Course Approval Form

For approval of new courses and deletions or modifications to an existing course.

More information is located on page 2.

Action Requested:

- [ ] Create new course
- [ ] Delete existing course
- [X] Modify existing course (check all that apply)
  - [X] Title
  - [X] Prereq/coreq
  - [ ] Credits
  - [ ] Schedule Type
  - [ ] Repeat Status
  - [ ] Restrictions
  - [ ] Grade Type

Course Level:

- [ ] Undergraduate
- [X] Graduate

College/School: College of Science
Department: Physics and Astronomy
Submitted by: Joe Weingartner
Ext: X3-4596
Email: Jweinga1@gmu.edu

Subject Code: ASTR
Number: 628
(Do not list multiple codes or numbers. Each course proposal must have a separate form.)

Effective Term:

- [ ] Fall
- [S] Spring
- [ ] Summer

Year 2011

Title:
Current: ASTR 766 Relativity and Cosmology
Banner (30 characters max including spaces):
New: ASTR 628 Relativity

Credits: (check one)

- [3] Fixed
- [ ] Variable

or
to

Repeat Status: (check one)

- [X] Not Repeatable (NR)
- [ ] Repeatable within degree (RD)
- [ ] Repeatable within term (RT)

Total repeatable credits allowed:

Grade Mode: (check one)

- [X] Regular (A, B, C, etc.)
- [ ] Satisfactory/No Credit
- [ ] Special (A, B C, etc. +IP)

Schedule Type Code(s): (check all that apply)

- [X] Lecture (LEC)
- [ ] Lab (LAB)
- [ ] Recitation (RCT)
- [ ] Internship (INT)
- [ ] Independent Study (IND)
- [ ] Seminar (SEM)
- [ ] Studio (STU)

Prerequisite(s):
MATH 214, PHYS 262, 303, 305

Corequisite(s):

Special Instructions: (restrictions for major, college, or degree; cross-listed courses; hard-coding; etc.)
Modification: The cosmology section removed and added, in greater depth, to ASTR 604; number changed from ASTR 766 to ASTR 628 to better reflect level of the course

Catalog Copy for NEW Courses Only (Consult University Catalog for models)

Description (No more than 60 words, use verb phrases and present tense)	**Notes** (List additional information for the course)

Indicate number of contact hours: Hours of Lecture or Seminar per week: 3 Hours of Lab or Studio:
When Offered: (check all that apply) [ ] Fall [ ] Summer [3] Spring

Approval Signatures

Department Approval Date

College/School Approval Date

If this course includes subject matter currently dealt with by any other units, the originating department must circulate this proposal for review by those units and obtain the necessary signatures prior to submission. Failure to do so will delay action on this proposal.

Unit Name	Unit Approval Name	Unit Approver's Signature	Date

For Graduate Courses Only

Graduate Council Member

Provost Office

Graduate Council Approval Date

Course Proposal Submitted to the Curriculum Committee of the College of Science

1. COURSE NUMBER AND TITLE:

ASTR 628 Relativity (3:3:0)

Course Prerequisites:

MATH 214 and PHYS 262, 303, 305.

Catalog Description:

Special relativity; four-dimensional spacetime; relativistic mechanics; tensors; general relativity; geodesics; Schwarzschild metric; applications of general relativity

2. COURSE JUSTIFICATION:

Course Objectives:

Develop an understanding of special and general relativity, laying a foundation for advanced study in modern physics and astrophysics

Course Necessity:

Our galactic astronomy course (ASTR 604) is being modified to include cosmology, in substantially greater depth than is currently covered in this course. The cosmology material in ASTR 628 will be replaced with astrophysical applications of general relativity.

Course Relationship to Existing Programs:

Relationships to complementary course described above. There are no similar courses at the graduate level.

Course Relationship to Existing Courses:

The course has been cross-listed with CSI 766.

3. APPROVAL HISTORY:

4. SCHEDULING AND PROPOSED INSTRUCTORS:

Semester of Initial Offering:

Offered alternate spring semesters.

