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:

- [X] Create new course
- [ ] Delete existing course
- [ ] Modify existing course (check all that apply)
  - [ ] Title
  - [ ] 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:** 604
(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
Banner (30 characters max including spaces)
New: Galaxies and Cosmology

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):	**Corequisite(s):**
ASTR 328 and MATH 214	PHYS 308

Special Instructions: (restrictions for major, college, or degree; cross-listed courses; hard-coding; etc.)

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)
The structure of the Milky Way as the basis for our knowledge of galaxies; the properties of galaxies from our local neighborhood out to the youngest galaxies in the far distant universe; observational and theoretical approaches to the structure and evolution of galaxies; the basics of cosmology and the formation of structure in the universe.	

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 604 Galaxies and Cosmology (3:3:0)

Course Prerequisites:

ASTR 328 and MATH 214

Catalog Description:

The structure of the Milky Way as the basis for our knowledge of galaxies; the properties of galaxies from our local neighborhood out to the youngest galaxies in the far distant universe; observational and theoretical approaches to the structure and evolution of galaxies; the basics of cosmology and the formation of structure in the universe. Computational tools introduced in ASTR 328 are developed further.

2. COURSE JUSTIFICATION:

Course Objectives:

The primary objective of the class is for the student to learn what is currently known about the structure, properties and evolution of galaxies and the basics of cosmology. In addition the students should leave the class with a better understanding of the current literature in this field, an improvement in ability to research an astronomical topic, and a greater knowledge of the computational skills required to do research in astronomy.

Course Necessity:

Our graduate galactic astronomy course, ASTR 704, was inadvertently deleted in the last catalog update cycle. We must restore it now, since it is a core course for students enrolled in the physics PhD program and concentrating in astronomy. We are modifying the course to cover cosmology as well as galactic astronomy. This will free up time in ASTR 628 (currently ASTR 766) to cover additional astrophysical applications of general relativity and result in a more balanced set of graduate offerings in astrophysics.

Course Relationship to Existing Programs:

All PhD students concentrating in astronomy/astrophysics will take this course. The course will be offered every other year. Assuming 3 to 5 graduate students per year concentrating in astrophysics, we expect an enrollment of 6 to 10 students. By setting the course at the 6xx level, we retain the possibility of offering it in conjunction with ASTR 404, which is required for all undergraduate astronomy majors and which we expect will appeal to many physics majors.

Course Relationship to Existing Courses:

There are no similar courses at the graduate level.

3. APPROVAL HISTORY:

4. SCHEDULING AND PROPOSED INSTRUCTORS:

Semester of Initial Offering:

Spring, 2011; Offered alternate spring semesters.

Proposed Instructors:

Satyapal, Rosenberg, Weingartner, Gliozzi

5. TENTATIVE SYLLABUS: See below.

SYLLABUS
ASTR 604: GALAXIES AND COSMOLOGY

Textbook
Extragalactic astronomy is a vast and constantly growing field. Many textbooks are either out of date or do not cover all of the topics we will be covering in this class. The required textbook will be An Introduction to Modern Astrophysics by Carroll and Ostlie. This book has significant gaps however so course notes and readings will also be used. In addition I list several recommended textbooks and websites under reading references.

Course Description
A graduate-level course that aims to provide an introduction to the structure, properties, and evolution of galaxies, starting with the Milky Way. In addition we will discuss the basics of cosmology and the evolution of structure in the universe.

Topics to be Covered:

- The morphological classification of galaxies including the Milky Way
- The stellar content of galaxies: distribution of light, stellar populations
- The gaseous content of galaxies: distribution of neutral and molecular gas in galaxies
- The dust content of galaxies
- The nature of AGN
- Galaxy interactions
- Introduction to Newtonian and Relativistic cosmology
- The structure of the Universe from the extragalactic distance scale, expansion of the universe, cosmic microwave background and the cosmic web

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Homework
Homework will be in the form of take-home assignments that will include problems, essay-type questions, and, in some cases, computational projects. I encourage students to work together.

Reading the Literature
As a graduate student a thorough knowledge of the current literature in the field is important. We will hold an additional class meeting every other week to discuss relevant papers in the literature. These papers will include seminal work, review papers, and current articles of interest. Students will be required to present the papers on a rotating basis.

Project
Students are also required to do a project/paper, and oral presentation on a choice of topics that will be listed. Minimum page requirement is 20 pages of double-space text and references plus figures. The goal of the project is to introduce you to conducting literature searches in astrophysics and to use your own creativity in defining a project. Projects can be in the form of essays on a particular research topic, a computational project, the analysis of extragalactic astronomical data, or an observing proposal to carry out a specific science goal.

Exam Format & Policies

There will only be a final exam in this course. The exam will be based on the homework assignments and will focus on your understanding of the concepts presented in class.

Grading Policy
Grades for this course will be determined using the following components.

Component	Percentage	
Homework	30%	
Project	45%	
Final Exam	25%	
Total	100%	100%

Useful Textbooks

- *Galaxies in the Universe: An Introduction* by Sparke and Gallagher
- *An Introduction to Active Galactic Nuclei* by Peterson - We will follow this textbook closely when we cover active galaxies. Much of it is available free online (see class website). It provides an excellent review of AGN at the advanced undergraduate level.

Other useful books

- *The Physical Universe* by Frank Shu - this is an excellent undergraduate book on introductory astronomy. For those who have not had any prior astronomy courses, a recommend this book as a review.
- *Galactic Astronomy* by Binney and Merrifield - this is a graduate textbook
- *Galactic Dynamics* by Binney and Tremaine - this is a graduate textbook
- *Galactic Astronomy* by Mihalas and Binney
- *The Milky Way as a Galaxy* by Gilmore, King and van der Kruit
- *Active Galactic Nuclei* by Krolik - an excellent reference book on AGN for graduate students

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Some useful references (the list will grow as we go along)

- A great reference on extragalactic astronomy for graduate students is available http://nedwww.ipac.caltech.edu/level5/index.html
- Joshua Barnes course on galaxies http://www.ifa.hawaii.edu/~barnes/ast626/ast626.html

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