Climate Change: Policy, Impacts, and Response

The George Washington University
School of Engineering and Applied Science
Department of Engineering Management and Systems Engineering
Environmental and Energy Management Program
Washington, D.C. 20052

COURSE TITLE ***Climate Change: Policy, Impacts, and Response***

COURSE NUMBERS: EMSE 6992-10 CRN 53668

Three (3) credit hours, 2.5 hours/session, one lecture session/week, 14 weeks

MEETING INFORMATION: Thursday, 6:10 pm to 8:40 pm; Elliott School of International Affairs, 1957 E St. NW, Washington DC Room 311

COURSE DESCRIPTION: You will explore available knowledge and key uncertainties about climate change, and the challenges of mitigating anthropogenic influences. You will also examine potential impacts of unmitigated climate change, and ways you might adapt to such impacts. You will consider these issues at local, national and international levels.

COURSE LEARNING GOAL: In this course, you will prepare to respond professionally and knowledgably to major challenges posed by climate change in an interconnected global world.

DESIRED LEARNING OUTCOMES: By the conclusion of the course, you will:

- Judge between primary and secondary sources of information about climate change, appraise the quality of evidence, and support arguments with logical reasoning.
- Locate, organize, classify, combine, evaluate, and assemble evidence about climate change, including uncertainties, controversies, major questions and typical misunderstandings.
- List, summarize, illustrate, and diagram, the key elements of the earth's climate system and how changes in those elements affect other parts of the system at various time and space scales.
- Identify, discuss, estimate, predict, critique, and verify the major sources of anthropogenic influence upon the climate system including greenhouse gas emissions.
- Name, describe, appraise, compare, and rate major opportunities for mitigating emissions, costs and benefits of each, and challenges to implementing each at an effective level.
- State, illustrate, demonstrate, examine, and assess possible impacts of climate change upon human and natural systems, and alternatives to address those impacts.
- Identify, state, discuss, examine, compare, and assess multiple alternative viewpoints and interests in the climate change dialogue at local, national, and international levels.

COURSE INSTRUCTOR: Dr. Rachael Jonassen, rachaelj@gwu.edu

INFORMATION ABOUT THE INSTRUCTOR: Rachael Jonassen holds MS and PhD degrees in Geoscience from The Pennsylvania State University and a BA in Sociology-Anthropology from Dickinson College. She was Professor of Hydroclimatology from 1978-2006, the last four years of which she concurrently served as Program Director for Carbon Cycle and Biogeoscience at the National Science Foundation where she received the Director's Award. She also served as NSF representative to the US Global Change Research Program. From 2008-2013 Dr. Jonassen was Senior Scientist for Climate Change at LMI. She is a Fellow of the Geological Society of America and Visiting Scholar at George Washington University where she has taught since 2009.

Climate Change: Policy, Impacts, and Response

COURSE PROCESSES: Lectures, discussions (in-class and through BlackBoard), small group work, multimedia, and projects are employed to provide students with the opportunity for active learning through multiple approaches and mechanisms. Grading methods will conform to standard university grading policy. Assignments will be vetted with *TurnItIn* (http://turnitin.com/).

COURSE PREREQUISITES: Masters or Doctoral candidate status or consent of instructor.

ASSUMED PRIOR KNOWLEDGE, SKILLS, AND ABILITIES: Knowledge of physics, chemistry, earth science, mathematics, and at least one social science, at college level. Ability to use word processing, spreadsheets, web and library search tools, and presentation tools. Skill at writing and expression in English at college level. Familiarity with, and consistent adherence to, the GWU Code of Student Conduct (http://studentconduct.gwu.edu/code-student-conduct).

COURSE RESOURCES: Required text: *Introduction to Modern Climate Change* (Paperback) by Professor Andrew Dessler. 2012, ISBN-13, 978-0521173155

Recommended text: *The Global Warming Reader: A Century of Writing About Climate Change* (Paperback) Edited by Bill McKibben, 2012, ISBN-13: 9780143121893.

Assigned readings from professional journals will be available online (including through the class BlackBoard site) and through Gelman Library.

ASSESSMENT OF COURSE OUTCOMES: You will have at least one, and usually several, opportunities to develop and demonstrate expertise in each of the learning outcomes listed above. This information will be posted on the course BlackBoard web site. Assignments may relate to more than one learning outcome.

GRADING EVALUATION METHODS: Grades will be recorded in BlackBoard and available to you real-time. Final course grades will be based on the following items and letter grades will be assigned as follows: A (≥90%), B (80-89%), C (70-79%), D (60-69%), F (<60%).

- Individual Paper/Project on a Major Climate Change Technical Issue (25%)
- Team Project Working with a Client on a Climate Solution (25%)
- Comprehensive Take Home Briefing Paper (25%)
- Class Citizenship (25%): including attendance, participation (including in-class and on-line discussion groups), contribution to the learning environment, and general classroom demeanor. Readings, as well as any on-line and in-class exercises count here too.