Proposed Instructors:
Weingartner, Becker, Sauer

5. <u>TENTATIVE SYLLABUS</u>: See below.

PHYS/ASTR 428, ASTR 628: Relativity and Cosmology (NEW)
Lectures
Place: Innovation Hall, room 131
Time: Tuesday, Thursday 3:00 – 4:15 pm

Lecture notes on the web at www.physics.gmu.edu/_joe/PHYS428.html
Instructor

Joe Weingartner (call me Joe)
Science and Technology I, room 317
jweinga1@gmu.edu
Office hours: Tuesday 1:15–2:45, Thursday 4:30–5:00, or by appointment

Course Textbook
Relativity: Special, General, and Cosmological, 2nd ed, W. Rindler (Oxford University Press)

Recommended Supplemental Text
Introduction to Electrodynamics, 3rd ed, D. J. Griffiths (Prentice Hall)

Evaluation
• Homework (60%). You are encouraged to discuss the problems with one another, but the detailed solution that you submit must be your own, independent work. Homework will be graded in part on clarity. You must clearly explain what you are doing in order to receive full credit. Also, you will not get credit if I have to struggle to read your handwriting. Homework will be due at the start of class on the announced dates. The point value of each problem is indicated in brackets. Problem sets for ASTR 766 are longer than those for PHYS/ASTR 428. The additional problems are more mathematically challenging and probe the physics to greater depth.

• 2 in-class exams (10% each). Tentatively scheduled for Feb 24 and Apr 7.

• Final exam (20%). This will be held on May 12, 1:30–4:15, in the same room as class.

Course Outline
1. Motivation for Special Relativity
2. The Foundations of Special Relativity
3. Spacetime and 4-vectors
4. Relativistic Mechanics
5. Introduction to Tensors
6. Electrodynamics
7. Introduction to General Relativity
8. Geodesics in Curved Spacetime
9. Curvature and Einstein's Field Equations
10. The Schwarzschild Metric and Applications

Recommended Reading (by topic)
1. Rindler 1.1 through 1.10; Griffiths 1.2, 7, 12.1.1, Appendix C
2. Rindler 2.1 through 2.8, 3.1 through 3.6, 4.3; Griffiths 12.1.2 and 12.1.3
3. Rindler 5.1, 5.4 through 5.6; Griffiths 12.1.4, 12.2.1
4. Rindler Ch 6 (omit 6.5 and 6.8); Griffiths 12.2.2 through 12.2.4
5. Rindler 7.1, 7.2
6. Rindler 7.3 through 7.7; Griffiths 12.3
7. Rindler 1.11 through 1.16
8. Rindler 8.3, 8.4, 10.1 through 10.4
9. Rindler 10.5, 10.6, 14.1, 14.2
10. Rindler 11.1, 11.2, 11.5, 11.6 through 11.12, 12.1 through 12.6

Recommended Study Strategy

For each topic, lecture notes will be available on the course web site in pdf format. Before class, print out the notes and read the relevant sections in Rindler, as indicated on the course web site. At this point, you do not need to master the material in Rindler, but familiarity with it will help you to keep up with the lecture.

During the lectures, structure your own note taking around the printed course notes. The pace will be too quick for you to write down everything on your own. Focus on writing down clarifications and extra detail not contained in the printed notes.

Only part of the class time will be devoted to lectures. We will also spend a lot of time working sample problems and going over homework problems. Solutions will be distributed in advance. You may want to take detailed notes as well.

After class, carefully review your lecture notes and the worked problems. Reread the relevant sections of Rindler, this time making sure that you have mastered the material. Make note of anything you don't understand and ask me about it at my office or at the next class.

The homework assignments will be challenging. For many problems, you will probably need to make multiple attempts in order to achieve the full solution. For this reason, it is critical that you start working on the problem set shortly after it is assigned. Allow yourself plenty of time to seek help, both from me and from your classmates. I suggest that you form study groups and meet regularly to discuss the problems. But make sure that you've put in serious effort before meeting with your classmates