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)
  - [ ] 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: 603
(Do not list multiple codes or numbers. Each course proposal must have a separate form.)

Effective Term:

- [X] Fall
- [ ] Spring
- [ ] Summer

Year 2011

Title:
Current: Planetary Sciences
Banner (30 characters max including spaces):
New:

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):**
MATH 213 and PHYS 262	

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

Course number revised from 703 to 603 and pre-req modified from PHYS 160 to PHYS 262, both to more accurately reflect the level of the course. Catalog description changed somewhat, but course content remains nearly identical, with only some new material on the important new field of extrasolar planets

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: ____ Hours of Lab or Studio: ____
When Offered: (check all that apply) [ ] Fall [ ] Summer [ ] 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 603 Planetary sciences (3:3:0)

Course Prerequisites:

MATH 213 and PHYS 262

Catalog Description:

Physics and chemistry of planets, planetary satellites, asteroids, comets, and extrasolar planets

2. COURSE JUSTIFICATION:

Course Objectives:

Develop an understanding of planetary sciences, a major field within modern astrophysics

Course Necessity:

The modifications to the course number and prereqs more accurately reflect the level of the course. Extrasolar planets are a hot topic of current research.

Course Relationship to Existing Programs:

There are no similar courses at the graduate level. The course can be taught together with the undergraduate course ASTR 403.

Course Relationship to Existing Courses:

None

3. APPROVAL HISTORY:

4. SCHEDULING AND PROPOSED INSTRUCTORS:

Semester of Initial Offering:

Fall, 2011; Alternate Fall semesters

Proposed Instructors:

Summers, Weingartner

5. TENTATIVE SYLLABUS: See below.

ASTR 403/ASTR 603: Planetary Sciences

Syllabus: Fall Semester, 2009

Catalog description: This course is an introduction to the physics and chemistry of planets and their natural satellites, asteroids, comets and the interplanetary medium. Topics include the history of the solar system, the origin and evolution of planets, their internal structure and atmospheres, and analytical techniques used in their remote and *in situ* study, including space exploration. Prerequisites: MATH 213 and PHYS 262

Introduction

This course is designed to provide the student with an introduction to the multi-disciplinary field of planetary sciences. The course will include a survey of the major properties of the solar system, focusing primarily but not exclusively on planets, along with an overview of solar system formation and evolution. The emphasis of the lectures will be on the physical and chemical principles that allow an understanding of the observed properties of planets and their evolution.

One important emphasis of this course is the comparative study of planets with the goal of understanding the diversity of planets in our solar system and the more than 400 planets discovered to date around other stars. The ultimate goal is to understand how this diversity arises from a set of common physical principles acting in a wide range of initial conditions and galactic environments. The evolution of planets will be explored with a goal of understanding the current state of the Earth and other terrestrial planets. The most important historical discoveries regarding planets will be reviewed as well as the major unanswered questions in planetology. The most important observational techniques along with theoretical tools used in planetary studies will be covered in detail.

The undergraduate course ASTR 403 is cross-listed with a graduate-level ASTR 603 planetary science course. Graduate students will be expected to complete all of the ASTR 403 assignments plus complete an additional original research project. This research project must include a research topic and plan that is pre-approved by the instructor. The instructor must be kept posted on a regular basis of progress and problems in the project. The nature and level of the project must be at a sufficiently high level that it could become part of a published study in a peer-reviewed journal.

Instructor and Contact Information

Michael E. Summers
Science and Tech I, Room 301C
Email: msummers@gmu.edu
Phone: (703) 993-3971
FAX: (703) 993-1269
Assistant: Maryanne Ozernoy: 703-993-1280
Office Hours (with appointment): Tues, Thurs: 4:30-5:30pm
Course Blackboard website: https://gmu.blackboard.com/

Specific Course Goals:

To provide the student with:

(1) an overview of the physical and chemical processes which have shaped the formation, evolution and current state of the planets in our solar system,

(2) an understanding of the key scientific discoveries and remaining questions regarding the planets and their satellites, and
(3) an overview of the primary analytical tools used in planetary studies, including both remote multi-wavelength telescopic observations and spacecraft exploration.