Climate Change: Policy, Impacts, and Response

UNIVERSITY RESOURCES AND POLICIES

Class Policies:

- Attendance is expected at every class session. Students should notify the instructor in advance if attendance is not possible on a particular date.
- Blackboard will be used to post all class materials, resources, homework, required and optional readings, detailed guidelines for the paper and the team presentations, the comprehensive final briefing, and grades. BlackBoard is mandatory for group assignments.
- Discuss arrangements for late submission of materials with the instructor in advance. Late work is subject to daily grade reductions except in special circumstances of demonstrated emergencies.

Academic Integrity: Each student is required to observe the University's code for academic integrity as presented at http://www.gwu.edu/~ntegrity/code.html.

University Support Services: Information regarding disability support services and counseling services can be found at http://gwired.gwu.edu.dss/ and http://gwired.gwu.edu/counsel/CounselingServices/AcademicSupportServices respectively.

EMERGENCY INFORMATION:

What to do if the instructor does not arrive:

If the Instructor does not arrive for the class at the designated starting time and has not notified the class of a late starting time or the cancellation of the class, the students should wait in the classroom for at least 30 minutes before departing. One member of the class should be selected to notify the EMSE Department of the Instructor's absence by calling the EMSE Department at 202-994-7541 on the next business day.

What to do in the case of an emergency:

- All students should familiarize themselves with the emergency evacuation routes from the course classroom. Pay particular attention to understanding how to leave if all power is out and there is no light.
- In the event of an emergency evacuation of the class building, the students are to assemble at:
  - Primary Location: front steps of GSA building E St entrance (next to Elliott School on White House side, middle of block),
  - Secondary Location: playground in Rawlins Park in front of Elliott School across E St.

  and not depart until the Instructor has accounted for all of the students.

General emergency preparedness information:

- GW Campus Advisories. Students should check the GW Campus Advisories Web Site at: http://www.campusadvisories.gwu.edu/index.cfm for current information related to campus conditions, closures, safety information and any other information concerning events that may disrupt normal operations.
- GW Alert. All students, faculty and staff registered in the GW banner system GW will receive emergency alerts, notifications and updates sent directly to their GW email address. If individuals elect to receive these alerts on a mobile device they may log on to GWeb Information Web Site at https://banweb.gwu.edu and update their contact information to include mobile devices.

Climate Change: Policy, Impacts, and Response

Course Schedule

Session Topics and Assignments

1. **Aug. 29 Getting started; how we got here and a short history of earth's climate over 2.3Ba.**

   Key Questions:

   Hour 1: What are the objectives, structure and requirements of the course?
   Hour 2: How has thinking about climate developed over the past centuries?
   Hour 3: How has climate changed over the long history of Earth?

   Required Text Reading: Dessler, Chapter 1, *An introduction to the climate problem*

   Optional Text Reading: Ahrennius, *On the Influence of Carbonic Acid*, in McKibben *The Global Warming Reader*

2. Sep. 5 How we know about past climate and how we measure our confidence and uncertainty. Evaluating the quality of some common resources.

   Key Questions:

   Hour 1: How do we know that climate can change?
   Hour 2: How does the international science community characterize the *Level of Scientific Understanding* of climate change issues?
   Hour 3: What are reliable resources to help understand climate change?

   Required Text Reading: Dessler, Chapter 2. Is the climate changing?

   Optional Text Reading: Callender, *The Artificial Production of Carbon Dioxide*, in McKibben *The Global Warming Reader.* Jonassen and Pielke, *Characterizing Uncertainty in IPCC AR4*.

3. Sep. 12 How the earth system behaves. How greenhouse gasses affect it. Lags in the response and non-linearity that complicates things.

   Key Questions:

   Hour 1: What are the major elements of the earth climate system and how do they interact with one another on various scales of space and time?
   Hour 2: What is the carbon cycle and how does it relate to other biogeochemical cycles and the earth's radiation balance?
   Hour 3: Why is the earth a complex system?

   Required Text Reading: Dessler, Chapter 3. *Radiation and energy balance* and Chapter 4. *A simple climate model*

   Optional Text Reading: Revelle and Seuss, *Carbon Dioxide Exchange between Atmosphere and Ocean*, in McKibben *The Global Warming Reader*

4. Sep. 19 The pattern of emissions, where they come from, how they are removed from the atmosphere, how long they will remain. Why we think we are in for a long and significant challenge

   Key Questions:

   Hour 1: How are greenhouse gases generated?
   Hour 2: What processes act upon greenhouse gases in the atmosphere?
   Hour 3: What is the lifetime of different greenhouse gases?

   Required Text Reading: Dessler, Chapter 5. *The carbon cycle*.

