Advanced Environmental Systems
Geographical Sciences 301
Spring 2020

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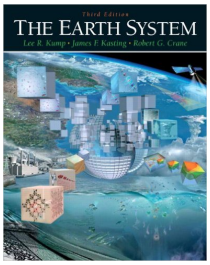
I. Course Text



We are using *The Earth System*, 3rd edition, by Kump, Kasting & Crane (**ISBN:** 9780321597793). The 2nd edition will work as well (especially if you can find it cheaper). Amazon has books from India at a fraction of the cost as well. Students may also find it useful to have a copy of an introductory physical geography text, such as the one used in GEOG201 by Christopherson (you can use virtually any edition you can find, no matter how old, or any one of countless texts in this area).

II. Course Description

GEOG301 is an advanced course in Environmental Systems, with emphasis in physical geography and Earth System Science. The major goal of this class is to provide a fundamental understanding of physical aspects and dynamics of the Earth as a system. GEOG301 builds on the material covered in GEOG201. The class explores how the Earth as a system is changing, both in the past and the future. This course will provide the students with an overview of the key elements of physical geography, including biogeography (factors and processes that control the geographical distributions of plants and animals), climatology (processes associated with controlling variations in weather and climate), and geomorphology (factors and processes that control changes to the physical structure of the earth surface in relation to geological structures). The primary course material was created by Dr. Ralph Dubayah, Dr. George Hurtt, and Donal O'Leary.

Learning Outcomes

1. To understand the fundamental laws and principles underlying the physical environment, how these control processes that occur on the land surface, in the oceans and in the atmosphere, and how these systems interact.
2. To understand the mechanisms that lead to variability in important physical characteristics such as air temperature, weather, climate, plants and other elements of the environment
3. To describe the key components, interactions and concepts that characterize the modern Earth system.
4. To understand the causes of change in the Earth System across temporal and spatial scales.
5. To understand human impacts on Earth systems, and to have a quantitative comprehension of the role of these impacts on climate and biological resources.
6. To understand approaches for monitoring and modeling the Earth system using remote sensing, computer models, and other data.
7. To understand contemporary issues surrounding climate change and loss of biodiversity

III. Course Organization

The course is organized around seven major topics: (1) Global Energy Balance and the Greenhouse Effect, which covers how the atmosphere and solar radiation interact; (2) Atmospheric and Oceanic Circulation - Water, Weather and Climate, which covers how the energy balance of the Earth interacts with the atmosphere and hydrosphere to produce climate and weather, and how the atmosphere and oceans interact; (3) The Geosphere – Plate tectonics, earthquakes, volcanism, weathering and mass movement; (4) The Biosphere - Ecosystems, including carbon and nutrient cycling, biodiversity, and the interaction of biosphere with other Earth systems; (5) The Cryosphere – Permafrost, seasonal snow, land ice, glaciers and sea ice and how cryospheric processes influence the Earth System; (6) Climate Change, past, present and future, and the impacts of humans on the Earth system; (7) Monitoring and Modeling Earth Systems, including research examples to illustrate integrative approaches scientists use to explore the Earth system.

Lectures

Lectures consist of material written by hand, accompanied by projected graphics. The instructors do not make their lecture notes available, but slides of the graphics will be available on Canvas. The text is meant to provide background to the lectures. While lectures cover some key concepts in the text, many new concepts are also presented only through lecture material. Supplemental reading material may also be assigned throughout the course.

Collaboration

Throughout the semester, students will be asked to interact in collaborative fashion during lecture. No laptops, notebooks (iPad type devices) or phone use is allowed during lecture without special permission from the instructor, except during the collaborative segments and as directed. Please be considerate of your classmates and do not try to skirt this rule.

IV. Course Requirements

Attendance is not required for this course. However, in-class participation, activities, assessments and collaborative exercises are required and graded. We strongly suggest that students attend every lecture. There is no mechanism to make-up missed in-class activities and exercises and these will negatively affect your grade except as governed under University regulations.

There will be 6 homework assignments during this course. The schedule for these assignments will be released during the semester and will be due about a week after they are assigned. Students may work together on these assignments, but the final work must be your own (i.e. in your own words, or using your own calculations). Presenting anyone else's work as your own, even if conducted collaboratively, will be considered academic dishonesty. No late assignments will be accepted, except as allowed under University regulations and with prior permission.