Course format:

(1) Lectures covering material in the required text,
(2) Homework assignments designed to illustrate various aspects of topics encountered in the lectures and readings, and
(3) Reading assignments both from the text and supplemental material
(4) **Group discussion**
(4) Two in-semester **exams**
(5) A term paper which focuses on a topic in planetary sciences chosen by the student in consultation with the instructor.
(6) **Class notes** will be posted on GMU Blackboard.

Required Text:

Planetary Sciences, Imke de pater and Jack Lissauer
Cambridge University Press, 2001
ISBN 0-521-48219-4

Course Policy and Grading:

	ASTR 403 - Undergraduate	**ASTR 603 - Graduate**
*Homework:	30%	20%
**Two exams:	30%	30%
Term Paper:	30%	40% (must include original research)
Participation:	10%	10%

Numerical Grade Ranges:
A: 90-100%
B: 80-90%
C: 70-80%
D: 60-70%
F: Below 60%

*Homework mainly from end-of-chapter questions.
**You are responsible for all material from text, and any additional assigned readings.
Make-up exams may be scheduled with instructor permission.

Tentative Exam Schedule:
Oct. 8 (Thursday) – Exam #1
Nov. 19 (Thursday) – Exam #2

Term Paper Presentations:
Tuesday, December 15: 1:30-4:15pm
Term Paper Due at that time.

Course Term Paper:

A term paper (or in the case of ASTR 603, an original research project) is required in this course. The goal of the term paper is to study a specific topic or area of research in much more depth than that covered in the regular course lectures. The topic is chosen by the student with close consultation with the instructor. Generally, the term paper topic will be related to topics discussed in the lectures, but a fair degree of latitude will be allowed in the choice of topic. I will be glad to help students pick a topic, to narrow its focus, and to help find reference materials. Students are encouraged to choose a topic that fascinates them and to begin working on their paper within the first few weeks of the semester. Students will be expected to give the class a brief update every 2-3 weeks. Term papers are almost always the highlight of the course.

The term paper must follow standard guides for research papers, and have the following sections:

Abstract: This should be an overview of what has been done and the results of your project.

Introduction: This explains why this project is of interest and what the goals of the paper are. In addition, any relevant historical and/or scientific background for the paper will be included here.

Body of Paper: This section describes the main research topic that you have chosen. Be sure to include a clear statement of the scientific topic, methods, observations, and current understanding or theory. This section should include a significant number (10-15) references to primary scientific literature and/or review articles. Please include figures and their corresponding captions within the body of the paper.

Conclusions: This should be a short statement of what you have learned from your study.

References: Bibliography (not Wikipedia)

The paper must be typed, double spaced, and have ~ 20-25 pages of text, and at least 3 figures (may have more, include captions for all figures). Please number all pages.

Makeup Policy:

Students will be permitted to submit late homework on a case by case basis. Late exams will be permitted if with an acceptable explanation and if performed within one week of the original exam. Late term papers will not be accepted. If the student does not submit the final paper at the time scheduled for the final exam, then an incomplete will be filed for the student.

ASTR 603 Graduate Student Project:

Graduate students are expected to complete all the reading and homework assignments expected of the undergraduates, and in addition participate in all classroom discussions. On the homework assignments, the level of work is expected to be appropriate to that expected for graduate students. Graduate students will also be required to complete at least 1 intermediate to advanced level homework problem from each chapter of the text for which homework is assigned. In addition, those students enrolled in ASTR 703 are required to undertake an original scientific research topic using either theoretical, computational, or observational methods as they related to planetary sciences. The topic area is flexible, depending upon the student's background, interests, and educational goals. The topic should be chosen in close consultation with the instructor.

Once an original research topic is chosen by the ASTR 703 student, usually by discussions with the instructor, the instructor will then meet with the student to define the scope, methods, data to be used, and primary goals of the scientific research project. In particular, the student must have a clear statement of the scientific problem that will be addressed, why it is important as a scientific project, the specific methods that will be used, and a list of expected accomplishments that can be reasonably finished before the final exam period presentation of

the term paper. Emphasis on hypothesis-testing will required as a portion of the paper. And finally, the paper must include at the end a discussion of unresolved issues and problems that have arisen during the course of the work. In addition the student must suggest improvements that might resolve the encountered problems or issues by future work.

