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:  

X NEW  ____ MODIFY  ____ DELETE

Local Unit: SCS  
Graduate Council Approval Date: 

Course Designation: EOS  
Course Number: 722

Full Course Title: Regional and Global Issues in the Earth Sciences

Abbreviated Course Title (24 characters max.): Regional and Global Issues

Credit hours: 3  
Program of Record: ESS M.S., CSI Ph.D.

Repeatable for Credit?  
D=Yes, not within same term  
T=Yes, within the same term  
N=Cannot be repeated for credit

Activity Code (please indicate):  
Lecture (LEC)  Lab (LAB)  Recitation (RCT)  
Studio (STU)  Internship (INT)  Independent Study (IND)  Seminar (SEM)

Catalog Credit Format  3: 3: 0  
Course Level: GF(500-600)  GA(700+)  X

Maximum Enrollment: 15  
For NEW courses, first term to be offered: F04

Prerequisites: Courses in ecology, chemistry and physics

Catalog Description (35 words or less): This course provides the student with a basis for evaluating existing and emerging issues in the Earth sciences at the regional and global scale, utilizing interdisciplinary scientific principles.

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

Description of modification:

APPROVAL SIGNATURES:
Submitted by:  
Department/Program:  
College Committee:  
Graduate Council Representative:  
email:  
Date:  
Date:  
Date:  
Date:  

GEORGE MASON UNIVERSITY
Course Coordination Form

**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.

<table>
<thead>
<tr>
<th>Unit:</th>
<th>Head of Unit’s Signature:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graduate Council approval: ________________________________ Date: ____________

Graduate Council representative: __________________________ Date: __________

Provost Office representative: ____________________________ Date: __________
1. COURSE NUMBER AND TITLE:

EOS 722 Regional and Global Issues in the Earth Sciences

Prerequisites: Courses in ecology, chemistry and physics

Catalog description: This course provides the student with a basis for evaluating existing and emerging issues in the Earth sciences at the regional and global scale, utilizing interdisciplinary scientific principles.

2. COURSE JUSTIFICATION

Course objectives: The objectives are to

- Provide the first principles underlying regional/global issues in the Earth sciences, with attention to linkages among the disciplines of atmospheric sciences, biology, ecology, hydrology, oceanography, geology, human health, toxicology, and mathematical modeling;
- Discuss concepts of systems control, feedbacks, modeling, and hierarchical scales (spatial and temporal);
- Identify the role of retrospective analyses in developing a scientifically sound basis for evaluation and analysis; and
- Review studies of specific issues of interest on a regional to global scale.

Course necessity: In SCS, we have courses addressing different spheres of the Earth, but not the biosphere. Using an interdisciplinary approach, this course addresses various Earth Science and environmental issues from a regional and global perspective, including the role of human activities on the global systems. This course provides very concrete assessments of environmental and Earth science issues to complement the studies from a pure physical science perspective.

Course relationship to Exiting Programs: This is not a required course for the Ph.D. in CSI in the Earth Observing track, but it will be an elective course for students in the Earth Observing track in Ph.D. It will satisfy the elective requirement of the human and biological dimensions for the MS in ESS.

Course relationship to Other Existing Courses: There is no similar course offered in SCS. The regional and global scale approach is the uniqueness of this course in addressing those Earth science and environmental issues.

3. APPROVAL HISTORY

4. SCHEDULING AND PROPOSED INSTRUCTORS

Semester of Initial Offering: Fall 2004.

Proposed instructors: Dr. George Taylor

5. TENTATIVE SYLLABUS: See attached.
I. INTRODUCTION, COURSE OBJECTIVES AND EXPECTATIONS

Objective: Provide the student with basis for evaluating existing and emerging issues in Earth sciences at the regional and global scale, utilizing interdisciplinary scientific principles.

This objective is met by a combination of activities designed to provide an understanding of the following:

➢ first principles underlying regional/global issues in the Earth sciences, with attention to linkages among the disciplines of atmospheric sciences, biology, ecology, hydrology, oceanography, geology, human health, toxicology, and mathematical modeling;
➢ concepts of systems control, feedbacks, modeling, and hierarchical scales (spatial and temporal);
➢ role of retrospective analyses in developing a scientifically sound basis for evaluation and analysis; and
➢ studies of specific issues of interest on a regional to global scale.

II. FIRST PRINCIPLES

Objective: Develop a knowledge base in critical disciplines and demonstrate the necessity of interdisciplinary thinking to address regional/global-scale issues:

   Gaia Hypothesis of Earth Systems
   Atmospheric, Biological, Hydrological and Geological Sciences
   Feedback Processes at a Regional/Global Scale
   Scaling in Space and Time
   Landscape Ecology and Human Interactions
   Remote Sensing as a Methodology
   Mathematical Modeling as a Methodology
   Retrospective Analyses as a Methodology
   Biogeochemical Modeling of Contaminants
   Ecological and Human Health Risk Assessment