We will have one midterm and a comprehensive final exam. Exams will be a mix of (i) multiple-choice, (ii) fill in the blank, (iii) short answer/diagram, and (iv) longer answer formats.

V. Course Grading

Course grades will be determined as the sum of the weighted scores of in-class activities and assessments, homework, the midterm and final. We curve the final, cumulative points earned (not individual elements of the grade). We will use the plus/minus grading system.

Class participation, activities and assessments	15%
Assigned Problem Sets	30%
Midterm Exam	25%
Final Exam	30%

VI. Course Prerequisites

Students must have completed GEOG201 and GEOG211, or their equivalent (with permission of the instructors), before taking GEOG301. Concurrent enrollment in GEOG201/211 and GEOG301 is not allowed. Students will not receive credit for GEOG301 if they have taken GEOG398B. Students are also expected to know simple high school algebra, and how to use a scientific calculator (either as a device or in software emulation).

VII. Course Related Policies

The University expects each student to take full responsibility for their academic work and academic progress. GEOG301 follows all University of Maryland course related polices for undergraduate students with regards to areas such as academic integrity, classroom conduct, attendance, absences, missed assignments, and complaints about grading, among others. The complete list of these policies governing our course is located here: Course Related Polices.

VIII. Course Schedule†

Lecture	Reading	Date	Topic
Introduction: The Earth - Sun System			
1	1	Tuesday, January 28, 2020	Class Introduction: The Earth System
2	10	Thursday, January 30, 2020	Origins of the Earth & Life
Section I: Global Energy Budget and Greenhouse Effect			
3	3	Tuesday, February 4, 2020	Radiation and Radiation Laws
4	3	Thursday, February 6, 2020	Planetary Energy Balance Models*
5	3	Tuesday, February 11, 2020	Atmospheric Composition and Structure
6	3	Thursday, February 13, 2020	Greenhouse Gases
7	3	Tuesday, February 18, 2020	Global Energy Budget
Section II: Atmospheric and Oceanic Circulation✢			
8	4	Thursday, February 20, 2020	Hydrologic Cycle, Atmospheric Moisture, Humidity
9	4	Tuesday, February 25, 2020	Adiabatic Processes*
10	4	Thursday, February 27, 2020	Winds and Atmospheric Circulation
11	4	Tuesday, March 3, 2020	Upper Level Flow & Vorticity
12	5	Thursday, March 5, 2020	Oceanic Circulation
13		Tuesday, March 10, 2020	**Midterm Review and Discussion**
		Thursday, March 12, 2020	**Midterm (Kump chapters 1, 3, 4, 5, 10)**
SPRING BREAK			
Section III: The Geosphere			
14	7	Tuesday, March 24, 2020	Circulation of the Solid Earth: Earth's Interior*
15	7	Thursday, March 26, 2020	The Dynamic Earth: Tectonics, Earthquakes, Volcanism
16	8	Tuesday, March 31, 2020	Weathering and Mass Movement
Section IV: The Biosphere			
17	8	Thursday, April 2, 2020	Nutrient Cycles*
18	9	Tuesday, April 7, 2020	Ecosystems & Biodiversity
19	13	Thursday, April 9, 2020	Biodiversity Through Time
20	11	Tuesday, April 14, 2020	Effects of Life on the Atmosphere
Section V: The Cryosphere			
21	6	Thursday, April 16, 2020	The Cryosphere*
22	6	Tuesday, April 21, 2020	Cryospheric Processes - Guest Lecture
23	6	Thursday, April 23, 2020	Cryospheric Processes - Guest Lecture
Section VI: Climate Change			
24	15	Tuesday, April 28, 2020	Climate Change: Past, Present & Future*
25	16	Thursday, April 30, 2020	Climate Change: Mitigation
Section VII: Synthesis - Putting it all Together			
26		Tuesday, May 5, 2020	**Earth Observation: In Class Assignment**
27		Thursday, May 7, 2020	Earth System Modeling
28		Tuesday, May 12, 2020	**Course Summary & Discussion**
		TBD	**Final Exam**

†Course schedule may be revised in class and via Canvas by instructors during the semester

*Problem set