George Mason University
Graduate Course Approval/Inventory Form

Please complete this form and attach 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, if changes in this course will affect other units.

Please indicate:  \(\text{X}\) ___ NEW  ____ MODIFY  ____ DELETE

Local Unit:  Physics and Astronomy  Graduate Council Approval Date:

Course Abbreviation:  ASTR  Course Number:  590

Full Course Title:  Selected Topics in Astronomy and Astrophysics

Abbreviated Course Title (24 characters max.):  SEL TOP IN ASTR & ASTRPH

Credit hours:  1-6  Program of Record:  MS, Applied and Engineering Physics

Repeatable for Credit?  \(\text{X}\) D=Yes, not within same term  Up to (6) hours
___ T=Yes, within the same term  Up to ___ hours
___ N=Cannot be repeated for credit

Activity Code (please indicate):  \(\text{X}\) Lecture (LEC) ___ Lab (LAB) ___ Recitation (RCT)
___ Studio (STU) ___ Internship (INT) ___ Independent Study (IND) ___ Seminar (SEM)

Catalog Credit Format  1-6 : 1-6 : 0  Course Level:  GF(500-600) \(\text{X}\) GA(700+)

Maximum Enrollment: 20  For NEW courses, first term to be offered:  04F

Prerequisites or corequisites:  Permission of instructor

Catalog Description (35 words or less)  Please use catalog format and attach a copy of the syllabus for new courses.
Advanced topics from recent theoretical or observational developments and/or their applications. Satisfies the needs of the professional community to keep abreast of current developments.

For MODIFIED or DELETED courses as appropriate:
Last term offered:  Previous Course Abbreviation:  Previous number:

Description of modification:

APPROVAL SIGNATURES:
Submitted by:  ________________________________ email: ________________

Department/Program:  ________________________________ Date: ________________

College Committee:  ________________________________ Date: ________________

Graduate Council Representative:  ________________________________ Date: ________________
Approval from other units:

Please list those units outside of your own who may be affected by this new, modified, or deleted course. Each of these units must approve this change prior to its being submitted to the Graduate Council for approval.

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Graduate Council approval: ____________________________ Date: __________
Graduate Council representative: _____________________ Date: __________
Provost Office representative: ______________________ Date: __________
Selected Topics in Astronomy and Astrophysics

Course:
Astronomy 590, Selected Topics in Astronomy and Astrophysics (3:3:0)
Lecture Wednesdays, 7:20-10:00 PM, Room 211, Innovation Hall

Prerequisite:
Permission of Instructor

Required Text:

Instructor:
J. C. Evans, Room 313, Science & Technology I, Office 703-993-1285
Department of Physics and Astronomy, Room 303, Science & Technology I, 703-993-1280

Contacting the Instructor:
There are several means of contacting the instructor outside of class. However, please do not be hesitant about asking questions in class.

Office Hours: Wednesday, 6:00-7:10 PM, or by appointment, Room 313, S&T I
Telephone: 993-1285, leave message and phone number on voice mail
E-mail: jevans@gmu.edu
Mailbox: Physics and Astronomy Department Office, leave written message with office staff

Web Site:
A web site has been established for this course, which will be used primarily for obtaining information and the assignments. The web site may be reached through the Physics and Astronomy Department web site at physics.gmu.edu or through the following URL, physics.gmu.edu/~jevans/phys590/spr04/radtran.html.

Course Description:
Study of radiative transfer, primarily in astrophysical contexts; topics includes definitions of fundamental quantities of the radiation field, radiative transfer equation, methods of solution of the transfer equation, boundary value problems, diffuse reflection and transmission, discrete space theory, moving media, comoving frame of reference, probabilistic radiative transfer, operator perturbation methods, polarization, multi-dimension radiative transfer, planetary and stellar atmospheres, magnetic media.

Course Objectives:
The objectives of this course are
(1) to familiarize students with the physical and mathematical concepts, definitions, and perspectives vital to the study of radiative transfer in a variety of gaseous media;
(2) to formulate the basic equations and consider their solution in the context of problems of interest to astrophysicists;
(3) to familiarize students with applications of these ideas to radiative transfer in gaseous media;
(4) to provide the background for students to engage in a study of more specialized topics in radiative transfer, such as, radiation gas dynamics;
(5) to develop a reasonable level of confidence in presentation and discussion of radiative transfer topics by utilizing a semi-seminar style of course operation.

**Method of Evaluation:**
Weekly essays and/or problem sets will be assign to the class, which will constitute 40% of the semester grade. These essay/problem sets will involve a certain amount of reading before they can be completed. Various topics will be assigned to students on which to research and to make a short classroom presentation. Also, representative problems from the problem sets will be presented by various members of the class on the board. All students will be asked to participate in making presentations during the semester. In addition to the essay/problem sets, each student will be expected to undertake a project/paper, which will constitute 30% of the semester grade. Finally, a midterm examination, 15%, and a final examination, 15%, will make up the remaining thirty percent of the grade.

