PHYSICS 208: **General Relativity**

INSTRUCTOR:	Flip Tanedo	ROOM:	Physics	2104
CONTACT:	flip.tanedo@ucr.edu	LECTURE:	TR	5:10pm – 6:30pm
OFFICE:	Physics 3054	OFFICE HOUR:		By appointment

Course Description

This course is a survey of the geometric theory of spacetime and its physical implications. Due to the restrictions of a 10 week quarter and in the interest of making this course broadly accessible, we take the 'Santa Barbara' approach of developing differential geometry tools as needed. We will understand the physics of curved spacetime, including black holes and the recent discovery of gravitational waves.

Course Materials

All course materials will be accessible through the course webpage[1]. Announcements and grades will be managed, begrudgingly, through `iLearn`.

Evaluation

Weekly homework assignments that may include small projects and *will include independent reading*. If you are taking this class, you already understand that real learning only occurs when one tackles actual problems; please do these assignments. No exams. I expect you to work together and to abide by the UCR academic integrity policies.

Textbook

The course textbook is *Gravity: An Introduction to Einstein's General Relativity* (ISBN `0-8053-8662-9`) by James Hartle. This book is straightforward, physically grounded, and is mathematically accessible. There are two other books which I strongly recommend depending on what you intend to get out of this course:

1. *Spacetime and Geometry: An Introduction to General Relativity* by Sean Carroll; based on `gr-qc/9712019`. Excellent for those who want to see more explicitly how differential geometry underpins this subject. Be sure to read the appendices. If we had two quarters for this course, we would use this textbook.
2. *Einstein Gravity in a Nutshell*, Anthony Zee. Like Zee's other 'in a nutshell' textbooks, this is a delight to read—even more so after you have some background in the subject. The text is conversational and excellent for meandering self-study, but the unconventional ordering may be difficult for our short course.

Refer to the course webpage for additional references. Feel free to also consult other references. Let me know if you find anything particularly useful.

[1] http://faculty.ucr.edu/~flipt/P208_2016.html

Topics

This is a preliminary partitioning of topics; I reserve the right to update this as necessary. Leftover weeks are for make-up lectures.

1. **Flat Spacetime** [3 lecs]. Hartle, Chapters 2 – 5. Spacetime as a metric space. Review of special relativity. Principle of relativity. Observers. Tensors.
2. **Gravity as Geometry** [4 lecs]. Hartle, Chapters 6 – 8. Curved space, the equivalence principle. Geodesic equation, locally inertial frames. Differential geometry as needed.
3. **Schwarzschild Solution** [4 lecs]. Hartle, Chapters 9, 11, 12. Black holes.
4. **Some Formalism** [4 lecs]. Hartle, Chapters 20 – 22. Need-to-know differential geometry, curvature, the Einstein equation.
5. **Gravitational Waves** [4 lecs]. Hartle, Chapters 16 and 23. Gravitational radiation and the 2015 LIGO discovery.