   Optional Text Reading: Keeling, *The Keeling Curve*, in McKibben *The Global Warming Reader*

Climate Change: Policy, Impacts, and Response

5. Sept. 26 Policy options that can change emissions. The McKinsey study, Socolow's wedges, and the Kaya Identity.

Key Questions:

Hour 1: What are the economics of carbon mitigation?
Hour 2: What are the major technological options for mitigation now available?
Hour 3: What does the Kaya Identity tell us about mitigation options?

Required Text Reading: Chapter 6. *Forcing, feedbacks, and climate sensitivity*

Optional Text Reading: Van Jones, *The Green Collar Economy*, in McKibben *The Global Warming Reader*

6. Oct. 3 Options for mitigation, the range of technical solutions and strategies for successful implementation.

Key Questions:

Hour 1: What are options for improving carbon intensity of fossil fuels?
Hour 2: How can we change energy intensity of the global economy?
Hour 3: What are the major low carbon energy options?

Required Text Reading: Dessler, Chapter 7. *Why is the climate changing?*

Optional Text Reading: Hansen, et al. *Target Atmospheric CO2*, in McKibben *The Global Warming Reader*

7. Oct. 10 Carbon capture and storage, status and challenges. Geoengineering.

Key Questions:

Hour 1: Can we capture carbon dioxide?
Hour 2: Can we safely store carbon dioxide for long time periods?
Hour 3: What are the major options for geoengineering and what are their challenges?

Required Text Reading: Dessler, Chapter 8, *The future of our climate*

Optional Text Reading: Tidwell, *To Really Save the Planet, Stop Going Green*, in McKibben *The Global Warming Reader*

8. Oct. 17 The future of climate, models and projections. How we estimate impacts.

Key Questions:

Hour 1: How do we model the climate system?
Hour 2: How do we project future climates?
Hour 3: How do we examine possible impacts of climate change?

Required Text Reading: Dessler, Chapter 9, *Impacts*

Optional Text Reading: Schwartz and Randall, *An Abrupt Climate Change Scenario*, in McKibben *The Global Warming Reader*

9. Oct. 24 Impacts on people, places and things. Characterizing risk.

Key Questions:

Hour 1: What are Integrated Assessment Models and what do they tell us about the challenges of climate change?
Hour 2: How does the IPCC determine possible impacts of climate change?
Hour 3: What are the major risks we face with climate change?

Required Text Reading: Dessler, Chapter 10, *Exponential Growth*

Optional Text Reading: Monbiot, *The Population Myth*, in McKibben *The Global Warming Reader*

10. Oct. 31 Adapting to the unknown, options for adaptation, balancing adaptation and mitigation.

Key Questions:

Hour 1: What is climate change adaptation and how do we think about it?
Hour 2: How can we improve resilience to various risks?
Hour 3: Which costs more: adaptation or mitigation?

Required Text Reading: Dessler, Chapter 11. *Fundamentals of climate change policy*

Optional Text Reading: Kolbert, *The Darkening Sea*, in McKibben *The Global Warming Reader*

11. Nov. 7 Engineering, political, and legal challenges of mitigation and adaptation. COP-19.

Key Questions:

Hour 1: What is a 100-year flood?
Hour 2: What is happening to the infrastructure in the polar areas?
Hour 3: Is it a good idea to live along the coast?

Required Text Reading: Dessler, Chapter 12. *Mitigation policies*

Optional Text Reading: Crichton, *State of Fear*, in McKibben *The Global Warming Reader*

12. Nov. 14 Climate change perspectives of other countries. Loss and Damage. NAMA.

Key Questions:

Hour 1: What is a Nationally Appropriate Mitigation Action?
Hour 2: Who are the winners and losers from climate change?
Hour 3: Who will pay for the losses you suffer from climate change?

Required Text Reading: Dessler, Chapter 13. *A brief history of climate science and politics*

Optional Text Reading: Shiva, *Climate Change and Agriculture*, in McKibben *The Global Warming Reader*

13. Nov. 21 International efforts to mitigate or adapt to climate change.

Key Questions:

Hour 1: How has the UNFCCC contributed to solving climate change problems?
Hour 2: Has the Kyoto Protocol been a useful experiment in mitigation?
Hour 3: What are the multinational (finance) organizations doing about climate change?

Required Text Reading: Dessler, Chapter 14. *Putting it together: a long-term policy to address climate change*

Optional Text Reading: Roy, "*The Briefing,*" in McKibben *The Global Warming Reader*

XX. November 28 – no class, Thanksgiving Holiday

14. Dec. 5 Team Presentations

Reading: Nasheed, *Speech at Klimaforum*, in McKibben *The Global Warming Reader*

15. Dec. 12 Comprehensive Take Home Executive Summary Assignment due 5pm