**Homework:**
Homework will be in the form of take-home essay/problem sets, which are to be completed within a given time frame. Copies of the essay/problem sets are on the course web site under Assignments. Students may use books, class notes, or journal articles as assistance in completing the essay/problem sets. However, the practice of working with other members of the class or seeking assistance from some individual outside the class will be determined by the instructor at the time each problem set is distributed to the class. Be sure you know what type of assistance you may seek before beginning the essay/problem set. Students will turn in their homework assignments and also present their results on the board at the beginning of each class.

**Makeup and Late Policy:**
There will be no makeup of essay/problem sets in as much as the time allotted for completing the essay/problem set will be 1 to 2 weeks. Students are expected to turn in the completed essay/problem set on the date given at the time it is distributed. However, should it be necessary to hand the essay/problem set in several days late, no penalty will be assessed. But, should the delay in submitting an essay/problem set exceed several days, then a penalty, to be determined by the instructor, will be assessed against the homework.

**Course Project/Paper:**
Each student will be expected to undertake a semester project/paper that will constitute 30% of the final grade. The project/paper must be approved by the instructor at the beginning of the project. The project/paper may be either of the following:
(1) an in-depth research paper on some aspect of radiative transfer or its application to a particular astrophysical environment,
(2) a research project involving equipment and some measurements, such as photographing the phenomena,
(3) a computer simulation project and paper on some particular radiative process, transfer problem, or application to an astrophysical problem.
The topic for the project/paper should be selected by the sixth week (Feb. 25) of classes with a preliminary report to be given in class during the twelfth week (Apr. 14) of classes. The final presentation will be during the last class meeting (Apr. 28) before the final exam (May 5).

**Examinations:**
There are two examinations planned for this course, a midterm (15%) and a final (15%).

**Letter Grades:**
Grades for this course will be determined by performance on the essay/problem sets, examinations, and the project/paper. The essay/problem sets will count as 40%, the midterm examination as 15%, the final examination as 15%, while the project/paper will count as 30% of the grade.

**Lecture and Reading Schedule:**
The assignments and dates indicated on the web site under *Assignments* are targets. Depending on progress in class, it may become necessary to adjust dates accordingly.

1/21,  *Topics*: Fundamental Definitions for Radiative Transfer Theory, Part I  
*Reading*: Sections 1.1 through 1.6, Lecture Notes – Radiative Transfer; *Assignment*: 1.

1/28,  *Topics*: Fundamental Definitions for Radiative Transfer Theory, Part II  
*Reading*: Sections 1.7 through 1.11, Lecture Notes – Radiative Transfer; *Assignment*: 2.

*Reading*: Sections 2.1 through 2.6, Lecture Notes – Radiative Transfer; *Assignment*: 3.

2/11,  *Topics*: The Equation of Transfer, Plane-Parallel, Steady-State, Absorbing and Emitting Atmosphere (Main-Sequence Stars)  
*Reading*: Sections 2.6 through 2.11; *Assignment*: 4.

2/18,  *Topics*: The Equation of Transfer, Spherically Symmetric, Steady-State, Absorbing and Emitting Atmosphere (Giant and Supergiant Stars)  
*Reading*: Sections 2.12 through 2.18, Lecture Notes – Radiative Transfer; *Assignment*: None.

2/25,  *Topics*: Source Function for True Absorption and Scattering  
*Reading*: Lecture Notes – The Source Function; *Assignment*: None.

3/3,  *Topics*: Coherent and Non-Coherent Scattering  
*Reading*: Lecture Notes – The Source Function; *Assignment*: 5.

3/10,  *No Class - Spring Break.*

3/17,  *Topics*: Methods of Solution of the Transfer Equation I  
*Reading*: Section 3.1 through 3.3; *Assignment*: 6.

3/24,  *Topics*: Methods of Solution of the Transfer Equation II  
*Reading*: Section 3.4 through 3.7; *Assignment*: None.

3/31,  *Topics*: Two-Point Boundary Problems  
*Reading*: Lecture Notes and Section 4.1 through 4.9; *Assignment*: None.

4/7,  *Topics*: Project/Paper Discussion - Computation of Radiative Transfer Through a Plane-Parallel Stellar Atmosphere  
*Reading*: Lecture Notes – Stellar Atmospheres; *Assignment*: 7.

4/14,  *Topics*: Project/Paper Discussion - Computation of Radiative Transfer Through a Plane-Parallel Stellar Atmosphere  
*Reading*: Lecture Notes – Stellar Atmospheres; *Assignment*: 8.

4/21,  *Topics*: Numerical Solutions of PDEs  


5/5,  *Topics*: Final Exam - Project/Paper Presentation  
*Reading*: None, *Assignment*: None.
References:


