PHYS 4800 General Relativity
Course Syllabus

Instructor Dr. Daniel Erenso; office: WPS 207D; phone: 615 494 8853; email: derenso@mtsu.edu; website: http://capone.mtsu.edu/derenso/; Class schedule: MW 2:20 pm - 3:45 pm

Office hours For outside classroom discussion you can see me during office hours: MW 11:20-12:20, TR 01:40-02:40pm or *by appointment*.

Text General Relativity-An Introduction for Physicists; M. P. Hobson, G. P. Efstathiou, and A. N. Lasenby, University of Cambridge; (2006); ISBN: 9780521829519

Purpose This course introduce to the mathematical methods to Einstein's theory of general relativity with a a limited application. We begins with reviews on special theory of relativity followed by discussion of the mathematical background that would include the necessary tools of tensor calculus and differential geometry. These tools are used to develop the topic of special relativity and to discuss electromagnetism in Minkowski spacetime. Gravitation as a spacetime curvature is then introduced and the field equations of general relativity are derived. The complete list of tops that would be covered is give on the table.

Grading The course grade will be determined by your performance on the homework assignments and your attendance.

Homework	**80%**	**Grade**	**A**	**B$^+$**	**B**	**B$^-$**	**C$^+$**	**C**	**C$^-$**	**D$^+$**	**D**	**D$^-$**
Participation	**20%**	**Minimum Score**	**90**	**87**	**83**	**80**	**77**	**73**	**70**	**67**	**63**	**60**
		F is below 60										

Homework There will be homework assignments that will be distributed in class or posted on the course website every on ***Monday or Wednesday at 02:20 pm*** and it will be due on the following week ***Monday or Wednesday at 02:20 pm***. Each homework assignment will receive a maximum of hundred points. The lowest homework score will be dropped. ***No late homework will be accepted***. Since you will be given exactly one week for each homework assignments, no excuses will be accepted ***except problems that prevent you from coming to school for the entire week***. To be accepted, homework has to be readable and understandable. Here, I list some ingredients that make a homework useful to you and also easy to read and evaluate for me:

- Work out the details and fully explain your line of reasoning. This is the only way to fully test and show your understanding of the technicalities and of the concepts.
- Highlight your final results.
- Always check that the final result makes sense physically, i.e. whether it has the correct physical units and, if it is a numerical result, the correct order of magnitude.
- The solution of each problem ***must*** be presented according to the order assigned in the homework. You must also begin the solution to each problem on a new page. ***Never use the back pages!***
- You ***must*** turn the complete solutions of each homework assignment along the cover page in class on the due date with your signature on it.

If the steps of the solution of a problem are not readable, credit will not be given although the final result seems to be right.

Exams There are no exams. Your grade will be determined by your attendance and average homework assignments score.

Dropping

It is the policy of the Department of Physics & Astronomy that no drops will be approved after the deadline posted in the university's course Schedule Book. The deadline for dropping ***without a grade*** for this semester is ***January 17, 2018.*** Deadline for students to drop a course with a grade of "W" is ***March 02, 2018.***

Disabilities

If you have a disability that requires assistance or accommodation, or if you have questions related to any accommodations for testing, note takers, readers, etc, please speak with me as soon as possible. Students may also contact the Office of Disabled Students Services (898-2738) with questions about services.

Lottery Scholarship

To retain Tennessee Education Lottery Scholarship eligibility, you must earn a cumulative TELS GPA of 2.75 after 24 and 48 attempted hours and a cumulative TELS GPA of 3.0 thereafter. You may qualify with a 2.75 cumulative GPA after 72 attempted hours (and subsequent semesters), if you are enrolled full-time and maintain a semester GPA of at least 3.0. A grade of C, D, F, or I in this class may negatively impact TELS eligibility. Dropping a class after 14 days may also impact eligibility; if you withdraw from this class and it results in an enrollment status of less than full time, you may lose eligibility for your lottery scholarship. Lottery recipients are eligible to receive the scholarship for a maximum of five years from the date of initial enrollment, or until a bachelor degree is earned. For additional Lottery rules, please refer to your Lottery Statement of Understanding form (http://www.mtsu.edu/nancial-aid/forms/LOTFOD.pdf) or contact your MT One Stop Enrollment Counsel or (http://www.mtsu.edu/one-stop/counselor.php).

Academic Honesty

Academic misconduct will not be tolerated in the Department of Physics and Astronomy. Offenses include, but are not limited to: Plagiarism, Cheating, Fabrication, and Facilitation. Instances of academic misconduct will, at a minimum, result in a zero for the assignment in question, followed by submission of a formal complaint to the Office of Judicial Affairs. If signs of cheating are detected or observed, all parties involved (copiers and facilitators) will receive a grade of zero and be included in the report. There will be no exceptions, all instances will be reported. Details regarding MTSU and TBR policy, including definitions for the offenses listed above, are available at http://www.mtsu.edu/juda_/integrity.php.

IX Statements

1. Students who believe they have been harassed, discriminated against or been the victim of sexual assault, dating violence, domestic violence or stalking should contact a Title IX/Deputy Coordinator at 615-898-2185 or 615-898-2750 for assistance or review MTSU's Title IX website for resources. http://www.mtsu.edu/titleix/
2. MTSU faculty are concerned about the well-being and development of our students and are legally obligated to share reports of sexual assault, dating violence, domestic violence and stalking with the University's Title IX coordinator to help ensure student's safety and welfare. Please refer to MTSU's Title IX site for contact information and details. http://www.mtsu.edu/titleix/

Topics	
Chapter 1	The spacetime of special relativity
	1.1 Inertial frames, Galilean and Lorentz transformations
	1.2 Axes rotation vs Lorentz transformation
	1.3 The interval and the lightcone
	1.4 Length contraction and time dilation
	1.5 Invariant hyperbolae
	1.6 Particle worldline and proper time
	1.7 The Doppler effect
	1.8 Velocity and acceleration
Chapter 2	Manifold
	2.1 What is a Manifold?
	2.2 Curves and surfaces in a Manifold
	2.3 Coordinate transformations and summation convention
	2.4 The Riemannian geometry
	2.5 Intrinsic and extrinsic geometry and the metric
	2.6 Length, areas, and volumes
Chapter 3	Vector Calculus on manifolds 49
	3.1 The tangent vector
	3.2 The basis vectors, the metric function, and coordinate transformations
	3.2.1 The raising and lowering vector indices
	3.3 Derivative of the basis vectors and the a¢ ne connections
	3.4 Local geodesic and Cartesian coordinates
	3.5 The gradient, the divergence, the curl on a manifold
	3.6 Intrinsic derivative of a vector along a curve
	3.7 Parallel transport
	3.8 Null curves, non-null curves, and a¢ ne parameter
	3.9 Refreshment from Theoretical Physics Part I: the calculus of variation
	3.10 The geodesic
	3.11 Stationary property of the non-null geodesic
Chapter 4	Tensor Calculus on manifolds
	4.1 Tensors …elds and rank of a tensor
	4.2 Mapping tensors into tensors
	4.3 Elementary tensor operations83
	4.4 Tensors and coordinate transformations