Term Paper Themes:

Planetary Formation: Theories and/or observations of planetary formation
Mars: Results from recent robotic missions, specifically Mars Exploration Rovers
Extrasolar Planets: Detection methods, or specific detections and planetary properties

Term paper/project – important dates:

Sept. 24 – Tentative title/topic due
Nov. 12 – Abstract (1 paragraph), outline, and key references
Dec. 14: Final Exam Period – Final paper due, 10-15 minute presentation.

Course Tutorials:

Tutorials serve as a brief review and/or refresher of focused topics that the students have likely encountered previously in their education, but usually in a different context. For example, most physics students have taken a course in Thermodynamics or at least have covered the key thermodynamic concepts in their Freshman Intro to Physics course. Yet I've found that almost all physics students remember very little in this area.

The Thermo tutorial reviews the Ideal Gas Law, State Variables (like Temperature, Pressure, Internal Energy, Entropy, Enthalpy, Gibbs energy) the First and Second Laws, Adiabatic and Diabatic processes, the concept of a heat engine, heat capacities and their relationship to atomic/molecular properties, and phase changes.

Tutorials usually takes about half an hour or so and provides enough refresher to then tackle the applications to the atmosphere.

Weekly Lecture Schedule (Tentative):

(1) Introduction and survey of the solar system (PS chapters 1 and part of 2)
(2) Solar Heating and Energy Transport (PS chapter 3)
(3) Planetary Atmospheres – part 1 (PS chapter 4, pp. 65-94)
(4) Planetary Atmospheres – part 2 (PS chapter 4, pp. 96-122)
(5) Planetary Atmospheres – part 3 (PS chapter 4, pp. 123-132)
(6) Planetary Surfaces (PS chapter 5)
(7) Planetary Interiors (PS chapter 6)
(8) The Interplanetary Medium and Planetary Magnetospheres (PS chapter 7)
(9) Meteorites & Asteroids (PS: 8&9)
(10) Comets (PS:10)
(11) Formation of Planets (PS:12)
(12) Extrasolar planets (PS:13)
(13) Planets and Life – The Science of Astrobiology (Supplemental material)

Additional recommended books:

Physics and Chemistry of the Solar System, 2nd Edition, J.S. Lewis, Academic Press, 2004.
Theory of Planetary Atmospheres, 2nd Edition, J.W. Chamberlain, D.M. Hunten, Academic Press, 1986.

Photochemistry of Planetary Atmospheres, Y.L. Yung, W.B. Demore, Oxford, 1998.
Earth: Evolution of a Habitable World, J. I. Lunine, Cambridge, 1998.
Astrobiology, a Multidisciplinary Approach, J.I. Lunine, Addison-Wesley, 2004.
Rare Earth: Why Complex Life is Uncommon in the Universe, P. Ward and D. Brownlee, Springer, 2003.
Life Everywhere, The Maverick Science of Astrobiology, David Darling, Perseus, 2002.

Useful websites:

NASA: Updates on all US space missions: www.nasa.gov
ARES – Mars Airplane: http://marsairplane.larc.nasa.gov/
New Horizons – Pluto mission: http://pluto.jhuapl.edu/
Aeronomy of Ice in the Mesosphere – AIM: http://aim.hamptonu.edu/
NASA Astrobiology Institute (NAI): http://nai.arc.nasa.gov/
The Astrobiology Web: www.astrobiology.com
The Kepler Telescope: http://kepler.nasa.gov/
The exoplanet encyclopaedia: http://exoplanet.eu/

Important Course Dates:

Sept. 15 – Enrollment Deadline. This is the last day to add into a course. Students may not register into any section after this date. No exceptions. This is also the last day to drop a course without losing tuition money.

Oct. 15 – Drop Deadline. This is the last day a student may drop a course. Students will receive a 33% tuition refund. After this date, students may withdraw from a course, but only according to strict guidelines.

Students with Disabilities:

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Resources at 703/993-2474.

All academic accommodations must be arranged through that office.

George Mason University Honor Code:

To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the University Community have set forth this:

Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.

http://www.gmu.edu/departments/unilife/pages/honorcode.html