saying that you intend to do so (otherwise it will not be counted).

On numerical work: When parameter values are given in a problem assignment, use them even when more accurate numbers are available. Round the final answer to the accuracy asked for with no rounding performed in-between. The reason for asking you to follow this procedure is, some problems are designed so that the difference between a wrong and a false solution path does show only up in the last digit asked for.

For full credit on home- and classwork you need only 90% of the maximally possible score. At the end of the semester up to 10% will be added to reach a maximum score of 100%. Additional homework problems will be assigned to the graduate students.

A standing assignment is to read the sections of the text as listed in the tentative schedule, which will be refined as we move along.

Prerequisites: General Physics PHY 2048 and 2049 or equivalent courses. Calculus up to partial differentiation and vector analysis.

Grades will be based on 40% for homework and classwork, 15% for the midterm (there is now only one), 15% for a test on homeworks and 30% for the final. Anticipated dividing lines are: $A \geq 90\% > A^- \geq 85\% > B^+ \geq 80\% > B \geq 70\% > B^- \geq 65\% > C^+ \geq 60\% > C \geq 55\% > C^- \geq 50\% > D \geq 40\% > F$.

ADA: Students with disabilities should register with the Student Disability Resource Center and bring a letter to the instructor indicating their needs. Please do so during the first week of class.

Honor Code: Students are expected to uphold the Academic Honor Code published in the FSU Bulletin and the Student Handbook.

For more informations see the "Required Syllabus Statements" linked on the course website.

Tentative Schedule follows on the next page.

Schedule (Tentative)		
Date	Topic	Rindler
M Aug 28	Attendance, Syllabus, Introduction (Relativity)	Chapter 1.1 - 1.11
W Aug 30	Introduction (EP Einstein's Equivalence Principle)	Chapter 1.12 - 1.16
F Sep 1	Introduction (Gravitational frequency shift)	Chapter 1.16
M Sep 4	Labor Day - No Classes	
W Sep 6	Gravitational frequency shift continued;	Chapter 1.16
	Bending of light	Chapter 1.16
F Sep 8	Canceled (Hurricane Irma)	
M Sep 11	Canceled (Hurricane Irma)	
W Sep 13	Canceled (Hurricane Irma)	
F Sep 15	Canceled (Hurricane Irma)	
M Sep 18	Special Relativity (SR) - Synchronization of Clocks	Chapter 2.6
W Sep 20	SR - Lorentz Transformations	Chapter 2.1 - 2.5, 2.7
F Sep 22	SR - Rapidity Parameter	Eq. (2.17)
M Sep 25	SR - Addition theorem for velocities	Chapter 2.10 - 2.11
W Sep 27	SR - Kinematics	Chapter 3
F Sep 29	SR - Space time and four Vectors	Chapter 5
M Oct 2	SR - Optics and Particle Mechanics	Chapters 4 and 6
W Oct 4	SR - Four Tensors	Chapter 7
F Oct 6	SR - Four Tensors	Chapter 7
M Oct 9	SR - Electrodynamics	Chapter 7
W Oct 11	General Relativity (GR) - Curved Spaces	Chapter 8
F Oct 13	GR - Static and stationary spacetimes	Chapter 9
M Oct 16	GR - Geodesics	Chapter 9, 10
W Oct 18	Review for the Midterm	
F Oct 20	Midterm	
M Oct 23	GR - Einstein's vacuum field equations	Chapter 10
W Oct 25	GR - Schwarzschild metric	Chapter 11
F Oct 27	GR - Schwarzschild metric	Chapter 11
M Oct 30	GR - Schwarzschild metric	Chapter 11
W Nov 1	GR - Schwarzschild metric	Chapter 11
F Nov 3	GR - Black holes	Chapter 12
M Nov 6	GR - Plane gravitational wave	Chapter 13
W Nov 8	GR - Full field equations	Chapter 14
F Nov 10	Veteran's Day - No Classes	
M Nov 13	GR - Full field equations	Chapter 14
W Nov 13	GR - Linearization	Chapter 15
F Nov 17	GR & Cosmology (Co) - Spacetimes	Chapter 16
M Nov 20	Test on Homeworks	
W Nov 22	Thanksgiving - No Classes	
F Nov 24	Thanksgiving - No Classes	
M Nov 27	GR & Co - Spacetimes	Chapter 16
W Nov 29	GR and Co - Light propagation in FRW	Chapter 17
F Dec 1	GR and Co - Light propagation in FRW	Chapter 17
M Dec 4	GR and Co - Dynamics of FRW universes	Chapter 18
W Dec 6	GR and Co - Dynamics of FRW universes	Chapter 18
F Dec 8	Review for the Final	
R Dec 14	Final 3-5 pm	