III. CASE STUDIES IN THE EARTH SCIENCES

Objective: Using timely case studies that are regional/global in scale, develop a framework for understanding how the issues evolved, the consequences for human health and welfare (ecology), and the potential strategies for remediation and restoration. For each topic, the initial discussion focuses on general principles followed by an in-depth presentation/discussion of one noteworthy aspect (a case study) of the topic. The following topics are only a sampling of what might be addressed; others may be added and some of the listed ones deleted

   Stratospheric Ozone Depletion and UV-B Radiation
Case Study: Atmospheric Processes and Human Health
Tropospheric Ozone and Particulates (PM$_{10}$ and PM$_{2.5}$)
Case Study: Human Health
Climate Change and Elevated CO$_2$ Levels
Case Study: Climate Modeling
  - Temperature and Species Migration/Extinction
  - Elevated Carbon Dioxide and Vegetation
  - Human Health and Tropical Diseases
  - Carbon Sequestration
Biological Diversity and Conservation Biology
  Case Study: Island Biogeography and Deforestation in the Tropics
Ecological Toxicology and Contaminant Transport
  Case Study: Mercury Sources, Transport, Fate and Effects on Humans and Ecological Systems
Invasive Species on a Regional and Global Scale
  Case Study: Chesapeake Bay Watershed and Intermountain West
Radionuclides in the Environment
  Case Study: Ural Mountains, Chernobyl and Three Mile Island
Eutrophication of Surface Waters and Nitrification of Watershed
  Case Study: South America, LA Basin and Chesapeake Watershed

Course Prerequisites: Chemistry, Physics, Ecology and Advanced Mathematics

Class Schedule: The class meets once weekly for 3 hours

Class Format: Each of the case study topics will be developed by the instructor at the first part of class. The last half of the class will be devoted to discussion, and the discussion will be led by a rappateur. The rappateur will be one or several graduate students, and their manner of handling and directing of the discussion will be worked out a priori with the instructor.

Course Expectations: Students are expected to (i) read selected background chapters from the text by Schlesinger, (ii) read class assignments from a selection of more advanced articles from the literature as provided by the instructor, (iii) develop an appreciation for the role of modeling as an investigative tool in the environmental sciences, and (iv) provide a critical analysis of a select environmental issue (of the student's own choosing) demonstrating his/her ability to evaluate the scientific rationale for alternative positions and solutions regarding the significance of a global issue in the environmental sciences. The last (iv) expectation will be met in the form of a written report (~ 15 pages) and as an oral presentation and defense.

Course Grading: Grading is based on (i) two take-home examinations (30% each), (ii) written report/term paper plus oral presentation (25%), and (iii) class participation and role as rappateur (15%).

Course Texts: The existing array of texts in the environmental sciences cannot address the intent or breadth of this course. Thus, selected readings of both a general and specific nature will be available in advance for the students. While this is somewhat of a disadvantage to the student, the current awareness of the literature and the focus on pertinent topics are significant advantages. Some of the background reading in the course will be provided by the text authored by W. Schlesinger and entitled "Biogeochemistry: An Analysis of Global Climate Change."
Course Instructor. The principal instructor is G. Taylor, who is responsible for all class activities. The instructor is available for consultation at any time although it is encouraged that an appointment be arranged.

IV. Schedule

<table>
<thead>
<tr>
<th>WEEK</th>
<th>TOPIC (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underlying Principles</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Introduction/Gaia Hypothesis</td>
</tr>
<tr>
<td>2</td>
<td>Gaia/Atmosphere (Chemistry and Physics)</td>
</tr>
<tr>
<td>3</td>
<td>Biosphere, Geosphere and Hydrosphere</td>
</tr>
<tr>
<td>Techniques and Methodologies</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Scaling, Feedback Processes and Computational Modeling</td>
</tr>
<tr>
<td>5</td>
<td>Remote Sensing and Retrospective Analysis</td>
</tr>
<tr>
<td>6</td>
<td>Biogeochemical Cycles of Contaminants and Pollutants Ecological and Human Health Risk Assessment</td>
</tr>
<tr>
<td>7</td>
<td>Ecological Toxicology and Contaminant Transport: Mercury as a Case Study</td>
</tr>
<tr>
<td>8</td>
<td>Tropospheric Ozone, Atmospheric Sources and Sinks, Particulates and Human Health</td>
</tr>
<tr>
<td>8</td>
<td>Global Climate Change (CO₂ and Temperature): Modeling, Retrospective Analysis, and Effects on Ecosystems</td>
</tr>
<tr>
<td>10</td>
<td>Stratospheric Ozone and Ultraviolet B Radiation: Human Health and Ecology</td>
</tr>
<tr>
<td>11</td>
<td>Radionucleides in the Environment: Chernobyl as a Case Study</td>
</tr>
<tr>
<td>12</td>
<td>Biological Diversity and Conservation Biology</td>
</tr>
<tr>
<td>13</td>
<td>Eutrophication of Surface Waters and Nitrification of Watershed: South America, LA Basin and Chesapeake Watershed</td>
</tr>
</tbody>
</table>
Student Presentations and Defense

14

Presentations and Defenses
Second Exam Distributed
Research Paper Due

Honor Code: The GMU honor and conduct code will be in force throughout this course. Material submitted to the instructor to be evaluated for purposes of grading will be assumed to be original and reflecting the student’s unique contribution.