Georgia Institute of Technology
Graduate Course Approval Form

Please complete this form and submit a copy of the syllabus for new courses. Forward it as an email attachment to the Secretary of the Graduate Council. A printed copy of the form with signatures should be brought to the Graduate Council Meeting. Complete the Coordinator Form on page 2. Changes in this course will affect other courses.

Please Indicate

X NEW

MODIFY

DELETE

Local Unit

Physics and Astronomy

Graduate Council Approval Date

Course Abbreviation

PHYS/ASTR

Course Number

660.1660

Full Course Title

Space Weather

Abbreviated Course Title

SPAC WEATHER

Credit Hours

3

Program-Record

PHAE

Repeatable for Credit

Y

Yes, not within same term

Up to

To

hours

N

No

Cannot be repeated for credit

Activity Code

X Lecture (LEC)

1 Seminar (SEM)

Lab (LAB)

Independent Study (IND)

Instruction (INT)

Catalog Format

3 Quarter

3 Semester

0 Course Level

X GR (500-660)

GA (700+)

Maximum Enrollment

20

For New Courses, First time offered

300 or 30

Prerequisites or Corequisites

Graduate standing or permission of instructor

Catalog Descriptions (50 words or less). Please use capital letters and attach a copy of the syllabus for new courses.

This is an overview of Space Weather including the Sun, Heliosphere, Magnetosphere and Ionosphere.

For MODIFIED or DELETED courses an appropriate

Previous course abbreviations

Previous number

Description of Modification

APPROVAL SIGNATURES

Submitted by

R. J. Major

email

Date

10/6/05

Department / Program

Graduate Committee Chair

Date

Date

Graduate Council Representative

Date
I. Course Designation: New Course  
II. Catalog Description:  
   a. Course Designation: PHYS 660 - Space Weather  
   b. Credit Hours: 3  
   c. Prerequisites: Graduate standing or permission of instructor  
   d. Description: This is an overview of Space Weather including the Sun, Heliosphere, Magnetosphere, and Ionosphere.  
III. Justification of the Proposal:  
   a. Course Objectives: To provide students with an interest in space related research with a background on the sources, types, and impacts of space weather. There is weather in space, and it impacts human technology and systems. This course is aimed at introducing students to this field.  
   b. Necessity or Desirability of Adding this Course: Since we are offering a PhD degree for students who want to specialize in this area, it is desirable to have an introductory, overview course on the field. We have found that people working in local industry on space related activities are interested in learning more about this field. It has direct impact on their work. It is also desirable to provide this overview for students who are not definitely interested in space weather, but may be after an introductory course.  
   c. Relationship of this Course to any Similar Course: There is no similar course now provided.  
IV. Department Recommendation:  
   a. Department: Physics and Astronomy  
   b. Date:  
   c. Possible Instructors: Faculty and staff of Physics and Astronomy Department, and SCS.  
V. Semester and Year for Planned Initial Offering: Fall Semester 2005  
VI. Student Syllabus:  
   Lecture 1 (Aug. 30, 2005):  
   (1) Syllabus (All)  
   (2) Overview of Space Weather Systems (Sun, Heliosphere, Magnetosphere, Ionosphere)  
   (3) Overview of Space climate  
   Sun  
   Lecture 2 (Sep. 6, 2005)  
   Structure of Solar Atmosphere: Photosphere, Chromosphere, Transition Region and Corona  
   Lecture 3 (Sep. 13, 2005)  
   Solar interior and Heliodynamology  
   Solar magnetic field: below, surface, and above  
   Solar Activity: Magnetic Reconnection  
   Lecture 4 (Sep. 20, 2005)  
   Solar Activity: Flare, Coronal Mass Ejection and Solar Energetic Particles  
   Heliosphere  
   Lecture 5 (Sep. 27, 2005)  
   Solar wind formation and acceleration, interplanetary magnetic field, corotating interaction regions, heliosphere during solar cycle
Lecture 6 (Oct. 4, 2005)
CMEs in the interplanetary space (magnetic clouds), interplanetary shocks, shock physics, energetic particles in the heliosphere (galactic, anomalous cosmic rays and solar energetic particles)
No Lecture (Oct. 11, 2005) – Due to Columbus Day Reces
Lecture 7 (Oct. 18, 2005) –
Solar wind interaction with the nearby interstellar medium.
(One and half hour midterm Exam on Oct. 18, 2005)

Magnetosphere
Lecture 8 (Oct.25)
Magnetosphere structure; Bow shock scattering; Charged particle orbits
Lecture 9 (Nov. 1)
Dawn-dusk electric field; gyrokinetic codes; magnetotail & current sheet
Lecture 10 (Nov. 8)
MHD codes & boundary conditions; parallel E-fields & precipitation; satellite diagnostics
(Instabilities in Magnetosphere; Geomagnetic Storms and substorms)
(Radiation belt)

Upper Atmosphere
Lecture 11 (Nov. 15, 2005)
Overview of interaction of solar radiation with the upper atmosphere
Atmospheric heating and composition
Diffusion, dynamics and chemistry
Lecture 12 (Nov. 22, 2005)
Geomagnetic storms, Airglow, Photoionization and photochemistry

Ionosphere
Lecture 13 (Nov. 29, 2005)
Ionospheric structure
Electron and ion temperatures
Electrodynamics
Lecture 14 (Dec. 6, 2005)
Summary of space weather effect on technology systems
Dec. 10 – last day of classes
Final Exam: Dec. 12 – 20, 2005

Homework:
4-6 homework; each area must have at least one homework assignment

Projects:
2 projects.
1. Run your favorite space weather model at CCMC (http://ccmc.gsfc.nasa.gov)

2. A comprehensive project, which should address the whole chain activities throughout the Sun, heliosphere, magnetosphere, ionosphere, and which should integrate the observations and simulations/calculations. One idea is to research on 2003 Halloween events. A large collection of Sun-Earth data is already at GMU.

Exams:
Midterm: 1.5 hour on Oct. 18, 2005; paper exam with open book
Final exam: 2.5 hour; paper exam with open book
Grades:

Homework (20%), Projects (35%), Midterm (15%), Final Exam (30%)

Text Book:

“Physics of the Space Environment”, Tamas L. Gombosi, 1999
“Introduction to the Space Environment”, Thomas F. Taucione, 1994

Supplement Referene Books:

“Physics of the Solar Corona”, Markus J. Aschwanden, 2004
“The Sun from Space”, Kenneth R. Lang, 2000
“Solar Activity and Earth's Climate”, R.E. Benestad, 2002

“An Introduction to Plasmas and Particles in the Heliosphere and Magnetospheres”, May-Britt Kallenrode, 2004

“Introduction to Plasma Physics : With Space and Laboratory Applications”, D.A.Gurnett and Bhattacharjee, 2005