COURSE SYLLABUS

PHYS 4396 – Special Topics: General Relativity Credit Hours: 3 Spring 2018

Farrington Building, Room 107 11:00 –11:50 MWF

Instructor: Phone: Main Physics Office: Fax: Email:	Dr. James B. Dent (936) 294-4860 (936) 294-1601 (936) 294-1585 jbdent@shsu.edu
Office hours:	Farrington, room 216 B 1pm MWF, or by appointment
Catalog Description:	This is a Special Topics course on General Relativity (Credits: 3).
Course Description:	General Relativity is one of the main pillars of modern physics. Since its formulation by Einstein just over 100 years ago it has become the foundation for our understanding of the universe's history and cosmic structure. It provides descriptions for phenomena from gravitational lensing and black holes to the recently discovered gravitational waves, and passed every observational test along the way.
	In this course we will first review Special Relativity and then delve into General Relativity through a combination of its mathematical underpinnings including tensors, curvature, covariant derivatives and connections, and its physical consequences. We will discuss classical tests and predictions of General Relativity including gravitational redshift, perihelion shifts, gravitational lensing, and gravitational waves. We will also discuss how the dynamics of cosmology arise from General Relativity.
	The course will be mathematically rigorous, but we will attempt to bring out the physics of General Relativity as early as we can, rather than putting it off until a full, formal derivation of the Einstein equations is presented.
Required Textbook:	None. Although there is no required textbook, I will provide copious notes of my own, and links to freely available online notes and videos. A short Bibliography of useful textbooks and notes is:

A.P. French, *Special Relativity*, E.F. Taylor and J.A. Wheeler, *Exploring Black Holes: An Introduction to General Relativity*, Steven Weinberg, *Gravitation and Cosmology*, Sean Carroll, *Lecture Notes on General Relativity* <u>https://arxiv.org/abs/gr-gc/9712019</u>.

Required Supplies: None. There will be some Mathematica code that will be made available to students, but a thorough knowledge of it is not necessary.

- Assignments: Homework assignments will be given regularly throughout the course duration. Dedicated, personal application of the concepts encountered is essential to mastery of the required material. Furthermore, these problems will be a valuable insight into what material is considered important by your instructor. Careful completion of all assignments is in itself a critical component of your course average. Moreover, failure to participate will almost certainly damage your exam performance.
- **Exams:** Two major examinations will be given during the semester (number is subject to reevaluation). If a special situation exists which would cause you to miss an exam, this MUST be made known to me prior to the date of the test if possible. A Final Project accompanied by a short presentation will also be required.
- **Grading Plan:** Homework will be worth 40%. The two semester exams together will comprise 50% of your grade. The final project makes up 10% of the full semester average.
- Class Rules: All class members are expected to respect the proceedings of this course, and the learning environment of their fellow students. This principle has several practical implications, some of which are enumerated below.

1) Do not cheat. Violators are subject to dismissal on a 1st offence.

2) Regular punctual attendance is expected of all class members.

3) There is to be no use of Cellular phones or other internet connected devices in the classroom, for either voice or text communication. Please discreetly excuse yourself if it becomes necessary to take a call.

Standard University Policies

The following are university-wide official policies which apply to this course. Additional details are available at the web address: <u>http://www.shsu.edu/syllabus/</u>

ACADEMIC DISHONESTY: All students are expected to engage in all academic pursuits in a manner that is above reproach. Students are expected to maintain honesty and integrity in the academic experiences both in and out of the classroom. Any student found guilty of dishonesty in any phase of academic work will be subject to disciplinary action. The University and its official representatives may initiate disciplinary proceedings against a student accused of any form of academic dishonesty including but not limited to, cheating on an examination or other academic work which is to be submitted, plagiarism, collusion and the abuse of resource materials. For a complete listing of the university policy, see:

http://www.shsu.edu/dept/dean-of-students/index.html

CLASSROOM RULES OF CONDUCT: Students are expected to assist in maintaining a classroom environment that is conducive to learning. Students are to treat faculty and students with respect. Students are to turn off all cell phones while in the classroom. Under no circumstances are cell phones or any electronic devices to be used or seen during times of examination. Students may tape record lectures provided they do not disturb other students in the process.

STUDENT ABSENCES ON RELIGIOUS HOLY DAYS: Section 51.911(b) of the Texas Education Code requires that an institution of higher education excuse a student from attending classes or other required activities, including examinations, for the observance of a religious holy day, including travel for that purpose. Section 51.911 (a) (2) defines a religious holy day as: "a holy day observed by a religion whose places of worship are exempt from property taxation under Section 11.20...." A student whose absence is excused under this subsection may not be penalized for that absence and shall be allowed to take an examination or complete an assignment from which the student is excused within a reasonable time after the absence.

University policy 861001 provides the procedures to be followed by the student and instructor. A student desiring to absent himself/herself from a scheduled class in order to observe (a) religious holy day(s) shall present to each instructor involved a written statement concerning the religious holy day(s). The instructor will complete a form notifying the student of a reasonable timeframe in which the missed assignments and/or examinations are to be completed. For a complete listing of the university policy, see:

/dept/academic-affairs/documents/aps/students/861001.pdf

STUDENTS WITH DISABILITIES POLICY: It is the policy of Sam Houston State University that individuals otherwise qualified shall not be excluded, solely by reason of their disability, from participation in any academic program of the university. Further, they shall not be denied the benefits of these programs nor shall they be subjected to discrimination. Students with disabilities that might affect their academic performance should register with the Office of Services for Students with Disabilities located in the Lee Drain Annex (telephone 936-294-3512, TDD 936-294-3786, and e-mail disability@shsu.edu). They should then make arrangements with their individual instructors so that appropriate strategies can be considered and helpful procedures can be developed to ensure that participation and achievement opportunities are not impaired.

SHSU adheres to all applicable federal, state, and local laws, regulations, and guidelines with respect to providing reasonable accommodations for students with disabilities. If you have a disability that may affect adversely your work in this class, then I encourage you to register with the SHSU Services for Students with Disabilities and to talk with me about how I can best help you. All disclosures of disabilities will be kept strictly confidential. NOTE: No accommodation can be made until you register with the Services for Students with Disabilities. For a complete listing of the university policy, see: http://www.shsu.edu/dotAsset/7ff819c3-39f3-491d-b688-db5a330ced92.pdf

VISITORS IN THE CLASSROOM: Only registered students may attend class. Exceptions can be made on a case-by-case basis by the professor. In all cases, visitors must not present a disruption to the class by their attendance. Students wishing to audit a class must apply to do so through the Registrar's Office.

USE OF TELEPHONES AND TEXT MESSAGERS IN ACADEMIC CLASSROOMS AND

FACILITIES: The use by students of electronic devices that perform the function of a telephone or text messager during class-time may be prohibited if deemed disruptive by the instructor to the conduct of the class. Arrangements for handling potential emergency situations may be granted at the discretion of the instructor. Failure to comply with the instructor's policy could result in expulsion from the classroom or with multiple offenses, failure of the course. Any use of a telephone or text messager or any device that performs these functions during a test period is prohibited. These devices should not be present during a test or should be stored securely in such a way that they cannot be seen or used by the student. Even the visible presence of such a device during the test period will result in a zero for that test. Use of these devices during a test is considered de facto evidence of cheating and could result in a charge of academic dishonesty. See: <u>https://www.shsu.edu/dept/dean-of-students/documents/2016-</u>2018% 20Student% 20Guidelines.pdf