FALL 2008

Fundamentals of Environmental Science (IDCE30287)

Mondays and Wednesdays 12:00-1:15pm, Bioscience B124

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Overview

This foundation science class will give you the literacy and skills you need to understand the science behind environmental problems that affect us all: Water pollution; air pollution; environmental health risks; population growth and the over-exploitation of natural resources.

It has three main objectives:

1. Knowledge Objective: That students be able to describe and understand how principles from science (especially Physics and Chemistry), as well as methods from Math, are used to model two main types of environmental problem: 1) problems of pollution; and 2) problems of natural resource over-exploitation. The class strengthens students' literacy in important scientific principles that help us understand and explore the dynamic nature of these problems.
2. Skills Objective: That students be able to apply simple, yet powerful mathematical models to such problems, manipulating quantitative data and interpreting diagrams and tables that use these data.
3. Attitudes Objective: That students become comfortable with handling quantitative data, equations and models, and more confident in their own abilities to understand and apply scientific and technical information.

The success of the class should be measured against these objectives.

The course aims to provide a solid foundation in important scientific principles, complementing courses with a joint science-policy orientation or a more policy-oriented approach. Students will be encouraged to think critically, work in teams to solve problems, present solutions and discuss topics. Real-world applications and case studies will be used to place the methods and models in a practical context. The required course text is: Masters G.M. and W. P. Ela (2007). *Introduction to environmental engineering and science*. 3rd edition. New Jersey: Pearson/Prentice Hall (ISBN 0-13-601837-8). This is an excellent text, fully updated. Graded elements include homework problems, class participation and a final exam. This is a required course for the Environmental Science and Policy MA.

Instructor's Expectation for Students

My expectation is that students will have studied the text book sections to be covered in the lecture sessions - and have questions - *before* the lecture. This ensures that the lecture reinforces things you have already seen, and makes class much more interactive and productive. *To be understood, this type of material needs active engagement by you in your own quiet study time and within your study groups too: just attending the lecture will not suffice*. I also expect that students will have attempted homework problems before coming to the extra problem-solving sessions. Make sure you finish the problem set for a given topic before we begin the next topic, and do not fall behind.

Class Structure
The syllabus will closely follow Masters and Ela's text, but we will depart from it to add elements they do not cover, discuss applications and read articles. We are being ambitious - the course will be intense but manageable and its success should be measured by how much you learn, and how your confidence increases. Personal study time – becoming 'best friends' with your text – is important, and will pay off. You should also work in study groups and meet with me to discuss problems and concerns. New concepts build on previous ones so be sure you grasp them as you proceed.

Problem-solving Sessions
We will hold two or three one-hour out-of-class problem-solving sessions per week. These will be run by the instructor. You are required to attend one of these sessions. The sessions will prove helpful to your progress on the homework and preparation for the final exam. Time and place TBD.

Dialogue Elements
Real-world applications and case studies for each major topic will be used to place the methods and models in a practical context. Students will be given additional readings about each major topic and questions to guide their reading. Breakout groups of 4-5 students will have a dialogue about particular questions then return to the full class to share ideas and stimulate a dialogue among students and the professor. Overall, ongoing dialogue with students will be actively sought by the instructor to talk about any issues related to the class, and to address and refine the educational experience.

Case Studies
Case studies from the instructor's own field experience will be used to illustrate applications of the methods being learned.

Graded Elements

Problem Sets
A number of homework problems will be assigned to each major topic/chapter and the answers will be given to you so you may check you are on track. Always do the following when answering the problems:

- Show all your working and calculation steps: you can get partial credit for the right steps even if the answer is incorrect.
- Include all your attempts at a problem so I can see the work you have done.
- Include units
- Please be neat – I have to read and understand your answers!
- Try to pay attention to significant figures (see handout), though the text does not always do this.

The problems are testing your understanding of concepts and your application of analytical tools. Example problems with solutions are given in the text, so study them carefully.

The problem sets are fundamental; they are worth 60% of your final grade.

Final Exam
There will be a take-home final exam. This is worth 20% of your final grade.

Grading
Equal weighting is given to level of accomplishment (getting the right answers for problems) and level of effort, including class participation – to score highly in the class you need to demonstrate a high level in both aspects.

1. Homework problem sets (60%)
2. Participation in class (asking and answering questions as we go, and dialogue sessions (20%)
3. Final exam (20%).

Office hours: Tuesday and Thursday afternoons 3:00pm-5:00pm. This is the time that you should sign-up either as a study group or as individuals. Please sign-up for an appointment – there will be a sign-up sheet on my door (IDCE Room 44). Faculty receive too much email – please do not rely on email to make appointments. Stop by to see me and sign-up for a time to meet.

Timetable of Topics Covered			
wk	**Dates**	**Topic**	**Aspects**
1	9/03	Introduction	Types of environmental problems, student interests, syllabus
2	9/08, 9/10	Mass and Energy Transfer (Topic 1)	Materials balance, equilibrium, steady and non-steady states, balancing units, conservative vs. non-conservative pollutants.
3	9/15, 9/17	Mass and Energy Transfer	Energy fundamentals.
4	9/22	Dialogue session Topic 1	Supplementary readings.
4	9/24	Environmental Chemistry (Topic 2)	Stoichiometry, enthalpy
5	9/29, 10/01	Environmental Chemistry	Chemical equilibria
6	10/06, 10/08	Environmental Chemistry	Organic chemistry, nuclear chemistry
7	10/13	no class (Columbus Day)	
7	10/15	Mathematics of Growth (Topic 3)	Types of growth. Resource consumption.
8	10/20, 10/22	Mathematics of Growth	Human populations, Case Study: Mexico City water supply case study
9	10/27	Mathematics of Growth	
9	10/29	Dialogue session Topic 3	Supplementary readings
10	11/03, 10/05	Risk Assessment (Topic 4)	Definition, measurements of risk, data used.
11	11/10, 11/12	Risk Assessment	Dose-response, exposure assessment. Case Studies: Mexico groundwater risk, Kenya malaria.
12	11/17	Dialogue session Topic 4	Supplementary readings
12	11/19	Water Pollution (Topic 5)	Hydrologic cycle, pollutant types, biochemical oxygen demand, oxygen-demanding wastes.
13	11/24	Water Pollution	Oxygen sag-curve, water quality of lakes and reservoirs, aquifers and groundwater.
13	11/26-11/28	**Thanksgiving recess**	
14	12/01, 12/03	Water Pollution	Aquifers and groundwater, Darcy's Law
15	12/08	Water Pollution	Groundwater contamination, pump-and-treat systems, remediation options.
15	12/09	Wrap-up	Revisiting the main concepts and techniques. Revisiting applications.
	12/17	Final exam due	
